POLICY OPTIONS FOR AN EU NO NET LOSS INITIATIVE

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Disclaimer

The authors have full responsibility for the content of this report, and the conclusions, recommendations and opinions presented in this report reflect those of the consultants, and do not necessarily reflect the opinion of the Commission.

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Contents

LIST OF ACRONYMS

BBOP	Business and Biodiversity Offsets Programme
CAP	Common Agricultural Policy
CFP	Common Fisheries Policy
CIP	Competitiveness and Innovation framework Programme
CSF	Common Strategic Framework
EAFRD	European Agricultural Fund for Rural Development
EEA	European Environment Agency
EIA	Environmental Impact Assessment
ELD	Environmental Liability Directive
ESF	European Social Fund
ERDF	European Regional Development Fund
HNV	High Nature Value
LFA	Less Favoured Area
MFF	Multi-annual Financial Framework (with respect to the EU)
MSFD	Marine Strategy Framework Directive
NNL	No Net Loss
NNLWG	No Net Loss Working Group
PAF	Prioritised Action Frameworks
PES	Payments for Ecosystem Services
RDP	Rural Development Programme
SEA	Strategic Environmental Assessment
SFM	Sustainable Forest Management
TACC	Trust Administered Conservation Credit offset system
WFD	EU Water Framework Directive

EXECUTIVE SUMMARY

Background and objectives

In 2010, the European Council adopted a new headline biodiversity target, which is to '*halt biodiversity and ecosystem service loss by 2020, to restore ecosystems in so far as is feasible, and to step up the EU contribution to averting global biodiversity loss'*. To support the achievement of this EU target (and the targets of the Convention on Biological Diversity agreed in Nagoya in 2010), the Commission developed in cooperation with Member States, an EU post-2010 Biodiversity Strategy, which includes six sub-targets and 20 related actions. These include Action 7, which is to '*ensure no net loss (NNL) of biodiversity and ecosystem services'*, in support of Target 2, which is that '*By 2020, ecosystems and their services are maintained and enhanced by establishing Green Infrastructure and restoring at least 15% of degraded ecosystems*'. The focus of this current study report is on Action 7b of the EU Biodiversity Strategy, which states that '*the Commission will carry out further work with a view to proposing by 2015 an initiative to ensure there is NNL of ecosystems and their services (eg through compensation or offsetting schemes).*'

The intention to attain NNL of biodiversity and ecosystem services was further encouraged in Council meetings in June and December 2011, when a preliminary definition of the NNL concept was adopted: *'that conservation/biodiversity losses in one geographically or otherwise defined area are balanced by a gain elsewhere provided that this principle does not entail any impairment of existing biodiversity as protected by EU nature legislation*'. In addition the European Parliament also adopted a resolution in 2012 urging the Commission to develop an effective regulatory framework based on the NNL initiative, taking into account the past experience of the Member States while also utilising the standards applied by the Business and Biodiversity Offsets Programme (BBOP).

To advise on the establishment of NNL policy, under Action 7b, the Commission established a Working Group on NNL of Ecosystems and their Services (NNL Working Group), which reported in July 2013. In addition this eleven-month contracted study was established, which aimed '***to support the Commission in developing the NNL initiative foreseen in the EU Biodiversity Strategy to 2020 by developing potential alternative options for this initiative, and analysing their main impacts.***'

To support this objective, this contract study carried out the following tasks:

1. **Development of a Business as Usual (BaU) scenario against which to evaluate alternative options.** This task was carried out through a literature review and new modelling (using the EU-CLUE-scanner framework) of the anticipated impacts of drivers of land use change on biodiversity and selected ecosystem services. This provided an overall indication of the most likely important impacts on biodiversity and ecosystem services under a business as usual (BaU) scenario; and hence helped to identify key gaps and inadequacies in the current environmental policy and legislative framework. It also developed indicators and metrics that were used later in the study to model the potential impacts of policy option scenarios.

2. **A stakeholder workshop**, which gathered feedback on the initial results of the BaU scenario analysis and identified some potential policy options for consideration.

3. **Development of policy options for implementing NNL goals**. This firstly assessed the current effectiveness and potential for existing EU policies to contribute to the NNL objective, and then identified a set of EU options for achieving the NNL target. Measures across all stages of the mitigation hierarchy[1] were considered and opportunities to improve existing policies and legislation or address policy gaps were identified. To avoid duplication with other initiatives and to maximise added value, the focus was on offsetting[2] and related policy measures that address residual impacts from developments and activities affecting the use of land or the sea. As part of the analysis, consideration was also given to the need for additional measures such as regulation, financing, governance change, research and other supporting actions, with the aim of selecting options that would achieve NNL as efficiently as possible.

4. **Analysis of the potential impacts of selected policy options**. The impacts (ie effectiveness), efficiency and overall policy coherence of each identified policy option were assessed individually, drawing on existing information (such as relevant published Commission impact assessments). The models used in the first task were then run again to quantify the potential 2020 impacts of four policy package scenarios reflecting increasing levels of policy ambition (with each scenario incorporating the policy options included in the former scenario):
   A. Better enforcement and implementation of existing measures, and encouragement of voluntary offsetting.
   B. New and enhanced measures to avoid and reduce impacts, and mandatory offsetting for residual impacts from EU funded developments.
   C. Development of a policy framework with mandatory NNL objectives for scarce biodiversity and priority ecosystem services and minimum key standards for offsetting at the EU level.
   D. Development of a policy framework for NNL with mandatory NNL objectives and key implementation standards for all biodiversity and ecosystem services.

5. **Preparation of recommendations**, based on the results of the compiled evidence and policy impact analysis, concerning the development of policies that would effectively achieve the NNL goals in the EU, whilst being efficient and consistent with other EU environmental objectives.

[1] A hierarchical procedure where appropriate actions are taken in the following order: avoidance, reduction/minimisation and restoration/rehabilitation of impacts, and then offsetting of residual impacts.

[2] Biodiversity offsets are measurable conservation outcomes resulting from actions designed to compensate for significant residual adverse biodiversity impacts arising from project development after appropriate prevention and mitigation measures have been taken.

Interpretation of the no net loss objective

It is possible to interpret the Biodiversity Strategy Action 7 objective of ensuring NNL of biodiversity and ecosystem services in the EU in a number of ways, which have considerably different implications for both biodiversity and ecosystem services and any consequent policy requirements. Therefore the intended scope of the EU's NNL objective was considered, taking into account the EU's headline target and the entire Biodiversity Strategy, statements by the Council, European Parliament and the NNL Working Group and the results of a policy workshop organised within the study. The following conclusions were drawn:

- Where offsetting of unavoidable residual impacts on biodiversity and ecosystem services is necessary, it is important to consider to what extent the NNL objective may be appropriately achieved through trade-offs. In order to achieve the EU's headline biodiversity target, it appears necessary to take steps to achieve both NNL of biodiversity **and** NNL of ecosystem services (ie two NNL conditions). In addition, the overall NNL objective would need to apply to all species and habitats that require conservation. According to the Council's conclusions and the European Parliament's Resolution, NNL measures should complement existing measures and therefore apply to all EU habitats and species, including those not covered by EU legislation. However, evidence from this study indicates that in practice existing measures for protected species would also need to be better implemented to achieve NNL.

- For biodiversity, the appropriate default objective for NNL is usually understood in such a way that losses affecting one species or habitat should be offset by equivalent gains in the same species or habitat so that a 'like-for-like' outcome is achieved. However, where supported by strong scientific evidence, it may be more appropriate to focus offsetting measures on biodiversity components and ecosystem service measures of higher importance. Thus offsetting should always be 'like-for-like-or-better'.

- Clarity about the role of offsetting is important. Introducing a clear requirement for those damaging biodiversity and ecosystem services to achieve NNL through offsetting would implement the polluter pays principle and create an incentive to limit damage by using avoidance or mitigation measures at earlier stages in the evolution of a development. However, this could lead to unintended biodiversity losses if existing mechanisms for protecting biodiversity and ecosystems were weakened in favour of offsetting. This is because offsetting might not always achieve NNL in practice, as a result of the difficulties associated with restoring or creating some habitats, avoiding time-lags, ensuring the additionality of offsetting measures and achieving equitable outcomes when biodiversity and ecosystems are changed or moved. Measuring the complex multi-dimensional, context-specific and dynamic values of biodiversity and ecosystem services in a practical and transparent way is also a challenge. Therefore, as noted in the June 2011 Council conclusions, NNL policy measures should not impair existing biodiversity that is 'protected by EU nature legislation'. In addition, to make the NNL objective consistent with the overall objectives of the EU's biodiversity strategy it is necessary to ensure that all NNL policies and the implementation of associated measures are in accordance with the widely held principles of the mitigation hierarchy (see above).

- NNL objectives should normally be achieved (and assessed) at relatively local scales in response to specific impacts, whilst also working within a framework to achieve NNL at larger regional and national scales. However, it is necessary to bear in mind that biodiversity compensation measures need to be ecologically viable (eg not too small or isolated) and this may require flexible policies that allow offsets to be pooled or located away from the impact area if there is an ecological need.

- The setting of NNL objectives for ecosystem services is complex because the benefits derived from such services vary according to their context and their beneficiaries and trade-offs are normally necessary. Consequently, it is appropriate to identify and set NNL objectives for ecosystem services individually and on a case-by-case basis (with, for example, strict sustainability for the most important and irreplaceable services but appropriate trade-offs for others).

- There are also considerable advantages from setting NNL objectives for biodiversity and ecosystem services at larger spatial scales, such as through regional programmes and even at national policy levels, to enable strategic planning and to provide compensation for cumulatively important impacts even if individually small. Such an approach also could help with the monitoring and assessment of programme objectives and performance within EU funds (eg Operational Programmes under Cohesion Policy).

It is clear from this (and evidence from international experience) that the EU's NNL strategy and policy (including any new instruments such as offsetting), need to be carefully developed with clear standards and principles that protect biodiversity and ecosystem services (such as the BBOP Principles). Furthermore, to ensure compliance with these standards it will be necessary to establish adequate regulation and monitoring and, where necessary, implement enforcement measures.

The challenge of achieving no net loss

The analysis carried out under this contract suggests that there are two main barriers to achieving NNL of biodiversity and ecosystem services. Firstly, there is a complex and wide range of significant pressures on ecosystems that are proving difficult to address. These include pressures from built developments and extractive industries, wide-scale pollution impacts, expansion of forest plantations and intensive forest management, impacts from past agricultural improvements and specialisation and on-going intensive management practices, abandonment of traditionally managed semi-natural habitats, continued high levels of commercial fishing, and the on-going impacts, and further spread, of invasive alien species. Furthermore, according to this study's modelling, and other evidence, these pressures are likely to continue affecting biodiversity and ecosystem services to 2020 and beyond (as well as being exacerbated by climate impacts, which are not addressed in this study). Given that some of the most widespread and significant impacts on biodiversity and ecosystems services arise from agriculture, forestry and other land uses, NNL measures will need to address these sectors fully. The NNL Working Group came to similar conclusions regarding the need for offsetting across all sectors.

Secondly, to address these pressures and achieve NNL, significant policy initiatives will need to be taken from the EU down to the more local scale. Although EU legislation contains many measures designed to avoid and reduce detrimental impacts on biodiversity and ecosystem services, there is evidence that several of these measures are not being implemented either sufficiently or always effectively by Member States. In addition, although much could be achieved by better implementation of existing measures, there are some significant policy gaps, most notably concerning the treatment of unavoidable residual impacts on biodiversity outside Natura 2000 sites, especially those related to agriculture and other land-use related activities.

Therefore, the achievement of the NNL objective will require the development of a NNL policy framework that seeks to improve the implementation of existing policies **and** carefully designs and develops requisite new policy measures for offsetting (as well as other policy gaps such as relating to invasive species, soils etc). However, policy measures will not be enough; substantial public and private support will also be needed, including commitment to awareness raising, guidance, training, capacity building and monitoring and assessment. It is therefore recommended that a comprehensive strategy and common policy framework for NNL is developed to address all stages of the mitigation hierarchy through initiatives to improve and better use existing policy instruments where feasible, complemented where necessary and appropriate by new policy measures to fill significant gaps.

Recommendations for a no net loss policy framework

Measures to reduce and avoid impacts under existing instruments

In accordance with the principles of the mitigation hierarchy, the improvement and enhancement of existing policies and instruments should focus firstly on measures that primarily avoid or reduce impacts. Although it was not feasible under this contract to identify all possible relevant policy options,[3] or to consider each option in detail, those that appear to have the greatest potential beneficial impacts are:

- Maintaining and improving the implementation of the Habitats Directive's requirements to avoid impacts on the Natura 2000 sites. This is especially important given their particularly high biodiversity value (and frequently their irreplaceability), and that they also provide additional ecosystem service benefits that have been estimated to outweigh the costs of protecting and managing the sites. No changes to the Directive are required, but better implementation is necessary to achieve the NNL objective. Of particular importance are more effective screening and provision of scoping opinions on proposed activities with respect to the need for an

[3] Policy measures to tackle widespread pollution and invasive alien species are particularly important, but it was beyond the scope of this study to consider these complex issues at all.

Appropriate Assessment, and enforcement action where assessments are inadequate or where impacts are allowed that contravene the Habitats Directive.

- Improved protection of landscape features outside Natura sites in accordance with Article 10 of the Habitats Directive.

- Adoption and implementation of the Commission's 2010 proposals for amending the EIA Directive and in particular the reference to the need to consider impacts on biodiversity.

- Full application of EIA to agriculture and forestry (taking into account appropriate assessment scales and proportionality with respect to biodiversity priorities).

- Measures to improve and integrate more strategic spatial planning approaches, such as mechanisms to identify strategic opportunities for Green Infrastructure enhancement and the location of offsets (see below) through wider application of SEA; improving SEA and spatial planning standards.

- Adoption of the proposed Marine Spatial Planning Directive (or a similar measure), and, in the longer term, the development of a similar Directive for terrestrial spatial planning.

- Thorough Biodiversity Proofing of all EU funding instruments (eg through *ex ante* and *ex post* policy impact assessments, incorporation of biodiversity objectives in fund and programme level objectives, programme SEA and project level EIA and environmental selection criteria).

- Using opportunities within the Common Agricultural Policy (CAP) to increase its role in maintaining biodiversity and delivering ecosystem services (particularly in relation to semi-natural habitats), for example by making the most of options to use the permanent grassland Pillar 1 green measure to protect important semi-natural habitats outside protected areas, and making sure that sufficient resources are allocated to the agri-environment-climate measure under Pillar 2 and that the measure is designed, targeted and implemented in ways that incentivise the continued management and enhancement of semi-natural habitats.

- Important supporting policy initiatives within agriculture would include better enforcement of environmental regulations and improved mapping of semi-natural habitats and features on farmland to enable improved targeting of support and monitoring and assessment against NNL objectives.

Offsetting of unavoidable residual impacts under existing instruments

Currently the only mandatory EU requirement to compensate for unavoidable residual impacts on habitats and species of Community interest is through the Habitats Directive (under Article 6.4). This is supported by the provisions of the Environmental Liability Directive (ELD) which require remediation for 'significant damage' to biodiversity resources and services. These also focus on habitats and species of Community interest, although Member States can extend the coverage to other biodiversity components. The provisions under both Directives make a substantial contribution to securing the NNL objective but evidence shows that the measures are not consistently applied, despite Commission guidance being available, and there is considerable scope for improving the level of implementation.

Revisions to the Habitats Directive are not required, but instead further guidance for national authorities relating to NNL and associated efforts to improve implementation and enforcement would be appropriate. This should aim to ensure that compensatory measures are only taken as a last resort, are strictly like-for-like, and result in direct measurable beneficial outcomes that achieve, as a minimum, NNL for the habitats and species concerned.

The contribution of the ELD to NNL objectives could be strengthened by increasing the scope of the biodiversity and ecosystem services damages to which the Directive applies, and by making this more consistent across Member States.

New offsetting instruments

To achieve the NNL objective, both offsetting and remediation will need to be extended beyond the treatment of residual impacts under the Habitats Directive and ELD to cover significant impacts on all species and habitats, wherever they occur (ie the policy measures in Scenario D described above). Previous studies have concluded that offsets and habitat banking can provide a cost-effective means of achieving NNL for many habitats, species and ecosystem services if they are well designed and adequately regulated. However, there is strong evidence from practical experience of operational offset schemes reviewed in this study, that mandatory requirements for the offsetting of residual impacts would be needed to make a significant contribution to the NNL objective. Thus, it is recommended that, in addition to taking the above steps to strengthen existing measures that aim to avoid, minimise and offset impacts in accordance with the mitigation hierarchy (ie policy measures in Scenario A), adequately regulated offsetting is considered as a mandatory requirement for all activities that have the potential to cause a significant detrimental residual impact on biodiversity and ecosystem services. This could be achieved at EU level through a framework directive, or similar instrument. As concluded by the NNL Working Group, the activities covered should go beyond built developments and extractive industries and include agriculture, forestry and fisheries.

To ensure that offsetting should not weaken existing protection levels, it would be appropriate for project-level permitting procedures to require evidence from the project proponent and competent authorities that NNL will be achieved through measures taken in accordance with the mitigation hierarchy. To be effective this process should include a critical review of the likely long-term effectiveness of proposed avoidance and mitigation measures.

Although offsetting is necessary to achieve the NNL objective, designing and implementing the necessary policy instruments will be very challenging and there are a number of legitimate concerns regarding the potential risks which will need to be fully addressed. The principal concern is that the inclusion of offsetting within a legal framework could be instrumentalised in a way that encourages developers to forego the proper application of the mitigation hierarchy and jump straight to offsetting. Some fear that this could even lead to the weakening of current levels of protection enshrined in the Habitats' Directive and the ELD. There are also many other challenges with offsetting including: i) how to ensure losses and gains are appropriately measured; ii) the issue of additionality; iii) ensuring that offsets are guaranteed over time; and iv) making sure that offsets are adequately monitored and assessed. Furthermore, at present there is limited experience of implementing offsetting in Europe and a lot of the technical tools required to underpin the policy are still under development.

Given these risks and practical challenges, it is recommended that offsetting should only be further extended through new legislation and made a mandatory requirement IF the provisions are sufficiently well designed and robust to ensure that it will be adequately:

- regulated according to clear principles and standards that are compatible with international best practice;
- monitored by competent environmental and nature conservation authorities, with clear enforcement measures triggered if the offset does not comply with agreed standards and/or meet its objectives and achieve as a minimum NNL; and
- supported and administered through appropriate governance procedures and adequately resourced institutions.

The potential strategic benefits of offsets (eg in terms of linking up fragmented habitats and enhancing Green Infrastructure) can be maximised if they are linked to other policy instruments. For instance, SEA might identify broad needs for offsetting (including from cumulative impacts), which can then be taken into account in developing mitigation strategies for development projects; or regional spatial plans might identify and safeguard areas that would be suitable for offsets or which are needed as part of an offset strategy. Indeed, the results of the scenario modelling carried out in this study suggest that mandatory offsetting for all significant residual impacts could lead to the restoration of large areas of semi-natural habitat, with the potential to significantly reduce habitat fragmentation compared to the BaU scenario.

Developing future policies

It is clear from the work carried out under this contract that the further development of an EU policy on NNL is both necessary, if we are to halt biodiversity loss, but also politically and technically challenging. If the political will exists, many of the gaps in the existing legislation and policies can be addressed on the basis of existing knowledge. However, the big challenge for the future will be the development of a comprehensive and technically robust policy framework for offsetting that will guarantee that it is applied in a manner that is consistent across the EU, is fully coherent with the mitigation hierarchy and delivers real, net benefits for biodiversity. International experience also shows that effective implementation will require significant EU and Member State level support in terms of investment in institutional capacity building, awareness raising, guidance, training and data collation and provision.

Policy options that require changes to existing legislation or the introduction of new legislation will require a certain amount of time to be developed, negotiated, adopted and implemented. In the meantime, many components of biodiversity continue to decline. It therefore seems appropriate to take urgent steps to improve the implementation of existing measures and in particular the offsetting requirements under the Habitats Directive and remediation under the ELD in relation to species and habitats of Community interest. This could be achieved through stronger enforcement and the development of guidance.

1 INTRODUCTION

1.1 The context of the contract

1.1.1 The EU's 2020 biodiversity targets

The conservation of biodiversity (ie ecosystems, species and genetic diversity) and associated ecosystem services is an important policy objective for the EU. Consequently, in 2001, EU Heads of State and Government adopted a target of halting the loss of biodiversity in the EU by 2010. However, despite the development of an EU Biodiversity Action Plan[4] to support the target, and the implementation of many environmental measures, a Commission assessment[5] indicated that the target had clearly not been achieved, with many species and habitats continuing to decline significantly. Although good progress was made with some actions (such as the establishment of the terrestrial components of the Nature 2000 network[6]) it was widely recognised that many intended actions need to be carried out more quickly and effectively.

The main causes of biodiversity declines from 2001 to 2010 were considered to be habitat loss (eg due to land use change, fragmentation), overexploitation, pollution, invasive alien species and climate change; which were driven by changing demographics, consumption and life style choices, institutional, market failures and economic growth (EEA, 2010a). Although existing measures and the Biodiversity Action plan set out to address these pressures and drivers, a study by IEEP and others for the Commission concluded that its effectiveness had been hampered by insufficient integration into other sectoral policies, incomplete implementation of existing legislation, policy gaps, insufficient funding, limited awareness about biodiversity, inadequacy of the policy framework and governance as well as missing administrative capacity, skills and knowledge gaps (Fournier et al, 2010).

However, over recent years there has been growing acknowledgement of the importance of conserving biodiversity, not only for its intrinsic value, but also because of its fundamental role in underpinning ecosystem services, that are of immense socio-economic value in the EU and globally (Russi et al, 2013; TEEB, 2010a; TEEB, 2011). This has led to widening concern over the situation and public and political desires to renew efforts to curb biodiversity losses. This has helped to bolster political commitments for action and, in March 2010, the European Council adopted the new target to '*halt biodiversity and ecosystem service loss by 2020, to restore ecosystems in so far as is feasible, and to step up the EU contribution to averting global biodiversity loss'*. This target now explicitly recognises the importance of the services provided by biodiversity in addition to the need to protect biodiversity for its intrinsic value. A longer term vision was also adopted: '*By 2050, EU biodiversity and the ecosystem services it provides – its natural capital – are protected, valued and appropriately restored for biodiversity's intrinsic value and for their essential*

[4] Communication on halting biodiversity loss by 2010 – and beyond: sustaining ecosystem services for human well-being, COM(2006)216 final.

[5] Communication on the 2010 assessment of implementing the EU Biodiversity Action Plan, COM(2010)548 final.

[6] Which comprises Special Protection Areas (SPAs) designated under the Birds Directive and Special Conservation Areas for Conservation (SACs) designated under the Habitats Directive.

contribution to human wellbeing and economic prosperity, and so that catastrophic changes caused by the loss of biodiversity are avoided.'

To support the achievement of the EU targets (and CBD targets agreed in Nagoya in 2010), the Commission has developed in cooperation with Member States, an EU post-2010 Biodiversity Strategy[7], including sub-targets and feasible and cost-effective measures and actions needed to achieve them.

It is important to note that the role of biodiversity in underpinning ecosystem services is clearly recognised in the Biodiversity Strategy, and as such it "is an integral part of the Europe 2020 Strategy[8], and in particular the resource efficient flagship initiative"[9]. The Strategy is therefore expected to contribute to the European Union's strategic objectives, including a more resource efficient economy, a more climate-resilient and low carbon economy, a leader in research and innovation, and the creation of jobs and business opportunities.

1.1.2 The aim of achieving no net loss of biodiversity and ecosystem services

Of particular relevance to this report is Target 2 of the Biodiversity Strategy (see Table 1.1) and supporting actions (see Figure 1-1), in particular Action 7, which is to "ensure NNL of biodiversity and ecosystem services".

[7] Communication on our life insurance, our natural capital: an EU biodiversity strategy to 2020, COM(2011) 244 final. Hereafter referred to as the "Biodiversity Strategy".
[8] Communication on Europe 2020: A strategy for smart, sustainable and inclusive growth, COM(2010)2020.
[9] A resource-efficient Europe – Flagship initiative under the Europe 2020 Strategy, COM(2011)21.

Table 1-1 The EU 2020 Biodiversity Strategy targets

Target 1: To halt the deterioration in the status of all species and habitats covered by EU nature legislation and achieve a significant and measurable improvement in their status so that, by 2020, compared to current assessments: (i) 100% more habitat assessments and 50% more species assessments under the Habitats Directive show an improved conservation status; and (ii) 50% more species assessments under the Birds Directive show a secure or improved status.

Target 2: By 2020, ecosystems and their services are maintained and enhanced by establishing Green Infrastructure and restoring at least 15% of degraded ecosystems.

Target 3

A) Agriculture: By 2020, maximise areas under agriculture across grasslands, arable land and permanent crops that are covered by biodiversity-related measures under the CAP so as to ensure the conservation of biodiversity and to bring about a measurable improvement in the conservation status of species and habitats that depend on or are affected by agriculture and in the provision of ecosystem services as compared to the EU2010 Baseline, thus contributing to enhance sustainable management.

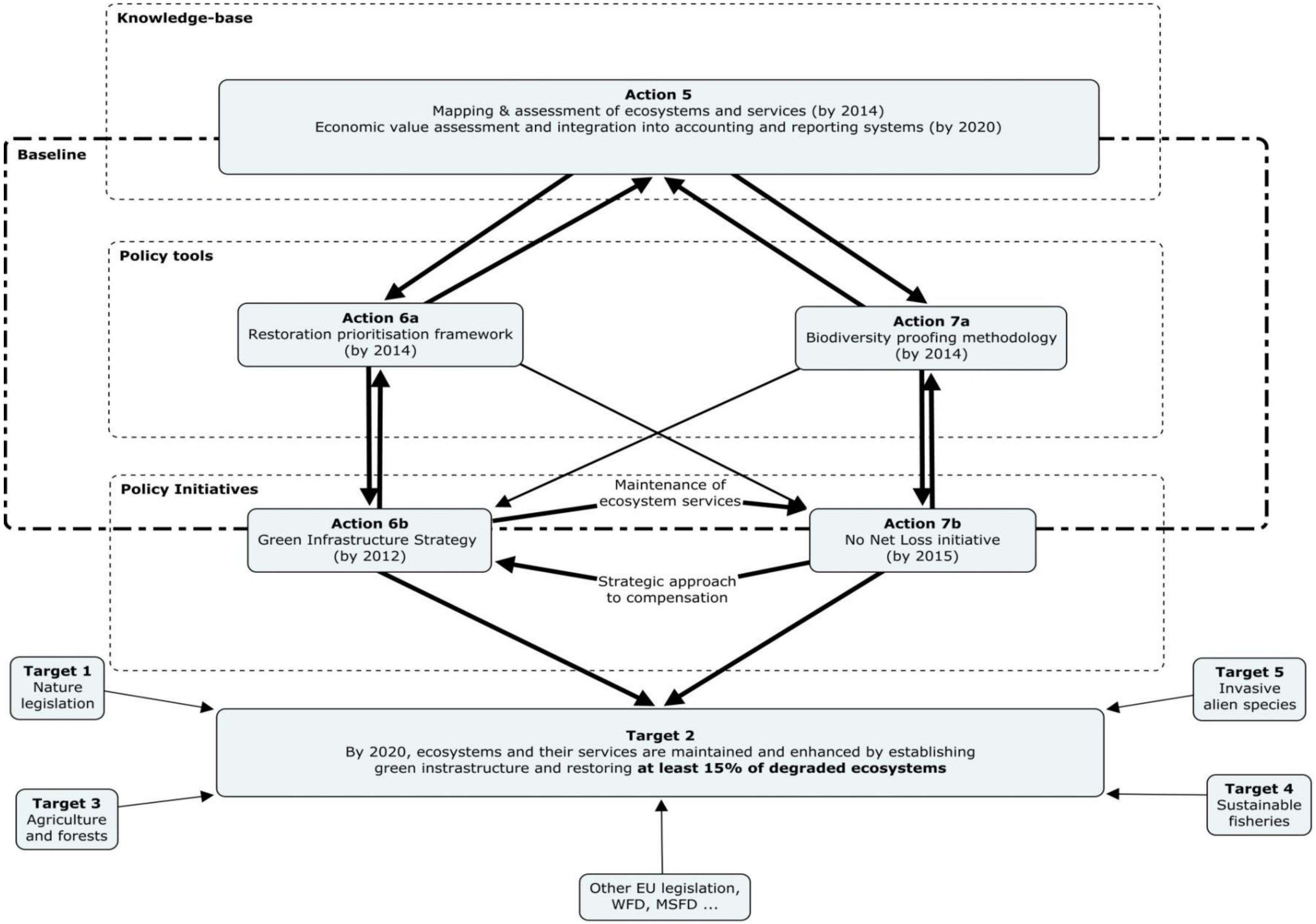
B) Forests: By 2020, Forest Management Plans or equivalent instruments, in line with Sustainable Forest Management (SFM), are in place for all forests that are publicly owned and for forest holdings above a certain size (to be defined by the Member States or regions and communicated in their Rural Development Programmes) that receive funding under the EU Rural Development Policy so as to bring about a measurable improvement in the conservation status of species and habitats that depend on or are affected by forestry and in the provision of related ecosystem services as compared to the EU 2010 Baseline.

Target 4: Fisheries: Achieve Maximum Sustainable Yield (MSY) by 2015. Achieve a population age and size distribution indicative of a healthy stock, through fisheries management with no significant adverse impacts on other stocks, species and ecosystems, in support of achieving Good Environmental Status by 2020, as required under the Marine Strategy Framework Directive.

Target 5: By 2020, Invasive Alien Species and their pathways are identified and prioritised, priority species are controlled or eradicated, and pathways are managed to prevent the introduction and establishment of new IAS.

Target 6: By 2020, the EU has stepped up its contribution to averting global biodiversity loss.

Figure 1-1 Biodiversity Strategy to 2020 – Linkages within Target 2 and with other targets



The No Net Loss (NNL) action consists of two complementary sub actions. Firstly, Action 7a states that “In collaboration with the Member States, the Commission will develop a methodology for assessing the impact of EU funded projects, plans and programmes on biodiversity by 2014”. This recognises the importance of ensuring that priorities for spending under the next EU budget period (2014-2020) do not constrain the EU’s general ability to reach its biodiversity policy objectives. In fact the need for minimising potential conflicts between biodiversity conservation objectives and other priorities for EU funding and their implementation, and increasing beneficial synergies (eg with respect to ecosystem-based climate change adaptation) has been recognised for quite some time. However, little progress has been made to improve the overall “biodiversity friendliness” of the EU budget (IEEP et al, 2012a). A related Action is 17c, which states that “The Commission will work with Member States and key stakeholders to provide the right market signals for biodiversity conservation, including work to reform, phase out and eliminate harmful subsidies at both EU and Member State level, and to provide positive incentives for biodiversity conservation and sustainable use.”

The focus of this current contract is on supporting the second component of the NNL framework, Action 7b, which states that “the Commission will carry out further work with a view to proposing by 2015 an initiative to ensure there is NNL of ecosystems and their services (eg through compensation or offsetting schemes).” This action has been introduced into the current biodiversity strategy because a key lesson from the failure to achieve the 2010 biodiversity target was that it will not be possible to halt the loss of biodiversity in future years without adopting policies and measures that can offset genuinely unavoidable residual impacts (see glossary of terms in Box 1.1).

The intention to ensure NNL of biodiversity and ecosystem services has been further encouraged in the Council conclusions on 21 June 2011, which emphasised the need to develop and implement a methodology taking into account existing impact assessment processes to assess the impact of all relevant EU-funded projects, plans and programmes on biodiversity and ecosystems. It also stressed the importance of further work to operationalise the NNL objective of the Strategy for areas and species not covered by existing EU nature legislation and of ensuring no further loss or degradation of ecosystems and their services. The conclusions also provide the following preliminary definition of the NNL concept: ***'that conservation/biodiversity losses in one geographically or otherwise defined area are balanced by a gain elsewhere provided that this principle does not entail any impairment of existing biodiversity as protected by EU nature legislation***'.

Subsequently the Council Conclusions of 19 December 2011 agreed ‘that a common approach is needed for the implementation in the EU of the NNL principle and invited the Commission to address this as part of the preparation of its planned initiative on NNL by 2015, taking into account existing experience as well as the specificities of each Member State, on the basis of in-depth discussions with Member States and stakeholders regarding the clear definition, scope, operating principles and management and support instruments in the context of the common implementation framework of the Strategy'.

The need for a NNL initiative is also referred to in the Resource Efficiency Roadmap, which calls for proposals to foster investments in natural capital, to seize the full growth and innovation potential of Green Infrastructure and the 'restoration economy' through a Communication on Green Infrastructure (2012) and a NNL initiative (2015).

In addition the European Parliament also adopted a resolution on 20 April 2012[10], urging the Commission to develop an effective regulatory framework based on the 'No Net Loss' initiative, taking into account the past experience of the Member States while also utilising the standards applied by the Business and Biodiversity Offsets Programme. Importantly, the report also refers to the importance of applying such an approach to all EU habitats and species not covered by EU legislation.

It is therefore clear that the potentially broad social and economic benefits of a NNL initiative for biodiversity and ecosystem services has been widely recognised, which has resulted in a strong and clear political mandate for the Commission to develop this initiative.

To help achieve its biodiversity targets the European Commission has established a number of Working Groups under a Common Implementation Framework to obtain the views of stakeholders on key issues. Amongst these was a Working Group on NNL of Ecosystems and their Services (NNL Working Group). The objective of the Working Group was to collect views from Member State representatives, stakeholders and experts on the way forward for the NNL initiative announced for 2015, within the mandate of the 2011 December Council conclusions, taking into account all relevant policies and instruments. The aim was to support the European Commission in its preparation of a NNL initiative. The Working Group completed its work in July 2013, with the production of reports on '*Scope and objectives of the no net loss initiative*' (NNLWG, 2013a) and '*Development of operational principles of any proposed EU no net loss initiative'* (NNLWG, 2013b) and a supporting glossary.

1.1.3 Terminology

For consistency, the key terms and their definitions used in this study follow those used by the NNL Working Group. These are provided in Box 1.1, together with some other terms of relevance to this study. However, it should be noted that these terms were not formally adopted by the NNL Working Group. Figure 1-2 below provides an illustration of how the NNL objective may be achieved, in accordance with the mitigation hierarchy, through the combination of avoidance, minimisation, and rehabilitation measures followed by offsets for residual impacts.

[10] http://ec.europa.eu/environment/nature/biodiversity/comm2006/pdf/EP_resolution_april2012.pdf

Box 1.1 Key definitions

Source: NNLWG glossary unless otherwise indicated

Additionality: the need for a compensation measure **to provide a new contribution to conservation, additional to any existing values**, ie the conservation outcomes it delivers would not have occurred without it (McKenney and Kiesecker, 2010).

Averted risk: The removal of a threat to biodiversity for which there is reasonable and credible evidence. 'Averted risk offsets' are biodiversity offset interventions which prevent future risks of harm to biodiversity from occurring (Conway et al, 2013).

Avoidance: Measures taken to prevent impacts from occurring in the first place, for instance by changing or adjusting the development project's location and/or the scope, nature and timing of its activities (Conway et al, 2013).

Baseline: A description of existing conditions to provide a starting point (eg pre-project condition of biodiversity) against which comparisons can be made (eg post-impact condition of biodiversity), allowing the change to be quantified. In ecological terms, baseline conditions are those which would pertain in the absence of the proposed development. Baseline studies may be undertaken to determine and describe the conditions against which any future changes can be measured (Conway et al, 2013).

Bio-banking: The name of the offset credits markets in New South Wales, Australia but the term can be confused with biological banks (eg of seeds). To avoid confusion, this term is not used as a synonym of habitat or conservation banking.

Biodiversity Offset Management Plan: A form of management plan (often called a Biodiversity Action Plan) typically adopted by developers to address the mitigation measures set out in the impact assessment which is developed as part of the environmental management plan to ensure their implementation. Biodiversity may be integrated throughout the environmental management plan, or may form a discrete component. Such documents may also incorporate biodiversity offsets, but are generally more focussed on project sites (and managing impacts on-site) rather than on offset areas and activities. The BBOP Standard requires a Biodiversity Offset Management Plan to capture the offset's management objectives and general design.

Biodiversity: The variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species (genetic diversity), between species and of ecosystems (CBD).

Compensation: Generally, compensation is a recompense for some loss or service, and is something which constitutes an equivalent to make good the lack or variation of something else. It can involve something (such as money) given or received as payment or reparation (as for a service or loss or injury). Specifically, in terms of biodiversity, compensation involves measures to recompense, make good or pay damages for loss of biodiversity caused by a project. However, it should be noted that **compensatory measures**, as referred to in Article 6(4) of the Habitats Directive are analogous to offsets.

Credit: A biodiversity credit is a unit of gain that can be traded in an offset market. Government typically defines a number of different credit types, which may be described as habitat types or in metrics related to particular species, and projects' impacts are converted into a requirement for a certain number of different credit types on the basis of 'like-for-like or better' (Conway et al, 2013).

Cumulative impact: The total impact arising from the project (under the control of the developer); other activities (that may be under the control of others, including other developers, local communities, government) and other background pressures and trends which may be unregulated. (Conway et al, 2013).

Easement: A right to use a part of land which is owned by another person or organisation (eg for access to another property). A conservation easement can be defined as a legally binding agreement not to develop part of a property, but to leave it 'natural' permanently or for some designated and very long period of time. The property still belongs to the landowner, but restrictions are placed both on the current landowner and on subsequent landowners. In some countries, 'servitudes' or 'covenants' are legal instruments that can be used to introduce conditions for land-use attached to land title that pass from one landowner to the next successor in title (Conway et al, 2013).

Ecological Equivalence (see also: 'like-for-like', like-for-like-or-better and 'trading up'): In the context of biodiversity offsets, the term is synonymous with the concept of 'like for like' and refers to areas with highly comparable biodiversity components. This similarity can be observed in terms of species diversity, functional diversity and composition, ecological integrity or condition, landscape context (eg connectivity, landscape position, adjacent land uses or condition, patch size, etc.), and ecosystem services (including people's use and cultural values) (Conway et al, 2013).

Equivalence: An offset project is considered equivalent if it is designed and sized in order to achieve ecological gains which are at least equal to the loss at the impacted site.

Ecosystem services: The benefits people obtain from ecosystems. These include provisioning services such as food, water, timber, and fibre; regulating services that affect climate, floods, disease, wastes, and water quality; cultural services that provide recreational, aesthetic, and spiritual benefits; and supporting services such as soil formation, photosynthesis, and nutrient cycling (Millennium Ecosystem Assessment, 2005).

Ex-ante (or prospective): 'Before the event': potential, likely or expected. In the context of biodiversity offsets, a 'prospective offset' is one where the decision to undertake an offset is made, and the conditions in the project area are characterised and documented, prior to any impacts associated with the development project.

Ex-post (or retrospective): 'After the event': looking back on or dealing with past events or situations. In the context of biodiversity offsets, a retrospective offset concerns a situation where the impacts associated with the development project have already occurred prior to the decision to undertake a biodiversity offset, or prior to the characterisation of pre-project conditions. Retrospective offsets increase the uncertainty and risk associated with offsets, but can be undertaken successfully if specific conditions are met.

Habitat (or conservation) banking: Habitat banking can be succinctly defined then as "a market where the credits from actions with beneficial biodiversity outcomes can be purchased to offset the debit from environmental damage. Credits can be produced in advance of, and without ex-ante links to, the debits they compensate for, and stored over time". Biodiversity credits in the context of this project include both habitats and species (EFTEC and IEEP, 2010).

Victoria: Units of measurement that take into account the area affected and the quality or condition of the biodiversity impacted (determined by the quantities of a number of chosen attributes related to the structure, composition and function of that habitat) (Conway et al, 2013).

Habitat: 'Habitat' is strictly a species-concept, referring to the particular abiotic and biotic conditions with which individuals or populations of the same species are typically associated. The term 'habitat' is also often extended to refer to the circumstances in which populations of many species tend to co-occur, in which case it is strictly a biotope.

Like-for-like: Conservation (through the biodiversity offset) of the same type of biodiversity as that affected by the project. Sometimes referred to as in-kind. If an offset conserves components of biodiversity that are a higher conservation priority than those affected by the development project for which the offset is envisaged. This is also known as '**like-for-like or better**' or '**trading up**' (Conway et al, 2013).

Mitigation: Measures which aim to reduce impacts to the point where they have no adverse effects. (Conway et al, 2013)

Mitigation banking. Mitigation banking in the USA is akin to offsetting, but the term 'mitigation banking' is inconsistent with the use of the term 'mitigation' outside the USA. Therefore the term is not used as a synonym of habitat or conservation banking.

Mitigation hierarchy: a hierarchical procedure where appropriate actions are taken in the following order: avoidance, reduction/minimisation, restoration/rehabilitation and offsetting. See NNLWG glossary for detailed discussion.

No net loss (NNL): In which the impacts on biodiversity caused by a project (or plan or programme[11]) are balanced or outweighed by measures taken to avoid and minimise the project's (plan's or programme's) impacts, to undertake on-site restoration and finally to offset the residual impacts, so that no loss remains. Where the gain exceeds the loss, the term 'net gain' may be used instead. No net loss (or net gain) of biodiversity is a policy goal in several countries, and is also the goal of voluntary biodiversity offsets. (Conway et al, 2013)

Offset: Biodiversity offsets are measurable conservation outcomes resulting from actions designed to compensate for significant residual adverse biodiversity impacts arising from project development after appropriate prevention and mitigation measures have been taken. <u>The goal of biodiversity offsets is to achieve no net loss and preferably a net gain</u> of biodiversity on the ground with respect to species composition, habitat structure and ecosystem function and people's use and cultural values associated with biodiversity (BBOP definition).

Out-of-kind: When the biodiversity conserved through the offset differs in kind from the biodiversity impacted by the project. The option of 'trading up' to an out-of-kind offset may be advisable where an offset arising from project impacts on a common or widespread component of biodiversity may instead be switched to benefit a more threatened or rare component (Conway et al, 2013).

Ratio: two types of ratios can be distinguished:

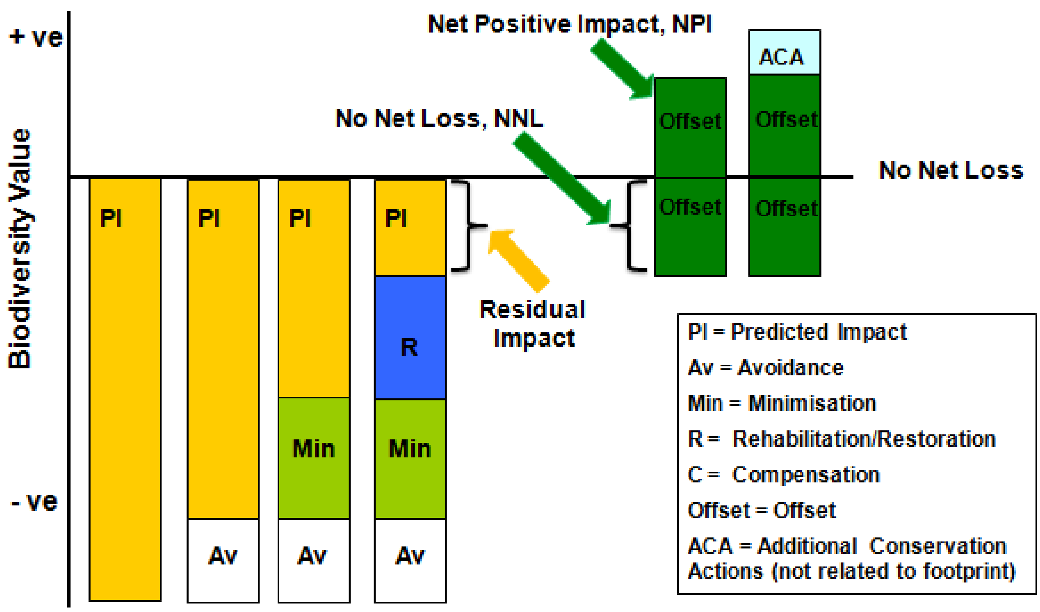
- "ratios" resulting from an analysis of qualified areas on the project site and on the offset site (comparison ratio, evaluated ratio);
- "ratios" not resulting from an analysis of qualified areas on the project site and on the offset site, either to fully design the offset (practice to be avoided) or to take risks into account in the last step of the offset design (risk multipliers).

[11] This NNL WG definition is revised because, whilst the term NNL in general usage focuses on projects, it also applies to plans or programmes (eg a regional programme under Cohesion Policy, see Hjerp et al., 2013). It could also be used in the wide sense also for policies, though this is part of wider biodiversity proofing.

Rehabilitation: Rehabilitation shares with restoration a fundamental focus on historical or pre-existing ecosystems as models or references, but the two activities differ in their goals and strategies. Rehabilitation emphasises the reparation of ecosystem processes, productivity and services, whereas the goals of restoration also include the re-establishment of pre-existing biotic integrity in terms of species composition and community structure. Reclamation projects that are more ecologically based can qualify as rehabilitation or even restoration (Conway et al, 2013).

Restoration: The process of assisting the recovery of an area or ecosystem that has been degraded, damaged, or destroyed. The aim of ecological restoration is to re-establish the ecosystem's composition, structure and function, usually bringing it back to its original (pre-disturbance) state or to a healthy state close to the original. An ecosystem is restored when it contains sufficient biotic and abiotic resources to sustain itself structurally and functionally and can continue its development without further assistance or subsidy. Restoration is frequently confused with rehabilitation; while restoration aims to return an ecosystem to a former natural condition, rehabilitation implies putting the landscape to a new or altered use to serve a particular human purpose. (Society for Ecological Restoration).

Figure 1-2: The achievement of no net loss in relation to the mitigation hierarchy



Source: BBOP[12], adapted from Government of Australia and Rio Tinto

[12] http://bbop.forest-trends.org/pages/mitigation_hierarchy

2 THE CONTRACT'S OBJECTIVES AND THEIR TREATMENT IN THIS REPORT

2.1 Objectives

The objective of this eleven-month contract was "***to support the Commission in developing the NNL initiative foreseen in the EU Biodiversity Strategy to 2020 by developing potential alternative options for this initiative, and analysing their main impacts.***" In accordance with the tender specification, which sets out a broad methodology, the following tasks were undertaken to achieve this objective.

2.1.1 Task 1: Develop a business as usual scenario against which to evaluate alternative options

A Business as Usual (BaU) scenario to 2020, was developed which describes the likely evolution of ecosystems and their services, as expected given existing legislation, practices and spending in the Member States.

The BaU scenario was developed in two ways. Firstly (Task 1a) a literature review focussing on recent modelling studies was undertaken to assess and quantify as much as possible expected land use and related biodiversity and ecosystem service changes up to 2020. This took into account key studies including the Biodiversity Baseline Report (EEA, 2010a) and other published studies, as well as on-going work by EEA, JRC and others at the EU and Member State levels.

Secondly, modelling was undertaken of the likely impacts of drivers of land use change on biodiversity and selected ecosystem services. This was based on the EU-CLUE-scanner framework, with global economic developments simulated with the CAPRI economic model and the IMAGE integrated assessment model (Perez-Soba et al., 2013).

The results of the literature review and the modelling were then compared and combined to provide an integrated overall indication of the most important likely impacts on biodiversity and ecosystem services and their causal pressures under the BaU scenario. In other words, it aimed to quantify the net loss of biodiversity that can be expected in the absence of further policy interventions, and hence the gaps to be addressed by the NNL initiative. This enabled the identification and assessment of the significance of gaps and inadequacies in the biodiversity and ecosystem policy and legislative framework, which in turn helped to further define the scope and range of policy instruments that were considered in Task 2 to be necessary to fully achieve NNL.

Furthermore, the exercise helped to develop the indicators and metrics that were used in Task 3 to assess the potential impacts of the range of policy options for achieving NNL identified in Task 2.

2.1.2 Task 2: Develop policy options for implementing NNL goals

Task 2 aimed to develop a set of EU options for achieving the NNL target, which considered all stages of the mitigation hierarchy (as required in the specification and in accordance with discussions in the NNL Working Group meetings).

Following the tender specification, EU policy options reflected differing levels of ambition, ranging from complementing existing legislation with additional guidance on implementing the mitigation hierarchy, to new mandatory measures. This does not imply that policy option packages might merely lead to a reduction in impacts without achievement of NNL of biodiversity or ecosystem services, but it is acknowledged that the achievement of NNL for some sectors (such as agriculture and fisheries) and some ecosystem services (eg soil carbon storage) is likely to be problematical and difficult to monitor. Nevertheless, as agreed at the Project Inception Meeting, this study worked on the assumption that the aim is to fully achieve NNL of ecosystems and the services they provide, and therefore to address all potentially significant causes of loss, although this might be achieved in the longer-term through stages. **Therefore no policy options for achieving NNL were ruled out at the beginning of this study.**

However, the task also aimed to identify EU policy options that would achieve NNL of biodiversity and ecosystem services with reasonable implications concerning costs, the deployment and implementation of regulations and modes of governance etc. Therefore the selected options attempt to achieve NNL as efficiently as possible, carefully considering the need for additional regulation, financing, governance change, research and other supporting actions.

This task took into account the results of Task 1, and outputs from previous studies, in particular:

- *The Use of Market-based Instruments for Biodiversity Protection - the Case of Habitat Banking* (EFTEC & IEEP, 2010) – hereafter referred to as the "2010 Habitat Banking Study".

- *Background Study Towards Biodiversity Proofing of the EU Budget* (IEEP et al, 2012a) hereafter referred to as the "Biodiversity Proofing Study".

- *Exploring Potential Demand for and Supply of Habitat Banking in the EU and Appropriate Design Elements for a Habitat Banking Scheme* (Conway et al, 2013) hereafter referred to as the "Habitat Banking Demand, Supply and Design Study".

The task was initiated with an audit of existing EU policies and an analysis of their current effectiveness and possible gaps. The results of this are provided in Annex 4. Detailed policy options were then developed for the policy areas and instruments that were considered to have the greatest potential to contribute to the NNL goal.

2.1.3 Task 3: Analyse the impacts of policy options

This component of the study analysed the likely impacts (ie effectiveness), efficiency and overall policy coherence of the identified policy options. This assessment was carried out at two levels and in two steps. Firstly, the effectiveness, efficiency and coherence of each individual policy option was assessed according to a standard set of criteria (eg relating to impacts, legal clarity, enforceability, practicability, costs and consistency with other existing policies). This drew on existing information (such as relevant published Commission impact assessments) but also involved subjective semi-quantitative assessments of likely impacts by the study team.

Secondly, to try to assess the impacts of the policy options more objectively and quantitatively, the models used in Task 1 were re-run with settings that reflected the policy options as much as possible. However, it was impractical to carry this out for each policy option separately, and therefore the options were combined into four policy packages that reflected four different levels of policy ambition.

The results of the individual policy option evaluations and the scenario modelling were then combined to provide an integrated indication of the likely overall impacts of each scenario on biodiversity and ecosystem services compared to the BaU scenario.

2.1.4 Task 4: Organise a stakeholder workshop to gather feedback on proposed policy options

A one day workshop was held on 3rd July 2013, which gathered feedback from key stakeholders on the initial results of the BaU scenario analysis and some of the potential policy options that could be considered in the study. In particular the workshop discussed and provided outline recommendations on policy options relating to strengthening existing policy instruments (eg SEA and EIA), agriculture and the use of offsetting. A summary of the key conclusions from the workshop are provided in Annex 11 and these were taken into account in the development of the policy options in Task 3 and final recommendations of this report.

2.1.5 Task 5: Develop recommendations on the way forward

Recommendations on the preferred options for developing the NNL initiative in the EU were developed, which drew on the outputs of the previous tasks. These recommendations took particular account of the assessment of the effectiveness of the various policy options and the policy packages undertaken in Task 4, to identify the policy measures that are most likely to effectively and efficiently contribute to the overall aim of achieving NNL of biodiversity and ecosystem services.

2.2 The structure of this report

Each chapter of the report provides further information on the aims of each task, the methods used and their rationale. The scope of the chapters broadly matches the tasks described above, but with some changes to facilitate the readability of this report.

- **Chapter 3** describes the development of the BaU scenario through the literature review and the land use modelling. It concludes with the identification of the expected main pressures on biodiversity and ecosystem services, which should therefore be the focus of measures to achieve the NNL objective.

- **Chapter 4** discusses some of the key considerations and principles that should be taken into account in the development of the EU NNL initiative, individual policy options and policy packages. This includes an assessment of the potential benefits of adopting the NNL objective and some of the risks associated with it.

- **Chapter 5** identifies and describes key EU policy options that could contribute significantly to the achievement of the NNL target, in response to the most significant impacts expected to 2020 as identified in Chapter 3 and the considerations and principles discussed in Chapter 4. The potential impact of each individual policy option is assessed in terms of their likely effectiveness, efficiency and coherence.

- **Chapter 6** assesses the potential net impacts of combining the most promising individual policy options described in Chapter 5 according to four scenarios – ie policy packages. The potential impacts of each policy package scenario are also assessed in relation to their likely effectiveness (through a qualitative assessment and quantitative modeling that builds on the BaU scenario) efficiency, and coherence.

- **Chapter 7** provides the overall conclusions of this contract and its specific recommendations.

Due to their size, the technical annexes referred to in this report are provided in a separate document.

3 ESTIMATION OF EXPECTED EU BIODIVERSITY AND ECOSYSTEM SERVICE IMPACTS UNDER A BUSINESS AS USUAL SCENARIO

3.1 Aim and overview

This chapter describes the results of Task 1, the aim of which was to describe the likely evolution of changes of ecosystems and their services under a Business as Usual (BaU) scenario. The BaU scenario assumes a continuation of current policies, legislation and practices in the EU and in the individual Member States (taking into account changes and reforms that are expected within the timeframe of the scenario). The tender specification for this project did not stipulate a timeframe for the scenario development under this task, but it was taken to be for 2020, to match the current 2020 biodiversity target.

A key function of this task is to identify and quantify the main pressures that are expected to lead to on-going biodiversity and ecosystem service losses and gains up to 2020. This is necessary to ensure that the policy measures identified later in this report (see chapter 5) under Task 2 focus on the main priorities. The overall expected impacts of these pressures are therefore quantified to help identify policy priorities and to set a baseline against which the achievement of NNL can be compared. This will also allow the impacts of selected policy options to be quantified in Task 3.

The assessment focussed on factors that affect land cover and its use, as these have a major influence on the status and spatial distribution of ecosystems (and associated species) and their services (Burkhard et al, 2009; Egoh et al, 2008; Kienast et al, 2009; Schulp et al, 2012; Willemen et al, 2008). Furthermore, land cover and land use are relatively easy to map and quantify using area statistics and remote sensing[13]. However, the development of a comprehensive and detailed baseline for biodiversity and ecosystems services is a complex task that would have ideally required new modelling of the impacts of economic and other drivers on land use. This could be a major study in itself, especially if the ambition is to define the baseline in terms of a comprehensive set of policy relevant indicators, such as those identified in the Biodiversity Baseline report (EEA, 2010a) and the EEA Streamlining Environmental Indicators Initiative (SEBI). Current models do not produce such outputs, and therefore new modelling modules would need to be developed. Such sophisticated modelling was beyond the scope of this study, and therefore a more pragmatic and efficient approach was followed where the task was split into two as described below.

Firstly, as part of Task 1a, a review was carried out of existing and on-going studies from which conclusions were be drawn on likely major land/sea use changes up to 2020 and their associated pressures and impacts on biodiversity and ecosystems. However, there are severe limitations with this approach because there have been significant changes in many of the drivers of land use change in recent years, in particular the economic down-turn in Europe and increases in some agricultural commodity prices (for food and biofuels). Furthermore a number of related sectoral policies such as the CAP are undergoing significant reform. Therefore, to help overcome the problems with reviewing past studies, a second approach, was used for terrestrial ecosystems (under Task 1b). This used existing

[13] However there do remain some gaps in the available evidence, particularly in relation to the distribution and composition of grasslands.

models to quantify likely broad land use changes and related pressures and their impacts on biodiversity and ecosystem services in relation to an updated BaU scenario. This approach also aimed to address gaps in data on the current status and trends in some key biodiversity attributes (eg habitat condition) and ecosystem services in Europe, which prevents direct extrapolation of these trends into the future. Therefore, under Task 1b, this contract simulated future changes of land use and land cover and subsequently provided a quantitative estimate of the resulting impacts on biodiversity and provision of ecosystem services in 2020 at EU and Member State levels. However, such an exercise for marine ecosystems was beyond the scope of this contract as suitable models and baseline data are not readily available.

3.2 Estimation of pressures and impacts on biodiversity and ecosystem services in the EU according to recent studies

3.2.1 Methodology

This task firstly reviews recent modelling studies and other relevant studies, to summarise and where possible quantify:

- Projected changes in land cover and land/sea use.

- Resulting likely EU level trends in key pressures, in particular:
    - habitat loss (ie outright destruction of the habitat) (eg from housing demands, infrastructure, industry etc);
    - fragmentation of habitat and populations eg due to infrastructure development;
    - habitat change (eg as a result of increased or decreased management intensity);
    - pollution (external eg as result of airborne nitrogen deposition);
    - over-exploitation (eg fisheries);
    - invasive alien species.

- Expected impacts of changes in pressures on biodiversity and ecosystems, where possible in terms of established biodiversity baseline and SEBI indicators for each main ecosystem type (eg in terms of ecosystem change, the conservation status of Annex I habitats and trends in selected species populations).

It should be noted that this review does not attempt to cover all potential impacts on biodiversity. Instead we focus primarily on land cover and use changes as well as changes in land management.

The studies reviewed here all assume various scenarios of drivers of environmental change (eg population growth, economic development, commodity prices) and policies (eg relating to pollution control, agriculture, and fisheries). Therefore the results of the studies are re-assessed and discussed in relation to how they might relate to a current BaU scenario, which takes into account the current status of drivers and policy measures (eg greening measures under the CAP).

In order to reflect the main environmental pressures and policies that address them across the main ecosystems, our review examines terrestrial developments and land use changes, then wide-scale pollution pressures that emanate from a variety of sources and land-uses, and then finally marine pressures.

3.2.2 Review of studies of projected land use change to 2020

This review draws on a number of reports covering modelling, scenario assessments and literature based or meta-analysis studies. We focus here on the projected land cover and use changes in the EU and where these can be quantified to 2020 and 2050; changes in land use intensity; and how these may relate to the development of the BaU scenario under task 1b. No attempt is made here to quantify the impacts of the observed or expected changes other than where this is pertinent to the information presented.

3.2.3 Projected land cover and use changes to 2020

The generalised trends for EU rural land are relatively well documented for the past two decades (see Box 3.1). Forest and transitional scrub areas have increased, as have urban areas, whereas agricultural land and most semi-natural habitats (excluding forests and transitional woodland scrub) have declined (see for example Conway et al, 2013; EEA, 2010b). Looking forwards, the literature reviewed here suggests that these broad trends are expected to continue along similar lines for the next seven years to 2020, but with greater uncertainty to 2050.

Box 3.1 Major area changes in land cover and use between 1990 and 2006

Consistent pan-European time series data on land cover change is limited and we necessarily rely on the Corine Land Cover data that shows consistently the observed change in land cover between 1990 and 2006.

The major area changes between 1990 and 2006 are the encroachment of urban land into agricultural (1.1 Mha) and forest and terrestrial semi-natural areas[14] (209,198 ha). In total urban land take over this period is in the region of 1.33 Mha across all non-urban land. The majority of other changes are represented by the encroachment and gradual development of forests and semi-natural areas, particularly transitional woodland scrub at 3 Mha. Of course these changes will have been different across the EU and at different times in the 16 years covered by the data. For example 82% (54,173 ha) of the transition of natural grasslands (as defined by Corine) into arable land occurred in the period from 1990 to 2000 with the remaining 18% (9,563 ha) changing between 2000 and 2006. These changes have occurred in light of different market and policy environments, yet the trends in all land cover changes are broadly consistent across the two time periods. It would be reasonable to assume that similar patterns of change will be observed over the period to 2020 but with varying degrees of magnitude between categories and regions.

Source: Own compilation based on Corine Land Cover data as displayed for the Land accounts data viewer of the EEA. Available at: http://www.eea.europa.eu/data-and-maps/data/data-viewers/land-accounts Accessed March 2013.

Despite broad agreement in the general trends in the reviewed literature there are significant differences in the quantified outcomes of the different models and studies reviewed. One of the challenges in comparing existing modelling and review studies is ensuring comparability between the different assumptions, nomenclature, data, scenarios and methodological approach that underpin their conclusions. We therefore focus on the

[14] Including forests, natural grasslands, inland wetlands etc

results and outcomes of the main studies in the area of EU land use change and an effort has been made to identify clearly why results may appear divergent. A summary of the studies, their duration and a brief description are provided in Table 3-1.

Table 3-1: Studies under review to describe future land cover and use changes

Study and duration	Description
ACCELERATES **2050 – EU-15**	Impacts on agricultural production and land use of four socio-economic scenarios and associated climate change (Audsley et al, 2006; Rienks, 2008)
AGLINK-COSIMO **2020 - Global**	Investigating the agricultural sector impacts of EU biofuel policy (Blanco Fonseca et al, 2010)
ATEAM **2050 - EU-15, CH & NO**	Impacts on agricultural production and land use of four socio-economic scenarios and associated climate change (Rounsevell et al, 2005)
Biomass Futures **2030 – EU-27**	Part of the Biomass Futures IEE project. Impacts of biofuel standards on the area of land used for bioenergy production (Elbersen et al, 2012)
CAPRI and Dyna CLUE **2020 – EU-27**	Three trade liberalisation scenarios with a specific focus on agricultural abandonment (Renwick et al, 2013)
EFORWOOD **Current – EU-27**	EFORWOOD - Tools for Sustainability Impact Assessment (Raulund-Rasmussen et al, 2011)
EFSOS II **2030 – EU-27**	EU Forest Sector Outlook Study (UNECE and FAO, 2011a)
ETC-LUSI outlook study **2020**	Outlook study that focuses on the influence of biofuels on land use in 2020, commissioned by EEA (Elbersen et al, 2012)
EU PRELUDE study **2035 – EU25**	Environment Agency PRELUDE project (PRospective Environmental analysis of Land Use Development in Europe). Long term scenario based analysis exploring the future of EU rural land to 2035. Five scenarios are considered against a modelled data baseline for 2005 (EEA, 2007).
EURURALIS-1 **2030 – EU-27**	Model-based assessment of 4 scenarios: effects of global demands and EU policies on land use impacts on agricultural production (Eickhout et al, 2007; Eickhout and Prins, 2008; van Meijl et al, 2006; Verburg et al, 2006).
EU Wood **2030– EU-27**	Study to estimate the real potential for changes in growth and use of EU forests (Mantau et al, 2010)
EURURALIS-2 **2030 – EU27**	Scenarios and policy option assessment using a modelling framework incorporating GTAP; IMAGE and CLUE-s. Policy options include various CAP reforms and biofuel policies (Verburg et al, 2010)
Fertilizers Europe	Forecasts of food, farming and fertilizer use in the European Union for ten years in the future (previously known as EFMA Forecast) (Fertilizers Europe, 2013)
Forest Europe et al, 2011 **Current – EU-27**	Forest sector reporting for the EU-27 and wider European Forest region.
GTAP – BIO **2015 - Global**	Investigating the agricultural sector impacts of simultaneous EU and US biofuel policies in scenarios with and without by-products (Taheripour et al, 2010)
Land-use modelling – Implementation (LUM-Implementation	A study commissioned by DG Environment to develop a framework for land use modelling for DG Environment and the simulation of a baseline scenario and two policy options on biodiversity and climate adaptation (Pérez-Soba et al, 2010; Verburg et al, 2012). The model forms the basis of the JRC LUMP modeling platform.
LUMOCAP **EU-27**	Project on dynamic land use change modelling for CAP impact assessment on the rural landscape (JRC[15])

[15] http://agrienv.jrc.ec.europa.eu/indexlm.htm

Study and duration	Description
MIRAGE-Biof **2020 - Global**	The 'IFPRI study' considering impacts of mandated EU biofuel use as predicted in NREAPs (Laborde, 2011)
PRIMES EU-wide Energy Model 2030 – EU-27	A partial equilibrium model for the European Union energy markets, PRIMES is used for forecasting, scenario construction and policy impact analysis.
REFUEL **2030 – EU-27**	Impacts on agricultural production of a base-line and three socio-economic scenarios (Fischer et al, 2007; Fischer et al, 2010)
SCENAR 2020-II (and update) **2020**	Outlook study for DG Agriculture and Rural Development on the future of agriculture and associated trends in rural areas (Nowicki et al, 2009)
SENSOR **EU-27**	Sustainability impact assessment: tools for environmental, social and economic effects of multifunctional land use in European regions (Helming et al, 2008)
UK Agricultural Futures **2050 – UK (England + Wales)**	Effect of four socio-economic scenarios on lowland agricultural land use (Morris et al, 2005)
(van Delden et al, 2012a) **2020 – EU-27**	Meta-analysis reviewing the outcomes of the following three comparable studies: the Land-use modelling – Implementation (LUM-Implementation) model (Pérez-Soba et al, 2010); The SENSOR model (Helming et al, 2008); and the LUMOCAP model (JRC-IES[16])
VOLANTE **2030 – EU-27**	Visions of land use transitions in Europe. 4 reference scenarios and 11 policy options are simulated using a combination of sector models and land use model. Together with a stakeholder visioning process the scenario results feed into a roadmap for sustainable land use in Europe

Source: own compilation. **Note:** Studies highlighted in purple represent the ten considered in the "Land as an Environmental Resource" study (Hart et al, 2013) as noted later in the section.

The majority of modelling, scenario and prediction studies concerning land in the EU relate to the major economic land use sectors of urban development, agriculture and, to a more limited extent, forestry. Semi-natural habitats, outside agriculture and forestry, receive far less attention, and fewer data exist to describe their extent, condition and potential future. The sections below are structured in relation to these land uses.

Observed trends in urban development

Between 2000 and 2006 urban land accounted for the greatest proportional increase in all land cover types (over 100,000 ha per year), mostly onto agricultural land. The rates of observed change (2000 – 2006) are not uniform within the EU and there have been variations in the rate of change over this time period. For example, from 2000 to 2006 the rate of urban land take increased more in countries such as Ireland, Cyprus and Spain (14, 14 and 15% respectively) compared to the EU average increase of 3% (Jones et al, 2012; Prokop et al, 2011).

Over the same period the greatest area taken up by new transport infrastructure[17] comes from agricultural land (74%; 39,167 ha)[18], followed by forests (16%; 8,594 ha). Although these areas are relatively small, the fragmentation and pollution impacts of transport infrastructure can be significant. Industrial areas (excluding ports and airports) account for

[16] http://agrienv.jrc.ec.europa.eu/indexlm.htm
[17] Road and rail networks and associated land
[18] The main contributing land types are non-irrigated agricultural areas (42%; 22,323 ha) followed by pastures (12%; 6,435 ha) and complex cultivation patterns (eight%; 4,405 ha).

42% (462,563 ha) of all urban land take with 58% (267,908 ha) of this coming from non-irrigated agricultural land.

Projected trends in urban development

Urban expansion is expected to continue its trends of rural land take at a rate of between 43,000 ha and 125,000 ha per year to 2020 in the EU (Conway et al, 2013; van Delden et al, 2012b). This is commensurate with that of existing and observed trends between 2000 and 2006[19] (EEA, 2010b) and other modelling studies such as the EEA PRELUDE study (1% increase per year to 2020) (EEA, 2007) and changes projected to 2030 from the IPCC Special Report on Emission Scenarios[20] (IPCC, 2000). However, it should be noted that the projections used in all these studies were developed before the financial crisis in the EU and may therefore be expected to overestimate urban development rates to some extent, over the near future.

In general, agricultural land is the main land use type lost to urban expansion (EEA, 2010b; Hart et al, 2013), with some studies suggesting as much as 64.5% of all land developed between now and 2020 will be agricultural (Conway et al, 2013). However, other land cover types are subject to significant area impacts including forests and transitional woodland scrub (10.6%), natural grasslands (2.2%) and sclerophyllous vegetation (2%) (Conway et al, 2013).

Studies considering the future trend in urban land do not often provide a further breakdown in the area of urban land other than at the highest level, such as urban residential, urban industrial. However, given that the projected trends are broadly commensurate with those seen in recent years it is reasonable to expect a similar distribution of changes to 2020 with habitat loss, fragmentation and pollution being the prevailing impacts.

Unlike many other changes between land use and land cover, urbanisation often represents a one-way transition. The growing spread of impervious surfaces has a particularly detrimental impact on land's ability to support ecosystem services such as the supply of clean water, climate and energy regulation and the provision of a variety of habitats needed for biodiversity to thrive (EEA and JRC, 2010). Furthermore the concentration of human populations in urban areas leads to the increased diversion of natural resources, such as water, from natural systems into urban centres (Hart et al, 2013) and soil sealing can result in the concentrated flow of water and pollutant run-off rather than being absorbed across a greater area.

[19] Based on observed land cover change between 2000 and 2006 using Corine Land Cover data. Approximately 114,000 ha of land were developed in the EU each year between 2000 and 2006. An increase of 0.6 – 0.7% of urban land area each year. Excluding the development of brownfield land and the transfer of artificial surfaces back to other uses suggests that the net decline in undeveloped land was 86,200 ha per annum over the same period (Conway et al, 2013).

[20] Based on the B1 scenario that combines a global orientation with a preference for social, environmental and broadly defined economic goals (ie more than simple profit). Governments are considered to be actively regulating and ambitiously pursuing goals related to, for example, equity, environmental sustainability and biodiversity.

Drivers of land use and management change in agriculture

The key drivers that have influenced and continue to influence agricultural restructuring include policies such as the CAP and renewable energy policy (Box 3.2), macro-economic developments, consumer behaviour (eg diets' meat content), agricultural commodity and input prices, technological developments, trade agreements and the impacts of climate change. The combination of these drivers means that EU agriculture continues to undergo a process of structural change, with significant consequences for biodiversity. Over the next 20 years a variety of factors will influence the development of agriculture including its land use extent and the management practices adopted. These will include the growth in demand for food and energy crops, climate change, technological development and demographic change. These drivers will impact in different ways in different regions of the EU presenting threats to biodiversity and ecosystems in some areas and opportunities in others (Poláková et al, 2011). Understanding these drivers is an important step to predicting future policy impacts and in the development of the BaU scenario.

Box 3.2: Renewable energy policy as a driver of agricultural land use change

One of the more recent policy developments stimulating demand for agricultural products comes in relation to EU biofuel policy. The Renewable Energy Directive (RED) requires that 10% of energy in the transport sector by 2020 comes from renewable sources. Member States' National Renewable Energy Action Plans (NREAPs) show how they intend to meet the current RED targets. These show that by 2020 biomass is planned to constitute 89% of total renewable energy in transport (Beurskens et al, 2011)[21]. Currently the majority of renewable energy in transport comes in the form of biofuels (typically bio-liquids but also biogas) derived from conventional agricultural crops such as oilseeds (for biodiesel) or cereal grains (for bioethanol). These first generation, or conventional, biofuels have had an influence on agricultural production, with average blending rate of biofuels to fossil fuels reaching 4.5% across the EU in 2010 (Kretschmer and Baldock, 2013) stimulating the growth of certain crops, particularly oilseed rape. Dedicated bioenergy cropping, driven by renewable energy policy is estimated to take place currently on 3% of the cultivated land area (~5.5 Mha), the majority of which is used to grow oil crops (82%) (Elbersen et al, 2012). The European Commission's Energy Roadmap 2050 provides estimates on the demand for biofuels under a number of different scenarios[22]. According to PRIMES[23] modelling, EU biofuel use may reach a maximum of 300 Mtoe. Not all of this increase will be produced in the EU of course, with a significant volume of imports anticipated in the future (Hart et al, 2013).

In 2012 the European Commission, recognising the negative impacts from Indirect Land Use Change (ILUC) as a result of conventional land-based biofuels[24], proposed changes to limit the contribution of such biofuels towards the RED target (capping their contribution at 5%) and incentivise the use of other feedstocks, namely waste and residue streams. If such policy changes are adopted they will likely have an impact on the foreseen changes to agricultural land use as a result of renewable energy policy. Although there is no law against the use of food and feed crops to produce biofuels in the EU, the reduced policy incentive could lessen the impact of the policy in slowing the decrease of agricultural area across the EU. At the time of writing this report the Commission's ILUC policy proposals remained under discussion with proposals for amendments set forward by the European Council and European Parliament.

[21] Some agricultural products are also used to generate biomass for heat and power, such as bio-liquids from oilseeds and vegetable oils, the combustion of perennial energy crops (eg *Miscanthus*), and biogas from green maize and livestock manure (Elbersen et al, 2012). The expected impact on agricultural land is unclear.

[22] Communication COM(2011) 885/2

[23] PRIMES EU-wide Energy Model - a partial equilibrium model for the European Union energy markets, PRIMES is used for forecasting, scenario construction and policy impact analysis up to the year 2030.

[24] Also referred to as first generation or land based biofuels dependant on food and feed crops.

Observed trends in agricultural land use

Agricultural land use in the EU has seen significant and dramatic changes over the past 50 years with a general decline in agricultural area as a result of encroachment or abandonment (Box 3.3) matched with widespread increases in specialisation and intensification of production. Poláková *et al* (2011) provide an assessment of the main trends in EU agriculture and their impacts on biodiversity (see Annex 1). Twelve different types of changes are observed ranging from specialisation, which is expected to continue in productive areas with negative impacts on habitat diversity through to agricultural land abandonment which is expected to continue in more marginal farming areas with negative effects from loss of high nature value (HNV) farming, but benefits for habitat re-creation in other areas. However these trends are not uniform across Member States and although the trend for intensification has slowed in most Member States, some areas, mostly in the EU12/13 continue to see increases.

Box 3.3 Observed changes in agricultural land use between 1961 and 2009

In the EU-27 between 1961 and 2009 there has been a 15% (31 Mha) decline in agricultural areas with a 6% (12 Mha) decline seen in the last decade of this period. These figures represent an average decrease in agricultural area of between 0.3% and 0.5% in area per year. Such changes are commensurate with other data sources such as the change in agricultural areas observed between the two Corine datasets of 2000 and 2006. Further examination of the data suggests that the decline in agricultural land area is not uniform across land use types. The trends shown in the Corine land cover data suggest that the decrease in agricultural area is concentrated on rain-fed arable land, pastures and mixed farmland (Conway et al, 2013; EEA, 2010b). These differences are expected to continue with the associated impacts on biodiversity and ecosystems.

Source: Land resource data. http://faostat3.fao.org/ Accessed: October 2012

These changes tend to affect farmland, and associated habitats, that are prevalent in certain areas such as next to existing urban areas or where production is operating at the margins of economic viability such as certain agricultural mosaics. It is often these areas of farmland that provide high levels of biodiversity or deliver ecosystem services that are accessible to major population centres. Changes to areas of farmland that are of higher nature value have a particularly significant impact on biodiversity. For example, in the 16-year period from 1990 to 2006 just over 300,000 ha of agricultural mosaics with significant natural vegetation have been lost. Significant proportions of this loss (21%; 65,035 ha) have been converted to some form of urban land (50% of this is discontinuous urban fabric 32,436 ha), or to arable land[25] (15%; 46,082 ha). However the greatest proportion (31%) of these agricultural mosaics are being lost to transitional woodland scrub[26] (62,831 ha) and sclerophyllous vegetation (32,446 ha), which is consistent with the abandonment of agricultural land management that may be expected and is predicted to continue in certain parts of the EU (Keenleyside and Tucker, 2010; Moravec and Zemekis, 2007; Pointereau et al, 2008). Similar transition patterns have been observed for natural grassland, moors and heathland and sclerophyllous vegetation.

[25] non-irrigated arable, permanently irrigated arable and rice fields

[26] Transitional woodland scrub follows a typical succession pattern and transitions primarily into some form of forest (85% of the area lost from this land cover or 1.6 Mha).

Changes to natural grasslands[27] warrant particular attention as they represent some of the most species-rich and ecologically vulnerable habitats on farmland in the EU[28]. Approximately one quarter of the natural grassland area that has been lost over the 16-year period starting in 1990 has been subject to agricultural improvement in some way, either to pasture land (1%; 2,743 ha) or other forms of agriculture such as permanent crops (3%; 8,488 ha). The greatest conversion (19%; 63,736) has been to some form of arable land. The importance of natural grasslands has been recognised in agricultural sector policy for over a decade with recent change to the Common Agricultural Policy (CAP) seeing further revision to rules relating to permanent pasture/grassland (see Box 3.4).

Box 3.4 The protection of permanent grassland under the CAP

Regulation (EC) No 1782/2003 and Regulation (EC) 73/2009 require Member States to ensure that the ratio of permanent grassland to other agricultural land does not decrease by more than 5%. However, some derogations are possible under the provision, for example, if the area is to be converted to environmentally compatible forestry.

The revisions to the CAP for the 2014 – 2020 period have changed the permanent pasture, now permanent grassland, requirements again, the detail of which can be seen in section 5.6. The new rules in the political agreement (Article 31 of the direct payments regulation) (Council document 10730/1/13 of 21 June 2013), out two types of obligation as part of the greening measures under the first Pillar of the new CAP:

- Farmers must not convert or plough permanent grassland in areas designated by Member States as being environmentally sensitive. Member States are required to designate permanent grassland, peatlands and wetlands deemed to be environmentally sensitive within Natura 2000 areas and have the option of designating further areas outside N2K areas, including permanent grassland on carbon-rich soils.
- Member States have to ensure that the ratio of the land under permanent grassland does not decrease by more than 5% at national, regional or sub-regional level (to be decided by Member States) compared to the situation in 2015.

If the ratio decreases by more than 5%, Member States must require land to be converted back to permanent pasture through placing obligations on farmers to do so. The exception to this is where the decrease below the threshold results from afforestation, provided such afforestation is compatible with the environment and does not include plantations of short rotation coppice, Christmas trees or fast growing trees for energy production.

[27] Natural grasslands here refers only to the 'Natural Grassland' category of land cover/use described in the Corine Land Cover 2006 dataset. The definition is as follows: '*Low productivity grassland. Often situated in areas of rough uneven ground. Frequently includes rocky areas, briars, and heathland*'. It is therefore appropriate to assume that this category includes semi-natural grassland and some other small areas of semi-natural vegetation that cannot be separated from the Corine data. NB: No consistent pan-European dataset exists to appropriately describe semi-natural or natural grasslands.

[28] Not all natural grasslands identified in Corine can be considered in agricultural use but for the purposes of identifying trends we are considering them as such.

Despite the major changes in agricultural practices having taken place already, intensive and specialised practices that put pressure on biodiversity continue across much of the EU and the impacts of past changes are still being realised in many areas, which may result in future biodiversity declines (Dullinger et al, 2013). Past increases and decreases in pressures may not necessarily appear in studies considering the future changes or developments in land management and land cover and may simply represent a continuation of the status quo in some systems. The continuation of such practices should be considered as equally important in terms of a NNL policy designed to address biodiversity and wider ecosystem services.

Projected trends in agricultural land cover

Despite the presence of some clear impacts on agricultural areas, such as continued urban expansion, the anticipated trends of agricultural land are more difficult to quantify. A review of ten modelling studies (see Table 3-1) considering the future change in agricultural land shows highly divergent results as a result of variability in their base assumptions (Hart et al, 2013). At the extremes the changes in EU agricultural land area range from an overall increase in Utilisable Agricultural Area (UAA) between 105,000 ha and 3.2 Mha (largely in response to biofuel policies, see Laborde, 2011; Taheripour et al, 2010) to decreases in UAA of between two and 50% (3.48 Mha and 87 Mha)[29] to 2030/2050 (Blanco Fonseca et al, 2010). The difference in these expected impacts can be explained by the variability of the model and scenario assumptions. In general terms, biofuel mandates are expected to lead to an increase in agricultural area, or at least a reduction in the rate of decline (although biofuels policy is currently under review); CAP support is expected to slow the rate of decline but does not lead to a direct increase in agricultural area; trade patterns (both Global and European) impact on agricultural markets and land supply influencing area trends in both directions; and yield and technological advancements, if positive, may result in area decreases.

When all these factors are taken into consideration and an assessment of the more realistic future scenarios is considered[30] the area of agricultural land is expected generally to decrease to 2020. The influence of policy drivers such as support through the CAP and the stimulation of bio-energy markets[31] may slow this decline but is unlikely to reverse it entirely. Quantifying the rate of decline is challenging and will vary greatly across the EU. However, figures can be found in some studies. For example, the level of agricultural land abandonment modelled in the EURURALIS study suggests that in total between 2 and 12% (areas of 3.5 and 25 Mha) of the agricultural area in 2000 will be lost by 2030 (Rienks, 2008)). Such declines are consistent with land use projections (to 2020) in a range of other studies including: in all development scenarios of the EEA PRELUDE study (EEA, 2007) and SCENAR-II study (Nowicki et al, 2009); a recent review of land use outlook studies for the

[29] Based on a UAA figure of ~174 Mha (Eurostat 2009 data based on farm structure survey)
[30] Such as reduced support for food and feed based biofuels and more marginal yield increases for a range of crop types
[31] It is worth considering that since this study was produced in 2008 there have been changes proposed to bioenergy policy as described in Box 3.2. If adopted these changes will alter the expected slowing of agricultural land area declines as a result of biofuel policies.

EEA (RIKS, 2010 quoted in (van Delden et al, 2012b); and studies focused on agricultural land abandonment such as by Keenleyside and Tucker (2010).

Many of the assumptions that underpin the continuing trend of decreasing agricultural land in the EU relate to increase in yields leading to either reduced areas of land necessary to meet commodity demands or that additional demands can be accommodated, such as for biofuel feedstocks (Nowicki et al, 2009). For example, increases in yields of between four and 30% are proposed in the EURURALIS study[32] to 2030, with similar increases expected in the REFUEL study (Fischer et al, 2007; Fischer et al, 2010)[33]. The latter study also assumed a disproportionate 2% annual increase in yields in EU-12 Member States progressing towards 80% of the EU-15 average. These scenario and model assumptions are understandable when considering agricultural development over the past 40 years and many models of future land use developed before 2007 have generally assumed more of the same, ie there is a presumption that agricultural productivity in Europe will continue to increase (Hart et al, 2013). However, evidence suggests that increases in yields per hectare, for cereal crops, have remained static or declined over the past decade in a number of countries in Western Europe. Although these could start to increase again given sufficient investment in research and development and technology or knowledge transfer to farmers this is more likely to 2050 than in the next seven years to 2020. Across the EU-27 there are differences in the potential yield increases that could be achieved. Yields in the EU-15 are much nearer their modelled potential[34] than those in the EU-12 indicating greater potential for increases in Eastern Member States. However, what is realisable in practice is often different to that which is technically feasible due to a range of economic, technical, climatic, environmental and behavioural factors.

Projected trends in agricultural land use and management

What is not shown in the broad land cover and use trends, or the modelling studies themselves, are the changes of land in and out of agricultural use at the local and regional scale and changes in agricultural land management intensity that will have both direct and indirect impacts on biodiversity and ecosystems. The issue of past trends in farm specialisation in the EU is complex, leading on one hand to increased input use and mechanisation in some areas, but reductions in inputs and management in others (eg as a result of technical advances and high cost driving efficiency measures) and agricultural abandonment in some areas (as a result of low competitiveness). Studies considering the future of agriculture in the EU such as Scenar 2020-II (Nowicki et al, 2009) and EURURALIS (Rienks, 2008) forecast a continuation of such trends. These include an increase in food and energy crops as a result of technological changes; declining livestock production, especially beef; decreased agricultural employment and number of farm holdings in the EU-12[35]; and the continued specialisation (in open-field arable, horticultural and livestock-rearing and dairy systems) and on the other hand, a continuing role for extensive livestock-based systems with mixed cropping for fodder and fallow land. The actual trends realised will be

[32] Based on figures from (Eickhout et al, 2007; Eickhout & Prins, 2008) van Meijl et al 2006
[33] Represented as annual increases of between 0.2% and 0.9% to 2030.
[34] Such as those that could be achieved given optimum input, climatic and technological conditions.
[35] Farm holdings decrease by 40% in the EU-12 as opposed to 25% in the EU-15

highly dependent on the location of a particular farm, the farming system concerned and a variety of biogeographical, economic and social factors.

Future trends in agricultural re-structuring are likely to have mixed implications for biodiversity although further losses are likely to occur across much of the EU. Further intensification is most likely in the EU-12 Member States, given the considerable scope for further farm investment, restructuring and technological improvement in these regions. This will have substantial biodiversity impacts as many of Europe's most threatened agricultural habitats and species remain in these regions, mainly as a result of their lower intensity farming. In addition, significant areas of semi-natural habitats and other High Nature Value (HNV) farmland are expected to be especially vulnerable to much reduced management and land abandonment (especially in more marginal areas), which will generally have detrimental impacts where large proportions of the landscape are affected (Poláková et al, 2011).

Observed trends in forest land cover

Based on the changes in Corine land cover between 1990 and 2006 forest area has been increasing mainly on to areas of existing transitional woodland scrub (86% of all land becoming forest; 1.6 Mha). The flux in and out of traditional woodland scrub, representing potential natural regeneration cycles or forestry harvesting operations, is also significant. Over the 16-year period observed 2.3 Mha have moved from woodland scrub to forest and 1.6 Mha moved from forest to woodland scrub. Of the remaining land becoming forest, almost equal measure comes from peatbogs, agricultural mosaics with natural vegetation, and pasture (10% each); natural grasslands (16%; 55,251 ha); sclerophyllous vegetation (12%; 43,182 ha), and arable land (21%; 77,461 ha). The remaining land cover and use categories in the EU are impacted relatively little by forests.

Despite the general expansion of forest areas, regeneration through natural succession does not necessarily improve forest connectivity and fragmentation remains a significant issue in many regions (Forest Europe et al, 2011)[36].

Over the last 10 years, Europe's[37] forest area designated for biodiversity and landscape protection has increased by half a million hectares annually now equating to 30 Mha in the EU-27. About 88% (139 Mha) of the EU-27 forest area is classified as semi-natural. Undisturbed forests and plantations cover 4% (4.9 Mha) and 9% (12.9 Mha), respectively. The amount of deadwood (standing and fallen) has increased marginally in European forests, however there is significant variation between forests stands and regions, influenced by management practices, forest type, policy etc. The area of forest that consists of a single tree species has decreased annually by around 0.6% during the last 15-year period. About 70% of the forests in Europe are dominated by two or several tree species, and the remaining 30% are dominated by one tree species alone, mainly coniferous species (Forest Europe et al, 2011).

[36] Trends observed over the 1990 – 2006 time period
[37] Figures are taken from the Forest Europe study (Forest Europe et al, 2011), which includes 46 countries in the European geographical region.

Projected trends in forest land cover

Total forest area has increased consistently over recent decades as a result of afforestation and the abandonment of agricultural and other areas. These area expansion trends are expected to continue at a rate of around 0.25% - 0.4% per year (with differences among regions such as 1.3% for South-West Europe and 0.15% for North Europe) (EEA, 2007; EEA, 2010b; Estreguil et al, 2013). The differences between such expectations is marginal and the natural development of forest areas continues to be relatively slow due to the regeneration time of forest communities often being longer (>30 years) than many of the scenario timelines.

Despite an expected increase in forest area the drivers for this change are likely to be different than they have been in the past. A review of Member State Rural Development Plans (RDPs) carried out by the European Commission in 2007-8 showed a potential for 890,000 ha of new forests to be established under RDPs[38]. However, due to the modifications of the programmes based on the changing needs and economic environment both the target figures and the implementation numbers are lagging behind the original expectations and by the end of 2011 Member States had established only 170,000 ha of new forests[39]. Other forest expansion targets exist, not all of which would be funded through the CAP, and some examples are given in Table 3.3.

Table 3-2: Selected Member State forest expansion targets

Member State	Target	Period
Denmark	Expand by 20-25%	80-100yrs
Hungary	Increase to 27% (annual 15,000 ha)	2040
Ireland	Increase to 17%	2030
Netherlands	Expand by 400,000 ha	2020
Poland	Expand by 33%	2050
Romania	Increase by 2,000,000 ha	2035
Spain	Increase by 45,000 ha	2008 - 2012
UK (Scotland)	Expand by 10,000 ha	per year

Source: (Forest Europe et al, 2011)

Information collected by the Commission through the Standing Forestry Committee (Szedlak T, 2013 *pers comm*) suggests that the potential for afforestation is significant, surpassing the observed trends over the past two decades. However, despite this potential several Member States indicated that there is limited intention to continue large-scale afforestation programmes as have been seen in the past and that expected increases in forest cover would more likely result from natural regeneration.

[38] Report on implementation of Forestry Measures under the Rural Development Regulation 1698/2005 for the period 2007-2013 http://ec.europa.eu/agriculture/fore/publi/forestry_rurdev_2007_2013_en.pdf

[39] European Commission's preliminary data based on Member States communications

Forestry land use intensity

Unlike agriculture where there tends to be a change in land cover in response to some forms of intensification, such as grassland to cropland, forest land cover types remain relatively static. For example, even in the 2030 wood energy scenario explored in the EFSOS II study (UNECE & FAO, 2011a), which requires a significant 98% increase in the mobilisation of woody biomass, overall forest area in the EU is not projected to expand in response nor is there expected harvesting in protected forests or forests not available for wood supply (for definitions see (Forest Europe et al, 2011). Of course the impacts on ecosystems and biodiversity are not simply related to changes in land cover. The increased harvesting intensity and extraction of residues and stumps from forest areas in this scenario will have wide ranging impacts on ecosystems and biodiversity, carbon stocks and water and soil quality (Raulund-Rasmussen et al, 2011).

Considering two of the main studies in forestry projections, EFSOS II (UNECE and FAO, 2011b) and EUwood (Mantau et al, 2010) there is general agreement that increased demands for forestry products such as timber for material use and woody biomass for energy will continue to increase towards 2030. Wood extraction is expected to increase by 15% in 2030 as compared to 2010, but still remain below the maximum potential sustainable extraction as predicted by the EFISCEN model (UNECE & FAO, 2011a). Harvest residue extraction also increases across this time period from 2.5% of stemwood removals in 2010 to 6% of stemwood removals in 2030, indicating a considerable increase in the intensity of harvesting methods over the twenty years. Countries that already practice stump extraction (Finland, Sweden and the United Kingdom) are assumed to continue to do so. The supply of extracted stumps increases from 3.6 in 2010 to 12.1 million m^3 round wood equivalent in 2030 (UNECE & FAO, 2011a).

Despite increases in growing stock within the current forest area fellings are also expected to increase in response to demand. By 2030 fellings are expected to increase by the same order of magnitude across the EU, except in South-West Europe, where increases are more marginal. In most regions, the average increment of forest biomass per hectare remains stable, with some increases shown in North Europe and South-East Europe (UNECE & FAO, 2011a).

Pressures on different ecosystem services from land use and management changes

Observing and predicting the changes in land cover and land use can only give us so much information about what to address through a NNL policy response. It is therefore important to understand the impacts these different changes have on biodiversity and ecosystem services and where the attention for mitigation may lie.

Extrapolating the potential impacts or response of different habitats and species to land management or use changes is challenging because they are influenced by a wide range of external factors such as climate, topography, the area of change etc. Therefore we necessarily rely on observations of the impacts that have been observed to date and how these may guide the development of any policy response.

Over the past decades considerable effort has been made to reduce the environmental pressures associated with a range of rural land uses, in particular agriculture and forestry[40] (Hart *et al*, 2013). In some cases these efforts have been rewarded, however despite progress, many ecosystems have continued to suffer damage and as a result there is still a long way to go to meet many European environmental objectives, in particular those in relation to soils and biodiversity (EEA, 2010a; Jones et al, 2012).

Table 3-3 summarises some of the current status and trends in selected environmental objectives in the EU that can be linked, at least in part, to changes in land use and management. As mentioned above, attributing trends and impacts to specific land use or management changes is problematic and has not been attempted here. The trends highlighted here are those found on agriculture and forestry land in the EU and thus require at least some level of action in these sectors in order to combat negative trends that prevail despite increased action on certain objectives (EEA, 2010c).

Table 3-3: Some trends related to selected environmental objectives in the EU

Objective	Trend and impact	Source
Biodiversity	Only 17% of habitats and species and 11% of key ecosystems protected under EU legislation were in a favourable state, despite action taken to combat biodiversity loss	(EEA, 2010a)
	Many species associated with agricultural land continue to decline and many habitats remain in unfavourable conservation status.	(ETC/BD, 2008)
	< 10% of grassland habitats of Community Interest had favourable conservation status in 2008	(EEA, 2009)
	Fragmentation, commercial harvesting of old-growth forest, climate change and pressure for the intensification of forest utilisation continue to lead to simplification of forest biotopes in some countries	(EEA, 2006)
	>50% of the species and almost two thirds of the habitat types of Community interest in forest ecosystems have unfavourable conservation status.	(EEA, 2010b)
	Only 21% of the conservation status assessments of forest habitats and 15% of forest species are favourable	(EEA, 2010b)
	Trees species variety has been declining by about 0.6% per year in the last 15 years, with roughly 30% of forests in EU dominated by single species, mainly coniferous	(Forest Europe et al, 2011)
Soil	~115m ha (12%) of Europe's total land area are subject to water erosion, and 42 million hectares are affected by wind erosion	(EEA, 2005)
	~58m ha of agricultural land is at risk of erosion of more than 1 tonne of soil per hectare per year (t/ha/yr) and 47.2m ha are at risk of soil erosion of more than 2t/ha/yr	(Hart et al, 2011)
	the mean rate of soil erosion on all rural land types by water in the EU-27 is 2.76t/ha/yr, with a higher mean rate in the EU-15 (3.1t/ha/yr) compared with the EU-12 (1.7t/ha/yr)[41].	(Jones et al, 2012)
	Almost half of Europe's soils (land area) have very low levels of organic matter[42]. This can be as much as 75% of soils in southern Member	(Nowicki et al, 2009)

[40] For example through the introduction of legislation, the development of incentive payments for agri-environment management and the provision of advice.

[41] This is thought to be due to the effect of high erosion rates in Mediterranean countries.

[42] Low levels are defined as below 3.4% soil organic matter or 2% soil organic carbon.

Objective	Trend and impact	Source
	States and some regions witness nearly complete organic matter depletion. Around 60m ha of soils with less than 3.4% soil organic matter are under intensively cropped agricultural land and approximately half of these soils are under arable or permanent crop management.	
	Around 16% of peatland is currently used for agricultural purposes, both cropland and grassland areas, much of which has been drained[43]. This can be as high as 70% in some Member States.	(Poláková et al, 2011)
	Emissions from cropland on peat soils in 2007 were 37.5 million tonnes CO_2 equivalent, corresponding to 88% of total emissions from cropland.	
	Compaction of soils from regular cultivation, and the use of heavy equipment, is widespread across the EU.	
	~50,000ha per year of urban land expansion between 2000 and 2006 were 'sealed' and the rate of soil loss has increased by 3% on average[44]. Similar overall changes are projected for 2000-2030.	(EEA & JRC, 2010)
GHG emissions	Agriculture contributes around 10.5% of EU GHG emissions[45]. However, EU agricultural emissions have fallen by 22% since 1990, mostly as a result of falling agricultural output in some Member States and by efficiency gains in the livestock sector rather than purposive actions.	(EEA, 2010d)
	Land use change, especially through conversion of pasture lands and deforestation contributes 17% of global total emissions. However, ecosystems also remove considerable CO_2 from the atmosphere. Based on current methodologies for accounting, emissions and removals of CO_2 in the EU-27 from Land Use, Land Use Change and Forestry (LULUCF) are calculated to provide a net removal of carbon, offsetting 7% of total EU emissions. LULUCF removals have risen but with no particular trend since 1990. The key driver for the increase in net removals is a significant build-up of carbon stocks in forests, as harvesting only represents 60% of the net annual wood increment. This trend is expected to continue.	(EEA, 2013) (IPCC, 2000) (Westhoek et al, 2006)

Source: Summarised from Hart *et al*, 2013 with further assessment of the source evidence

The summary of trends provided here represents only a partial picture at the EU level of the impacts on ecosystem services and biodiversity driven by changes in agricultural and forestry land use and management changes. At the regional and local level responses and trends are likely to vary significantly, something that therefore needs to be accommodated through some flexibility in the proposed policy options set out in chapter 5 of this report.

Synthesis and considerations for the BaU scenario

The information reviewed in this section has shown a broadly consistent picture for general trends in land use and land cover change to 2030 but with variation in the precise scale of change. Many studies that consider the future trends in land use to 2020 and beyond involve scenario development. These can represent both realistic continuations with regard

[43] Including the vast majority of peat soils in northern and western Europe

[44] This rate is much higher in some countries, for example it was 14% in Ireland and Cyprus and 15% in Spain (Prokop et al, 2011, quoted in JRC and EEA, 2012).

[45] in the form of nitrous oxide from soils and methane from enteric fermentation and manures.

to known policy developments and more radical shifts in order to explore extreme development pathways. Predictions with any degree of accuracy are thus difficult to identify. We have therefore necessarily focussed on those scenarios that match best to existing trends for more short-term projections (to 2020) and agreement between scenarios for longer-term projections. It is clear however that the longer-term projections are much more uncertain.

From the review carried out here, we anticipate that agricultural land in the EU will decrease in area at a rate of between 0.2% and 0.7% per year. This land is largely taken up by urban development which is expanding by around 0.6% – 0.7% per year. Differences are observed within agricultural land use, with greater losses of rain fed agricultural land and natural grasslands (both to urban expansion and natural succession). Forest areas are expected to increase by 0.25% - 0.4% per year with significant fluctuations between transitional woodland scrub communities and high forest[46]. Intra land use and management variations are expected to match existing trends to 2020 but with greater uncertainty to 2050. However, agricultural specialisation and intensification is expected in some areas with extensification, marginalisation and abandonment in others, particularly those areas operating at the margins of productivity. Forest management is also likely to intensify in some areas, particularly regarding the removal of forest residues. Although, as noted above regarding urbanisation, the recent economic crisis in the EU may mean that some model projections are no longer completely valid, but such effects are not expected to have substantial impacts on agriculture and forestry as they are more influenced by global market forces.

The impact of all these land changes on biodiversity and ecosystem services is difficult to assess, as there are complex interactions and local variations, and changes in other important pressures (eg disease, invasive alien species, hunting, and climate change) will also have a significant influence on future trends. Much will depend on the level of ambition of Member States and individual land managers in addressing environmental priorities in the face of the need to increase production of agricultural and forest commodities. Predicting the response of land managers within the agriculture and forestry sectors presents particular challenges for the development of a BaU scenario and indeed any analysis of potential future impacts of policy change. Any response is influenced by a wide variety of factors, not least proposed changes to sectoral policy which must be considered in the development of the BaU.

There are proposals set out in a number of policies that will influence land use, and the consequential impact on biodiversity and ecosystems, over the coming decades. Proposed changes to EU renewable energy policy has been discussed already (see Box 3.3), but perhaps the more significant changes will come from changes to the recently agreed Common Agricultural Policy (CAP). Within the period 1990 – 2006 there have already been significant changes to major elements of the CAP such as the removal of coupled support to production and set-aside along with changes in rural development policy. For the 2014 –

[46] Based on figures from Conway *et al*, 2013 and (van Delden et al, 2012b) (urban trends); based on (Rienks, 2008), (EEA, 2007), (Nowicki et al, 2009) and (van Delden et al, 2012b) (agricultural trends); based on (EEA, 2007); (EEA, 2010a); (Estreguil et al, 2013) (forest trends).

2020 period the CAP has undergone another major reform with changes to all substantive elements of the policy (Box 3.5).

Box 3.5 Changes to the CAP with potential bearing on development of a NNL policy

Many aspects of the new CAP have been finalised at an EU level and are set out in the Council texts from 25 June 2013[47], with some elements still to be agreed. With the information available a number of changes should be noted that have bearing on the potential for the CAP to support the development of a NNL policy. These changes include: the requirement for Member States to make 30% of Pillar 1 direct payments contingent on practices beneficial to climate and the environment on most farms; and at least 30% of the total EAFRD funds must be reserved for measures delivering environmental and climate benefits through specific measures[48]. The EAFRD has been restructured allowing the increased flexibility to use different measures in combination to meet six union priorities and three cross cutting objectives; the re-designation of Areas of Natural Constraint (ANC) has been put back to 2018; the protection of carbon rich soils and wetlands was removed from the GAEC standards; and the WFD and SUPD was removed from the SMR under cross compliance. Further details of these changes can be seen in section 5.6.

Many, but not all, of the agreed changes to the CAP can be seen as positive for the environment. The requirement to bring some environmental management into Pillar 1 is significant and has the potential to increase the scope of the CAP to deliver more environmentally beneficial agricultural management across the EU. So too are the changes to Pillar 2 with increased flexibility to use and tailor different packages of measures to meeting specific environmental challenges. These changes could see major improvements to environmental delivery. However, realising these improvements will require Member States to implement effectively the different measures at their disposal and for individual land managers to adopt such measures. Budgetary resources will be one of the key factors in such decisions. The disproportionally large decrease in CAP funding for Pillar 2 (-18%) compared to Pillar 1 (-13%)[49] as a result of the political agreement on the EU Multiannual Financial Framework (MFF) for 2014-2020 will have an impact on environmentally beneficial rural development expenditure in many Member States. The decision of Member States to transfer money between the two pillars (including the level of funds transferred from Pillar 1 to Pillar 2 and whether or not Member States with the option to do so will transfer funds from Pillar 2 to Pillar 1) will also play a significant role.

Of course despite the significant and wide ranging influence the CAP has on agricultural land management, market forces and agricultural commodity prices play an equally significant role in land management decisions. Similar can be said in relation to forests.

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[47] Council of the European Union (2013) Presidency suggestions for an adjusted Council mandate, 11546/13, Brussels, 25 June 2013; Council of the European Union (2013) Presidency suggestions for an adjusted Council mandate, summary of open issues – Annex, 11546/13 ADD1, Brussels, 25 June 2013; and Council of the European Union (2013) Further Presidency suggestions for an adjusted and complete Council mandate – Annex I, 11546/13 ADD2, Brussels, 25 June 2013.

[48] Investment; Forestry; Agri-Environment; Organic farming; Natura, excluding WFD-related payments; ANCs and Forest Environment Measure.

[49] Figures based on a comparison between 2020 and 2013 support.

The development of the BaU will therefore need to take account of proposed policy and market changes within the limits of the model and data availability.

Conclusions on the likely impacts of land use changes on biodiversity and ecosystem services is provided in section 3.4, which also draws on the results of the BaU modelling in section 3.3.

3.2.4 Projected water pollution trends to 2020

Substances causing water pollution in the EU include nitrogen, phosphorus, heavy metals, various pesticides, pharmaceuticals, and other persistent chemicals such as dioxins, DEHP and TBT (EEA, 2012a). Nitrogen and phosphorus are the most important in terms of volume and areas affected. Nitrogen and phosphorus cause widespread eutrophication, with phosphorus generally having most impact on freshwater ecosystems, and nitrogen in marine and transitional waters.

The principal point sources for aquatic nitrogen and phosphorus pollution are waste water treatment plants (ie sewage), with lower contributions from industry sites and aquaculture. The principal source of diffuse nitrogen and phosphorus pollution is run-off from agricultural fields resulting from fertiliser use and livestock manure. Overall, 30-40% of European water bodies are under significant pressure from diffuse water pollution, and 22% from point sources (EEA, 2012a).

The overarching EU policy target on water pollution is the Water Framework Directive[50] requirement that all water bodies achieve good ecological status[51], good status[52], or good ecological potential[53] by the end of 2015. This is supported by a suite of legislation including the Urban Waste Water Treatment Directive (UWWTD), the Nitrates Directive, the Groundwater Directive, and the Sewage Sludge Directive, and reinforced by mechanisms such as the CAP cross-compliance rules. The UWWTD, in particular, requires that all wastewater discharges from areas with large populations either meet more stringent treatment criteria, or reduce phosphorus and nitrogen loading by at least 75%, where these discharge into waters designated as, inter alia, at risk of eutrophication ('sensitive areas'').

Although it is unlikely that the Water Framework target will be achieved by 2015, it can be expected that a significant proportion of water bodies not currently at good status will be restored to good status by 2020. According to a recent IEEP led study (Tucker et al, 2013) this is likely to be sufficient to achieve, at an overall level, the EU's target of restoring 15% of degraded ecosystems. Similarly, assuming that implementation of the UWWTD is addressing all the major water pollution point sources, it can be assumed that point source water pollution pressures will be reduced sufficiently to restore more than 15% of impacted waters by 2020 if that Directive is fully implemented as required. However, biodiversity

[50] Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for the Community action in the field of water policy

[51] Good ecological status applies to all freshwater, transitional and coastal water bodies that have not been declared as 'heavily modified'

[52] Good status applies to groundwater bodies

[53] Good ecological potential applies to freshwater, transitional and coastal water bodies that have been designated as 'heavily modified'

impacts and ecosystem losses are still likely to occur in areas, and therefore more or faster actions to address water pollution impacts in these locations will be needed to achieve NNL of biodiversity and ecosystem services at all appropriate scales (see discussion in chapter 4 on appropriate NNL objectives scales).

3.2.5 Projected air pollution trends to 2020

Pollution from substances deposited via atmospheric pollution includes acidification from sulphur dioxide (SO2), eutrophication from nitrogen compounds (NOx) including ammonia (NH3) and SO2, and damage to plant health from ozone (produced from emissions of volatile organic compounds (VOCs) and NOx). Of these issues, eutrophication of terrestrial and freshwater habitats is now the most widespread problem across the EU (as acidification impacts are declining). In 2010, the percentage of sensitive ecosystem area at risk from eutrophication is close to 100% in nine EU Member States, and in only four EU Member States is it at or below 50% (EEA, 2012b).

The main sources of SO2 are power stations and refineries burning sulphur-containing fuels. NOx come from transport, power generation, and heating. VOCs are produced by a wide range of industrial processes that use solvents. Ammonia mainly originates from livestock manure and intensive animal rearing.

Current air pollution policy targets are driven by the 2005 Thematic Strategy on air pollution[54] and the EU air pollution legislation that supports this strategy. The Thematic Strategy sets targets for 2020 for improvements to areas affected by acidification, eutrophication, and ozone, and states that these improvements will be delivered by reducing SO2 emissions by 82%, NOx emissions by 60%, VOCs by 51% and ammonia by 27% in 2020 relative to the 2000 baseline. This includes a reduction of the area affected by eutrophication by 31% compared to the 2000 baseline (Amann, 2012).

Current modelling of expected achievements to 2020 (Amann, 2012) concludes that SO2 emissions will fall drastically, NOx emissions are expected to decline by more than 65% until 2030, and VOC emissions will decline by 40% up to 2030, but only minor changes are expected for NH3 emissions. These results show that these emission reduction predictions are not sufficient to meet some of the Thematic Strategy targets. The modelling work also explores a 'Maximum Technically Feasible Reduction' (MTFR) scenario, which indicates that a further reduction in NOx emissions of 15-20% compared to the baseline, a 30% reduction in NH3, and a 35% reduction in VOCs would be possible if Member States were to invest in full application of the available technical measures, beyond what is required in current legislation.

It is therefore clear that under the current BaU scenario, legislation and policy is delivering significant improvements in air pollution impacts. Current models and monitoring indicate that this could be sufficient to achieve Target 2 of the Biodiversity Strategy (ie more than 15% restoration of degraded areas) with respect to the area affected by acidification, but not eutrophication by 2020. The MTFR scenario would achieve the 15% target, but Member

[54] Communication of 21 September 2005 from the Commission to the Council and the European Parliament - Thematic Strategy on Air Pollution COM(2005) 446

States will be unlikely to make the necessary technical investments or policy actions unless EU legislation is tightened up in the forthcoming review of air pollution policy. Moreover, it would appear that it is not technically feasible to fully avoid eutrophication, which suggests that measures to offset residual impacts may be appropriate and need to be considered.

3.2.6 Projected changes to biodiversity and ecosystem services in the marine environment to 2020

There are a number of drivers which may potentially exert pressure on the EU marine environment up to 2020. These include fishing, aquaculture, marine energy production, marine extraction, marine transport, waste management, waste water treatment, and agriculture. Some of these, such as fishing, have been impacting marine biodiversity and ecosystem services for decades, and have well established policy frameworks to regulate them. Others are more emergent drivers, such as marine renewable energy developments, and the policy frameworks to plan them effectively are still in their infancy (ie marine spatial planning). Climate change is predicted to be a major driver of marine biodiversity loss in the coming decades. As a result it has been the focus of the majority of modelling studies, which have tended to analyse the impacts of rising sea surface temperatures and acidification on marine biodiversity, and the interactions these variables may have with other pressures (eg fishing mortality, eutrophication). Climate change impacts however are outside of the scope of this study.

Historically fisheries have had the largest impact on EU marine ecosystems. In 2012 47% of fish stocks in the Atlantic (European Commission, 2012a) and at least 90% of stocks in the Mediterranean and Black Sea (Naver, 2012) are overfished. Furthermore, the impact of fishing on non-commercial marine aquatic organisms is also known to be significant: fishing can affect the relative abundance and size distribution of bycatch species, affect habitats, and provide discarded fish to scavenging populations of seabirds, all of which can lead to changes in species interactions that can affect other parts of the ecosystem. The effects of fishing are difficult to separate from natural changes in species abundance due to environmental changes in say, temperature and currents. Attempts have been made to develop overall indicators of the impact of fisheries on marine food webs, but these are not yet being used in fisheries management.

However, there is still capacity for rebuilding EU fish stocks and restoring degraded marine habitats (Crilly and Esteban, 2012). The extent to which this is done, and the time frame in which these goals are achieved, depend very much on policy and fisheries management decisions. Currently the EU Common Fisheries Policy (CFP) is in the process of being reformed. The CFP is widely acknowledged to have failed to achieve its aim of ensuring an environmental, socially and economically sustainable EU fishing industry. The review process aims to reverse this trend, by among other things, introducing a ban on discarding and phasing out ineffective fleet reduction subsidies. The degree to which this is achieved depends very much on the policy measures adopted under the reform, and equally how these are implemented, and therefore it is extremely difficult to predict what the impact of fishing will be on EU ecosystems and biodiversity over the next decade and beyond.

Nevertheless a number of studies have been performed to model a range of different fisheries management scenarios. O'Leary et al (2011) modelled a business-as-usual scenario based on the assumption that fisheries ministers continue to set annual total allowable catches above levels advised by the scientific advisory body. Their model found that political adjustment of scientific recommendations as is currently the case dramatically increases the probability of a stock collapsing within 40 years (O'Leary et al, 2011). Collapse is even more likely when levels of juvenile bycatch are factored into the model (O'Leary et al, 2011). More worrying still is that these scenarios are 'best-case' in that the scientific advice within the model is based on perfect knowledge of stock status when in reality advice is generated in the face of uncertain stock sizes and fishing mortality rates (O'Leary et al, 2011). The business-as-usual scenario run in the impact assessment to the CFP reform (European Commission, 2011a) found that if the status quo continues, there will be a slow improvement in environmental indicators but targets will not be met as a result of discarding, unassessed stocks and remaining overcapacity. Only 6% of modelled northern stocks could be said to be fished sustainably in 2022 (6% in 2017) (European Commission, 2011a).

In addition to the 'status quo' scenario the impact assessment modelled four reform options. Of the four, one most closely resembles the package of measures proposed by the Commission and the amendments currently being negotiated by the Council and European Parliament:

- ("Option 4"): Achieving environmental sustainability within a flexible time horizon in order to strike the best feasible balance between environmental, economic and social sustainability without EU-led individual tradable quotas. In this option yearly reductions in total allowable catches are capped to 25%, and public financial support will be focused on coastal communities, but there will not be any management tool in the CFP to deal with overcapacity. Member States would be free to implement tradable quotas or not, but current fleet reduction subsidies would be discontinued.

In terms of environmental sustainability, this option would dramatically outperform the status quo scenario (European Commission, 2011a). The quantitative modelling showed that it would result in 79% of stocks being exploited at sustainable levels by 2022 (ie. at F_{MSY}) (European Commission, 2011a). However, due to the voluntary nature of the tradable quota system overcapacity of the EU fleet would remain. From a qualitative point of view it can be argued that maintaining overcapacity would negatively affect compliance and the ability of management systems to achieve the necessary reductions in fishing mortality (European Commission, 2011a). For not assessed or poorly assessed stocks to move to F_{MSY} it will be necessary to develop or strengthen existing assessments which can be used to implement appropriate harvest control rules (European Commission, 2011a).

Maritime transport activity, occurring in ports, at sea or during ship construction/ maintenance/ dismantling also presents different environment impacts (Miola et al, 2009). However, it is important to recognise that despite these impacts maritime transport is generally considered environmentally friendly compared to other transportation means (Miola et al, 2009). Indeed, as a result EU policy aims to promote the growth of maritime transport. Maritime transport in the EU-27 is predicted to grow from 3.8 billion tonnes in 2006 to approximately 5.3 billion tonnes in 2018 (CEC, 2009). Passenger traffic, including ferries and cruise ships is also expected to grow (CEC, 2009). There are no specific predictions modelling the ecological impacts of this expansion, but generally speaking maritime transport can lead to the following impacts: loss of coastal habitats from port expansion and development; introduction of alien invasive species as a result of ballast water exchange in ships; and dredging to maintain shipping channels may remove subtidal benthic species and communities as well as cause re-suspension of sediments, nutrients and contaminants which may have a harmful effect on marine organisms (eg deposition of dredged material can smother sub tidal communities) (Miola et al, 2009). Obviously during this period Community rules on environmental protection will apply such as the Habitats, Birds, Water Framework and Waste Directives.

In relation to marine renewable energy, models indicate the industry is expected to grow significantly: across Europe between 1.0 GW and 2.5 GW of installed capacity of both wave and tidal stream energy could be installed by 2020 (Carbon Trust, 2009). Of course this estimate relies on several assumptions based on financial and technological factors, electricity networks, as well as environmental and regulatory issues (Carbon Trust, 2009). This growth in the ocean energy sector is being led by the UK (Scotland specifically) and to a lesser extent Ireland and Portugal (IHS Emerging Energy Research, 2010). With respect to the impacts on the marine environment of this projected growth, studies indicate that marine renewable energy installations have the potential to be both detrimental and beneficial to the environment, but the evidence base remains limited (Inger et al, 2009). Some studies suggest that installations may increase local biodiversity and potentially benefit the wider marine environment, as they have the capacity to act as artificial reefs, fish aggregation devices, and de facto marine protected areas (Inger et al, 2009). Full biodiversity impacts will be dependent upon where installations are sited and whether they are designed to either minimize negative environmental impacts or as facilitators for ecosystem restoration (Inger et al, 2009).

3.3 Estimation of land use changes and overall impacts on biodiversity and ecosystem services based on modelling of the Business as Usual Scenario

3.3.1 Modelling methodology

Land-use change projections

This contract simulated land use changes in the EU under the Business as Usual (BaU) scenario, using the CLUE-scanner (Pérez-Soba et al, 2010; Verburg et al, 2011, 2012). The CLUE-scanner is a multi-scale, multi-model framework that combines sector models, a land use allocation model and indicator models, connecting global and European scale analysis to environmental impacts at the local level (see Figure 3-1). CLUE-Scanner is a user-friendly version of Dyna-CLUE developed for the Commission by Verburg and others as part of the DG ENV Tender 'Land Use Modelling - Implementation'. This model was adopted by JRC and re-named LUMP. The LUMP adds some additional tools for specific assessments to the Dyna-CLUE core model, but basically is the same model, using the same land use base map and land use allocation procedure. In the CLUE-scanner framework, global economic developments simulated with the CAPRI economic model and the IMAGE integrated assessment model are used to project future land-use changes at national level. Land use is subsequently allocated to land cover types with a 1-year time step and 1 km^2 spatial resolution with the Dyna-CLUE model (Verburg and Overmars, 2009), which is the core of the CLUE-scanner. The CLUE family of models are the most frequently used land-use allocation models and very appropriate for scenario analysis. The model has been used in many FP and other EU projects, eg EURURALIS, SENSOR and FARO[55]. The use of the model in many case studies at local and continental scale by different institutions worldwide (including FAO, CGIAR and many international institutes and universities) has proven its capacity to model a wide range of scenarios and provide adequate information for indicator models. The version of the model implemented in the CLUE-scanner framework is Dyna-CLUE. Figure 3-1 shows the land use change allocation procedure.

Land use change is simulated in two steps. First, requirements for agricultural land are simulated per country using a combination of a macro-economic model (CAPRI) and a land use and environmental development model (IMAGE). These models account for the impact that policy measures such as trade restrictions and production subsidies have on the land use demand. Requirements for urban areas are estimated from demographic changes and changes in area use per person (including prosperity and spatial planning considerations). The remaining area is covered by different types of forest and (semi-)natural vegetation. When agricultural land is abandoned, it is assumed that re-growth of vegetation can occur on the abandoned area. The rate of re-growth is determined by soil and climate conditions, and the proximity of forests related to seed dispersal. Grazing or population pressure near cities can retard natural re-growth while active management (eg afforestation) can provide an advantage as compared to natural succession.

Second, the resulting changes in national land use claims are spatially allocated using Dyna-CLUE. The CLUE modelling framework was developed to simulate land use change using empirically quantified relations between land use and its driving factors in combination with dynamic modelling of competition between land use types. The model translates the driving factors and policy specifications into spatially explicit assessments of land use change at high spatial and temporal resolution (yearly results at 1 km^2 resolution across the EU-27). This model bases its assessment on a wide range of different land cover classes derived from the CORINE land cover map. The CORINE land cover map is aggregated into 17 classes, 9 of which are dynamically simulated in this study (Table 3-4).

[55] EURURALIS: Discussion support tool for the future of rural Europe. www.eururalis.eu
SENSOR: Tools for Environmental, Social and Economic Effects of Multifunctional Land Use in European Regions. http://www.sensor-ip.org
FARO: Foresight Analysis of Rural areas Of Europe. http://www.faro-eu.org

There are 'four boxes' that provide the information to run the model:

- Spatial policies and restrictions (eg Natura 2000).
- Land use demand (ie agriculture, urban and nature).
- Location characteristics, maps that define the suitable location for each land use type based on empirical analysis; for example, the European soil map is translated into functional properties such as soil fertility and water retention capacity. In addition to the soil map there is a set of 100 factors that range from accessibility to bio-physical properties; the factors can be dynamic in time (eg in case of population which is based on a downscaling of EUROSTAT NUTS level projections). A full list of factors considered can be found in (Verburg et al, 2006).
- A set of rules for possible conversions between land use types (conversion elasticity, land use transition sequences).

For each time step, the land use demand is allocated based on the location characteristics, the land use type specific conversion settings and the spatial policies and restrictions.
Basically, the allocation is done by:

1. Calculating the suitability for each land use type throughout Europe.
2. Making a preliminary land use allocation by allocating the land use type with the highest suitability to each $1km^2$ grid cell.
3. Comparing the preliminary allocation with the demand.
4. If the preliminary allocation is unequal to the demand, the competitive advantage of the land use types is adapted and a new preliminary allocation is made..
5. Steps 1-4 are repeated until the demand is fulfilled.

The allocation takes into account spatial policies and restrictions by excluding designated areas from land use changes. Rules for possible conversions between land use types are accounted for by prohibiting specific land use conversions or by increasing the suitability of land use types relative to each other, hence making the conversion of one land use type in another more likely. This is elaborated in Annex 2.

Figure 3-1 The CLUE-scanner land use allocation framework

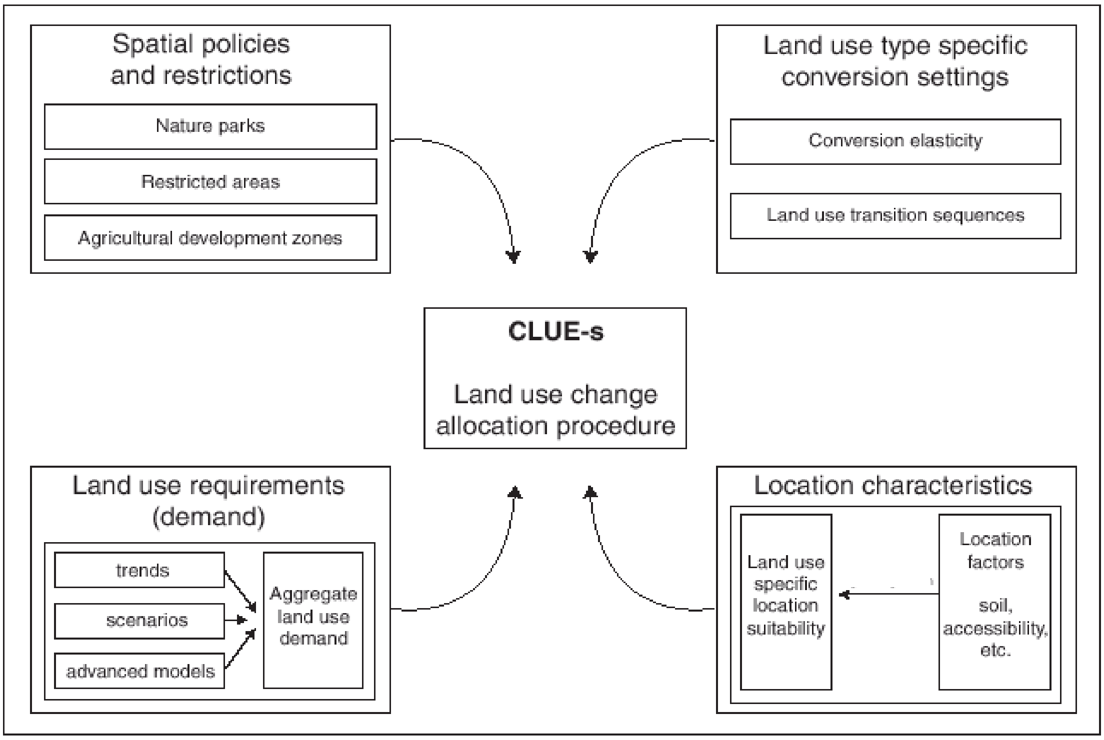


Table 3-4 Land use classification of CLUE-scanner simulations

See Annex 2 for detailed description of the land use classes

Nr.:	Land cover class:
0	Built-up area
1	Arable land (non-irrigated)
2	Pasture
3***	(semi-) natural vegetation (including natural grasslands, scrublands, regenerating forest below 2 m, and small forest patches within agricultural landscapes)
4*	Inland wetlands
5*	Glaciers and snow
6	Irrigated arable land
7	Recently abandoned arable land (ie "long fallow"; includes very extensive farmland not reported in agricultural statistics, herbaceous vegetation, grasses and shrubs below 30 cm)
8	Permanent crops
9**	Arable land devoted to the cultivation of (annual) biofuel crops
10	Forest
11*	Sparsely vegetated areas
12*	Beaches, dunes and sands
13*	Salines
14*	Water and coastal flats
15*	Heathland and moorlands
16	Recently abandoned pasture land (includes very extensive pasture land not reported in agricultural statistics, grasses and shrubs below 30cm)
17**	Perennial biofuel crop cultivation

Notes:

*These land use types are assumed to be constant over time during simulations with CLUE-scanner. These areas are assumed to be unsuitable for agriculture or urban expansion. This assumption is based on the adverse environmental conditions at these locations that hamper natural succession. Within the timeframe of the modelling (20 years), assuming that these land use types are constant will yield the most accurate simulation results.

** In most cases, biofuel crops are part of (non-irrigated) arable land and therefore not shown on the map. Biofuel crops are explicitly mapped only in specific projects.

*** These classes are considered to be an intermediate stage in the natural succession from recently abandoned farmland to (semi-) natural vegetation. Under certain conditions succession will be so slow that the vegetation will remain in the abandoned farmland class for a long period.

Strengths and weaknesses of the approach

The nature of the policies included in a BaU scenario, the policy proposals, and the uncertainty over their possible implementation and effectiveness, mean that it is not possible to directly incorporate them into the model used in this study. In many cases different policies influence a single model parameter and the combined effect of the policies on such a model variable needs to be assessed. Therefore, a step is added where the combined impacts of all the policy options within each scenario are assessed with respect to the model parameters that can be adjusted (see 6.2 and Annex 2). This has been carried out through expert judgement taking into account the qualitative assessment in the preceding section. It should, however, be noted that it is very difficult to make assessments of these overall impacts on land use change and offsetting. Therefore these settings should be seen as ‘overall effect’ assumptions that are incorporated into the model, rather than as exact representations of the policy options. Whereas in economic models policies can be more directly represented, the use of proxy variables to represent policies is common in land use models that consider the more complex suit of decisions leading to patterns of land use change.

- The modelling framework is very flexible and can be adapted to various needs for specific assessments and scenarios. However, modifications of the modelling framework are to some extent limited by the available data and the state of understanding the land system, which hampers the representation of certain decision mechanisms important to land use change.

- Modelling changes in land use intensity is hampered by the currently limited availability of spatially explicit data on land use intensity, which would allow the modelling of the integrated environmental impacts of policies, such as the differences between extensive permanent grassland and intensively managed temporary rotational grasslands, for example. Also for natural land cover types (forest, seminatural vegetation), changes in the quality of the ecosystems cannot be simulated. Ecosystem quality needs to be derived from separate indicators that, for example, provide insight into the fragmentation. There are recent attempts to represent land use intensity changes, but these are outside the scope of this study (Kuemmerle et al, 2013; Temme and Verburg, 2011).

- The current model is limited in its capacity to address feedbacks amongst environmental impacts and the drivers of land change.

- Although it is possible to couple the modelling framework to many alternative detailed indicator models, this is not always recommended. Many indicator models are based on detailed understanding of processes at the micro-level and therefore may be subject to scaling errors when applied at a 1 km^2 spatial resolution. It is therefore important to choose indicator models that are suited and sensitive to the information provided by the CLUE-scanner framework at the thematic, spatial and temporal scale of analysis. A good fit with the thematic content of the different land use classes is also required.
- Uncertainty in model outcomes can originate from different sources. Model outcomes are vulnerable to multiple types of uncertainties, including uncertainty in the input data, structural uncertainties in the model and uncertainties in the model parameters. The model validity has been assessed in multiple cases. An analysis of the different sources of uncertainty for Europe was described by Verburg et al (Verburg et al, 2013a).

- CLUE-scanner and the JRC Land Use Modelling Platform (LUMP) are the main European-scale land use models. LUMP adopted the modelling core of the CLUE-scanner and complemented the model with some specific indicators. Both models use a 1km resolution land use map as a basis of the simulations. This map is based on CORINE2000, which is the most reliable and most recent land cover map available at a European scale. As the CLUE-scanner and LUMP use the same modelling core and spatial input data, the models will most likely result in very similar outcomes if a similar scenario parameterisation is simulated. The main uncertainty that can result in inconsistencies between the two models is the uncertainty in parameterisation. This is exogenous to the model and depends on scenario formulation and translating the parameters into model settings.

- The large spatial extent of the modelling constrains the thematic detail. Land use change modelling is done with an aggregated version of CORINE land cover as a base map. CORINE, being a land cover map, does not make a distinction between land use systems. Consequently, different management regimes in agricultural land can neither be distinguished in the base map nor in the modelling. Additionally, no distinction is possible between different management phases in forest. In some cases, managed forests that have been recently felled sometimes are classified as (semi)natural vegetation. Consequently, land shifts between (semi-)natural vegetation and forests can be overestimated.

Indicators and measurement of ecosystem services

Several methods for classifying and mapping ecosystem services exist. As the classification of ecosystem services defines which ecosystem services need to be mapped to give a coherent picture of the status of ecosystem services and changes therein, choosing an adequate classification of ecosystem services is a first step when mapping a set of ecosystem services. The Millennium Ecosystem Assessment (MA 2005) made a first step in classifying ecosystem services into groups of Provisioning services, Regulating services, Cultural services and Supporting services. The TEEB project (The Economics of Ecosystems and Biodiversity (TEEB, 2010a)) as a follow-up considered the supporting services as part of the functioning of the ecosystem instead of an actual service. As an addition, TEEB added habitat services as a category. Finally, the Common International Classification of Ecosystem Services (CICES) makes a subdivision in services provided by living organisms and services provided by a combination of biotic and abiotic components of the ecosystem. The CICES classification provides a flexible and hierarchical classification that enables cross-references between ecosystem services and other instruments for environmental accounting. It has therefore been proposed as a general framework for ecosystem service quantification in the MAES initiative (Maes et al, 2013). The CICES classification closely links with the TEEB classification: It has a five level hierarchical structure (section – division – group – class – type), making it clearer which ecosystem services are provided by similar components of the ecosystem. The CICES classification was adopted here. A set of ecosystem services indicators was chosen that covers a broad range of CICES categories.

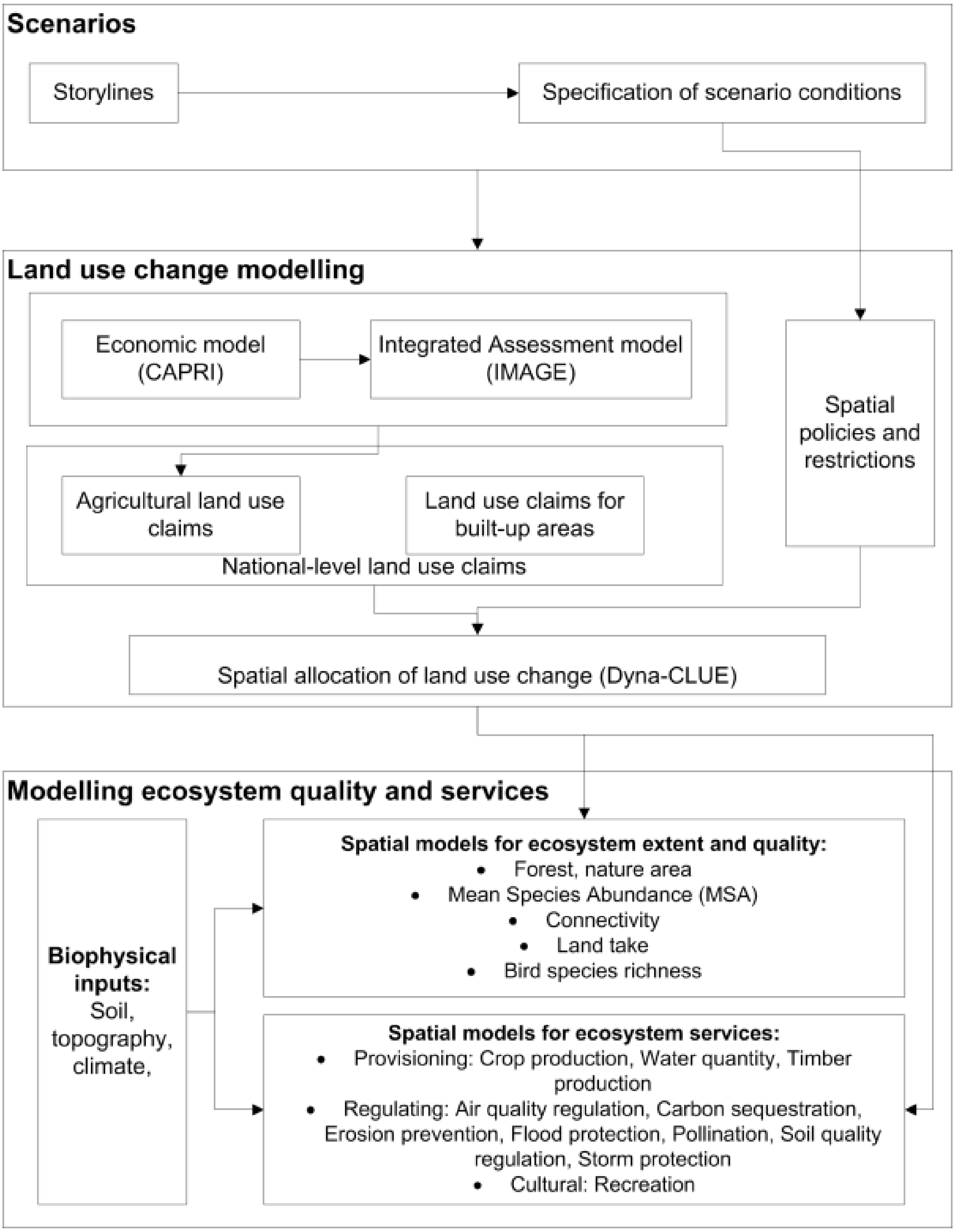
For many ecosystem services, models are available that describe the provision of the service as a function of the land use only (eg Burkhard et al, 2009) or combine land use with static ecosystem properties like soil and topography (Kienast et al, 2009; Schulp et al, 2012). This is a frequently used and generally accepted approach for mapping services and has also been adopted at European scale for many ecosystem services (Maes et al, 2011a). A similar approach is adopted in this study. Using the outputs of the land-use change modelling described in section ”land use change projections”, we quantify and map a set of ecosystem services and biodiversity indices use existing methods (Figure 3-2). We aimed at as much consistency with the methods used in the MAES work as possible. However, for some ecosystem services we adapted the methodology based on developments in past and on-going EU (DG/FP7) projects at the Institute for Environmental Studies (IVM) at VU University. The rationale for using alternative methods, if applicable, is specified below and can be summarised as follows.

1. Most methods for mapping and quantification of ecosystem services have been developed to map and quantify the current status of ecosystem services. Consequently, they are based on available data that describe the current status of the European environment. However, projections of the future status of the environment provide less detail than data on the current status of the environment. Most importantly, the thematic and spatial resolution of future land use change projections is typically lower than the thematic and spatial resolution of CORINE land cover (Verburg et al, 2006) (EEA, 2000). Also, no future projections have been made for several drivers of changes in ecosystem services. If methods used by Maes et al (Maes et al, 2011b; Maes et al, 2012a; Maes et al, 2012b) are not feasible using future land use projections as input, we choose alternative methods that do fit the land use projections.

2. The scientific field of ecosystem service mapping is evolving quickly. Some indicators used by Maes et al (Maes et al, 2011b; Maes et al, 2012a; Maes et al, 2012b) are based on data or methods for which alternatives have been developed. Indeed, several caveats

are identified in the MAES work, some of which have been further developed. Therefore if improved methods have subsequently been developed by the Institute for Environmental Studies (IVM) for other DG Environment or Framework Programme research to quantify net changes of the provision of ecosystem services these have been used here.

Figure 3-2 Ecosystem service projections through CAPRI, IMAGE and CLUE modelling



With the set of indicators described below, we quantify and map the status of ecosystems and their services for the base year and 2020 and changes therein. The indicator set covers a broad range of ecosystem service categories. Apart from a few exceptions, all ecosystem services calculations are done at 1 km^2 resolution. Changes are calculated at 1 km^2 resolution, country specific and for the EU27 as a whole. For visualization purposes, maps are aggregated to NUTS2 level. In the following sections, the proposed indicators are described. Annex 2 provides a full description of the calculation of indicators.

Nutrition – Terrestrial food crop production

Consistent with Maes et al. (2011a) this study calculates the area percentage of cropland and changes therein at the NUTS2 level. Additionally, crop yields and livestock densities (CICES category Terrestrial animal foodstuff) are provided at NUTS2 level as simulated with CAPRI. CAPRI is an agricultural sector model with which medium term horizon (8-11 year) impacts of different agricultural policies can be analysed. CAPRI links a regional supply model with global models that determine the prices of agricultural goods, equilibrium prices of young animals.

Nutrition - potable water

Consistent with Maes et al (2011a) this study reports the area of open water as an indicator for the CICES category Nutrition – potable water. As in many parts of Europe open water is used for water extraction this is a useful indicator for the level of supply that enables the comparison of supply level in different regions. However, this is unlikely to change in the timeframe of the study, whilst the actual balance between supply and demand is expected to change due to population changes, changes in water extraction by industry and agriculture. We therefore expand the supply indicator into an indicator of the actual service delivery to users. For this, we calculate the ratio between the area of open water and area built-up and arable land per watershed-country region.

Materials – Biotic: Forest biomass stock

Within the CICES category Materials – Biotic materials, we calculate forest biomass stocks and changes therein. This is done using the carbon sequestration indicator described in the section ”Regulation of waste – Dilution and sequestration – Carbon” (below).

Regulation of waste – Dilution and sequestration – Air quality regulation

Consistent with Maes et al (2011a) this study calculates the capacity of the land cover to capture and remove air pollutants in a 3 km radius around artificial land use, for each of the land use simulations. To calculate this, first, a buffer zone of 3 km around roads and railroads and built-up areas was mapped. Secondly, within these zones the capacity to capture and remove air pollutants for each land use type (from Pistocchi et al, 2006) is coupled to the land use.

Regulation of waste – Dilution and sequestration – Carbon

Carbon sequestration / emission in soil and vegetation is quantified using the method developed by (Schulp et al, 2008). This is a dynamic bookkeeping model that calculates the amount of CO_2 (Mg C km^{-2} yr^{-1}) sequestered or emitted from soils and biomass. This method is considered the best option to quantify carbon stock changes for this project. The model is tailor-made for simulating carbon stock changes based on CLUE-scanner land use change projections and is based on European-scale data. This method for quantifying carbon stock changes is used in numerous European projects, including FP projects VOLANTE and SENSOR, EURURALIS and the DG ENV project report "Land use modelling – implementation. Preserving & enhancing the environmental benefits of "land-use services"; DG ENV contract 07.0307/2008/511790/SER/G1 (Pérez-Soba et al, 2010).

In this carbon bookkeeping model, emission / sequestration is defined by an emission factor; a region-specific, land use type specific amount of sequestration / emission per km^2 per year. The emission for each location is equal to the emission factor. When the land use changes, the emission factor changes to the emission factor of the new land use type. Emission factors from Janssens et al. (2005) and EFISCEN (Karjalainen et al., 2003) for soil and biomass are used.

Other factors influencing carbon emission and sequestration are (1) the amount of carbon already present in the soil (Bellamy et al, 2005; Sleutel et al, 2003) and (2) the age of forests. These factors are accounted for in the model by assigning a higher emission factor to croplands with higher soil organic carbon contents. In forest, the sequestration speed levels off with increasing age.

Flow regulation – Water flow regulation – Storm protection

Consistent with Maes et al. (Maes et al, 2011a) we map the area of land use types that reduce wind speed and wave speed and hence protect against damage from storms. As the thematic resolution of the land use simulations is lower than the CORINE map (which is used in Maes et al. (Maes et al, 2011a)), the parameterization is slightly adapted. The indicator is calculated for NUTS2 regions located along coasts that contain built-up area. Within these NUTS2 regions, we calculate the area percentage of land use types that protect against damage from storms: Inland Wetlands; Beaches, Dunes and Sand and; Salines (Table 3-4). Land use types not included are coastal lagoons and estuaries as these cannot be distinguished from other water in the land use change modelling.

Flow regulation – Water flow regulation – Flood protection

To indicate the capacity to regulate surface water quantities at European scale, currently the annually aggregated soil infiltration (mm) is used (Maes et al, 2011a). A limitation of this indicator is the absence of a direct link with actual flood regulation and with the impacts of land use change. An indicator that includes a direct link to the actual level of flood regulation and that can be directly applied to the CLUE-scanner land use change projections is available (VOLANTE project; Sturck et al. 2014). For these reasons we propose to use the latter indicator.

The VOLANTE flood regulation indicator generates a dimensionless index of flood regulation provision. The base principles of the indicator are:

a. Natural and close-to-natural land use types provide higher flood regulation supply than intensely modified areas.

b. Different catchment types (defined by size and landform configurations) exhibit different discharge responses to land use and soil conditions.

c. Within a catchment, the response of the river discharge to precipitation events depends on the location of specific land uses and soil conditions.

d. River discharge response to runoff generated by certain land use and soil conditions and their distribution within the catchment might differ considerably, depending on the underlying precipitation events.

The flood regulation supply index is based on catchment experiments within the hydrological model STREAM (see Box 3.6). For these experiments, a number of catchments are selected to cover the geomorphological variety of catchment forms within the EU. Each catchment is calibrated based on observed river discharge data. Land use and soil are iteratively changed within the selected catchments based on predefined location characteristics of the catchment, and the effects of these land use and soil alterations within the specified zones during different types of events of heavy precipitation are analysed. The resulting index itself is based on alterations in water retention within a distinct time frame at the outlet of a catchment.

BOX 3.6 Spatial Tools for River basins and Environment and Analysis of Management options (STREAM)

STREAM is a conceptual empirical hydrological model by the Institute for Environmental Studies of the VU University Amsterdam (IVM). Its core compartment is formed by a GIS based spatially distributed rainfall runoff model. The model has been developed to assess the processes which impact water availability within the river basin. Its use is specifically optimized for the analysis of effects of land use and climate changes on freshwater hydrology in large river basins, which facilitates the use of the STREAM instrument for applications as extensive scenario analysis in water resource management. The model is capable of processing input data of any spatial and temporal resolution.

First, an extreme scenario of soil / land use combinations is designed for each experiment catchment, representing the "worst-case" scenario in terms of water retention. Second, 205 soil / land use combinations are tested iteratively per catchment and precipitation type. The discharge outputs retrieved from these model runs are analysed for the quantities of retained water after a precipitation event occurred. These values are compared for each run to a 'worst case' scenario, where soil and land use parameters are set to least favourable conditions. The relative difference of each run is compared to the worst-case scenario for the respective catchment and precipitation type is than normalized to the maximum of all runs, and used as an indicator for the flood regulation capacity of that specific soil / land use / catchment combination. These indicator values are stored in a lookup table that can be used for scenario analysis.

To map changes in the flood regulation capacity, the CLUE-scanner land use projections are combined with a soil map (European Soil Database (JRC, 2006)) and a catchment map (USGS) to obtain a map indicating soil-land use-catchment combinations. For each combination, the flood regulation capacity is looked up in the lookup table described above.

Flow regulation – mass flow regulation – soil particle flow regulation: Erosion prevention

The model currently used in Maes et al (2011) to quantify the regulation of soil particle flow at European scale is the MESALES model. This is a factor scoring model in which data on land use, slope, soil properties and climate are combined to predict the seasonal and averaged soil erosion in five classes ranging from very low to very high (Le Bissonnais et al., 2002). A limitation of this indicator is the limited thematic resolution (ie the indicator does only distinguish a few main land use types). Especially the role of pasture and some agricultural systems in erosion prevention is underestimated. The erosion risk indicator used in the DG ENV report "*Land use modelling – implementation. Preserving & enhancing the environmental benefits of "land-use services"* (Pérez-Soba et al, 2010) overcomes several of these shortcomings and gives a more quantitative output, providing better possibilities to quantify net loss or gain of the ecosystem service. This indicator builds on the Universal Soil Loss Equation (USLE) (Wischmeier and Smith, 1978) and results in a quantitative estimate of erosion risk in ton ha^{-1} at a 1 km^2 resolution.

In the USLE, first, a potential for soil erosion is derived from topography, rainfall regime and soil erodibility, whereby rainfall regime is considered to be variable in time. Second, the land use maps resulting from each scenario are used to derive a measure for the protective vegetation cover, so that an actual soil erosion map can be obtained (Pérez-Soba et al, 2010).

Changes in the soil loss are a direct reflection of the change in soil particle flow regulation. Areas showing an increase of erosion risk either face an increase of rainfall intensity, or a decrease of the protection by vegetation. An increase of erosion risk at a certain location can, therefore, be considered as a net loss of the ecosystem service at that location. The opposite applies for a decrease in erosion risk.

Flow regulation – mass flow regulation – regulation of pollen flow (pollination)

A common indicator to map the regulation of pollen flow is the visitation probability by pollinating insects (Ricketts et al, 2008). This indicator describes the probability that a crop gets visited by a pollinator as a function of the distance to pollinator habitat. The current status of pollen flow is best indicated by mapping the visitation probability based on high-resolution land cover data (Maes et al, 2012b). However, a realistic map of visitation probability depends on high-resolution land use / land cover data while future land use change projections at a resolution higher than 1 km^2 are not available at a European scale.

Consequently, realistic mapping of future changes of the visitation probability is not possible using the land use change projections foreseen in this contract and therefore we propose an alternative approach as developed by Serna-Chavez et al (2014).

In this method, an empirical relation is established between the percentage natural habitat and the percentage cropland that is accessible for pollinators. The relation applies in areas with land cover consisting of a mix of croplands and natural habitats, as these are the areas where there is an actual flow of pollination. The relation is based on analysis of 10x10km windows in aerial photographs.

To map the flow of pollen using this indicator, land use maps resulting from the CLUE-scanner simulations are classified into natural habitat and other land cover. The percentage natural land cover in a 5 km radius is calculated. With the equation given by Serna-Chavez et al., (2014) the percentage cropland that can be accessed by pollinators from this natural habitat is calculated for croplands.

Regulation of the physical environment – Soil quality regulation

A common indicator to map the capacity of the ecosystem to maintain soil quality is the soil organic matter stock in the topsoil. We apply this indicator in this study. The current status of the soil organic matter stock is derived from (Jones et al, 2004; Jones et al, 2005) while changes in soil organic matter stock are calculated with the indicator described in the section "*Regulation of waste – Dilution and sequestration – Carbon".* The carbon stock changes resulting from this indicator are converted into soil organic matter stocks assuming a carbon content of soil organic matter of 58% (Maes et al, 2011a) and added to the map of the current status.

Cultural services: recreation capacity

The only cultural ecosystem service that is regularly mapped (also in (Maes et al, 2011a; Maes et al, 2011b; Maes et al, 2012a)) is the capacity of ecosystems to support nature-based recreation or tourism. Here, we closely follow indicators developed earlier by Maes et al (2011a; 2011b; 2012a; 2012b) but make a few adaptations to fit the spatial, temporal and thematic resolution of the land use modelling outputs, based on the work by Van Berkel and Verburg (van Berkel and Verburg, 2011).

The capacity of the ecosystem to support recreation and tourism is mapped based on the degree of naturalness; the presence of protected areas, the presence of coasts, and the bathing water quality. These are combined into a recreation potential index that expresses the capacity of ecosystems to provide recreational services (Maes et al, 2011a). A difficulty of this approach upon coupling with CLUE-scanner land use simulation results is that the input data layers indicating the degree of naturalness and the bathing water quality are not available for future scenarios. Hence, it is not possible to project future changes of the capacity of ecosystems to provide recreational services. As the land use changes simulated in the BaU scenario and the policy options are expected to alter the capacity of the ecosystems to provide recreational services, we use a method that is able to capture these changes. Van Berkel and Verburg (2011) developed an indicator for the capacity of the ecosystem to provide recreational services that builds on the CLUE-scanner land use simulations. In this indicator, the degree of naturalness is quantified as a function of the land use. Other assets of the approach developed by Van Berkel and Verburg (2011) included are: (1) the landscape relief as an asset for nature-based tourism and recreation (this is consistent with many studies on people's preferences for tourism / recreation areas); (2) the nearness of rivers as an asset for tourists, additional to lakes and marine coasts; (3) the presence of natural monuments as specified by the IUCN as an asset for tourism; (4) the assets of High Nature Value farmland for recreation and tourism. We quantify changes in the degree of naturalness based on the approach developed by Van Berkel and Verburg (2011) because it gives the most comprehensive picture of the assets for nature-based tourism and changes therein.

Ecosystem coverage and quality indicators

Ecosystem coverage

This indicator is based on the indicator *Ecosystem Coverage* (EEA, 2009), which is considered highly relevant in the context of the 2020 biodiversity target and the CBD AICHI targets (strategic goals B ("…*By 2020, the rate of loss of all natural habitats, including forests, is at least halved and where feasible brought close to zero*…") and D ("…*restoration of at least 15 % of degraded ecosystems*…")). Ecosystems are components of biodiversity as defined by the Convention on Biological Diversity. The indicator measures the change in area of various habitats and ecosystems across Europe. We are able to project possible changes to three ecosystem types: forests, (semi-)natural vegetation and abandoned farmland (both arable land and pastures). A number of other ecosystem types (wetlands, heathland and moorland) are also included as land cover classes in the CLUE model (Table 3-4), but these land use types are not subject to change in the scenario employed and are therefore not presented here. The methodology is well established (eg SEBI indicator 004 and analogous versions in SCI and BIP indicator schemes). A change in each of the ecosystem types indicates a change in habitat availability for species depending on this habitat. Abandoned farmland is a land use class not available in CORINE, but is available in CLUE-scanner. We consider it relevant to include it here because most abandoned farmland is traditionally managed low intensity farmland (such as semi-natural grasslands) that is often of High Nature Value (HNV) and comprises many habitats of Community interest and associated species that are the focus of the Habitats and Birds Directives. However, in some situations farmland abandonment can provide the opportunity for the long-term development of more natural ecosystems and associated valuable habitat for some species. Abandoned farmland can develop in to valuable habitat for species, for which it is an indicator for potential future habitat.

Land take

The ecosystem coverage indicator indicates changes in area of particular cover types. The indicator is analogous to the CSI014 "Land take" indicator[56]. Natural succession or nature management can cause a change between more natural land cover types, which are not as dramatic to the environment (although specific species can be affected) as a change from more natural cover types to agriculture, or artificial land use types such are build-up area.

[56] http://www.eea.europa.eu/data-and-maps/indicators/land-take-2/assessment-2

This indicator can help to identify causes of land use change and habitat loss, and thus assist in defining appropriate No Net Loss policy instruments.

We quantify how much land is converted between land use classes (a) forest and (semi-) natural vegetation, (b) farmland, including abandoned farmland (ie irrigated arable land, non-irrigated arable land, permanent crops, pastures, abandoned pastures and abandoned arable land) (c) built-up land. Absolute loss and gain of ecosystem cover and net turnover (gains-losses) are mapped. We classify the causes of land use turnover in land use conversions towards more natural land cover (land gain) and land use conversions towards more artificial land cover (land take) (See Annex 2 for details).

Land cover connectivity potential

This indicator (described in Pérez-Soba et al 2010 pp 125-127 and Verburg et al, 2011) uses the CLUE-scanner land use maps of 1 km^2 resolution to estimate the weighted Euclidean distance between smaller sized patches of natural habitat and the nearest larger sized habitat patch (>25 km^2). Distance is weighted by the resistance values of land use types in between areas of natural habitat. Resistance values are expert based and no distinction is made for species-specific dispersal capacities. In summary, built-up areas have been assigned a high resistance value (10), cropland and open water have been assigned intermediate resistance values (4), and other land use types, including pasture and recently abandoned farmland, have been assigned low resistance values (1 or 2). A list of all friction values can be found in Annex 2. A patch is defined as a cluster of map raster cells with natural land use that are directly adjacent to one another. Natural land use includes the land use types: (semi-) natural vegetation, inland wetlands, forest, and heathland and moorlands. If such a cluster of natural land use is larger than 25 km^2 this cluster is considered a large patch. If the cluster is smaller, it is considered a small patch. Patches can be composed of different natural land use types, no distinction is made between these. Barrier effects in the landscape other than the main land use types at the 1 km^2 grid, such as roads railways and rivers, are not specifically taken into account in this indicator. Given these limitations, it only offers an initial indication of the potential coherence of possibly valuable natural areas. The indicator has been defined in such a way to be largely independent of the area of natural land use types in the region. Therefore, also areas with limited natural area may still have, in theory, a good connectivity potential. This way the indicator has added value to the other biodiversity indicators included in this study. This indicator has been developed to best identify differences in landscape connectivity potential (here: permeability) at the relatively coarse scale of analysis. Other indicators such as the frequently used proximity indicator (Gustafson and Parker, 1994) are not sufficiently sensitive to the data used at the spatial and thematic resolution of analysis.

Bird species richness

Based on methods described by (Eggers et al, 2009; Louette et al, 2010; Overmars et al, 2013) an indicator for bird species richness and changes therein has been developed. The indicator is based on data on species occurrence and their sensitivity to environmental pressures (Delbaere et al, 2009). In this indicator, we focus on the impact of land use changes on bird species richness. Bird species richness is a commonly used indicator for biodiversity because reliable comprehensive data exist on the distribution and ecology of most bird species in Europe. Also, bird species richness is correlated with the species richness of other species groups (Ekroos et al, 2013). Land use change has been one of the most important drivers of biodiversity loss and is therefore used here as one environmental pressure of interest. The indicator shows the percentage of a set of bird species potentially present at a certain location, based on coarse-scale distribution data and high-resolution land use data. This percentage is calculated based on data of a set of species of which the management and conservation potentially could be effective for most of the other species occurring in the same landscape (Overmars et al, 2013). See Annex 2 for a list of species (168 in total).

Additional to the indicator for total bird species richness, two sub-indices were calculated. First, an indicator was calculated including only birds mentioned in Annex I of the Birds Directive. This is a subset of 91 birds. The indicator highlights where changes are expected that affect species that are agreed to get special habitat protection. Second, an indicator was calculated including only birds that have farmlands as their primary habitat. The selection of farmland birds was based on Donald et al. (Donald et al, 2006). This is a subset of 45 bird species.

Mean Species Abundance (MSA)

This indicator is constructed to show the potential impact of land-use change on biodiversity. Biodiversity is described by the Mean Species Abundance (MSA) and the approach used is derived from the GLOBIO3 concept. The MSA is one (100%) in pristine nature areas and decreases as a function of several factors. The MSA responds to land-use change and is affected by fragmentation, Nitrogen deposition, infrastructure development and land-use intensity. These factors are driven by the (global) driving forces but also by specific nature policies, which are spatially explicit.

The biodiversity index or MSA is derived from land-use, land use intensity (agriculture and forestry), the N-deposition, fragmentation, infrastructure developments and policy assumptions on high nature value (HNV) farmland protection and organic agriculture. The methodology used is the GLOBIO3 approach initially developed for biodiversity assessments at a global scale (Alkemade et al, 2009), but also applied to level of Europe (Verboom et al, 2007).

The indicator provides an approximation of the land-use related changes in biodiversity. As it is not able to discern actual habitats, applies to a 1 km^2 resolution that is too coarse to capture detailed ecological processes and only uses a limited range of factors that influence biodiversity, the results do not provide a precise, local account of biodiversity. It does, however, allow for the comparison between the current and different future situations. It shows potential changes in biodiversity at a generalised level.

3.3.2 The Business as Usual scenario

Scenario setup

In the BaU scenario for this study we sought to describe foreseen future developments that will affect biodiversity and ecosystem services up to 2020. In the short timeframe of this study, changes in land use and land management intensity will be an important driver of changes in biodiversity and the provision of ecosystem services. Based on the information set out in Section 3.2 we have included the relevant variations to land use and land management that are expected over this time period where they could be adopted into the model.

To project how ongoing changes in demography, economic growth, and sectoral policies affect changes in land use, and as a consequence biodiversity and ecosystem services, we have built on work carried out in two key pan-European projects in which members of this study team are involved. First, the V-A2 scenario developed in the FP7 project 'Visions of Land Use Transitions in Europe' (VOLANTE). Second, components of the 'Land use modelling – implementation' project (IEEP et al, 2010) such as the reference scenario developed for DG Environment by Pérez-Soba et al (2010)[57]. Both the VOLANTE A2 (V-A2) scenario and the DG ENV reference scenario are based on the scenario group developed for the Special Report on Emissions Scenarios (SRES). The SRES is one of the best known and most widely used scenario in environmental sciences and has formed the basis of many previous exercises, including ATEAM, Accelerates, EURURALIS and FARO. It lends itself easily to further adaption because of its well-developed framework and broad scope, and accordingly current models are set up to run with SRES developed scenarios. Table 3-5 summarises the main characteristics and data sources of the BaU scenario.

Although the SRES-based scenarios defined for VOLANTE cover a wide range of policy options, the V-A2 scenario does include many ongoing European policies. Changes in demography and economic growth are much in line with past trends. No significant shocks in trade liberalisation, coupling of payments or consumer behaviour are expected. The scenario expects a +4°C change of global mean temperature by 2100. Until 2020 only marginal changes of temperature and precipitation patterns are expected and consequently, no significant changes in agricultural productivity are expected by 2020 as a result of climatic change[58]. Technological progress resulting in changes of productivity is in line with the past trends.

However, there are some areas, such as the CAP and renewable energy policy, where recent policy developments necessitate a change to the V-A2 model scenario settings. Below we describe how these policy developments were incorporated into the BaU scenario, and what elements of the policies cannot be captured in the modelling study. We first discuss recent policy developments that affect the total area allocated to particular land uses in the model.

[57] The scenario was constructed in joint co-operation between the contractors and DG ENV, JRC and EEA representatives.

[58] This refers to the preferential or detrimental changes in local climates, such as greater solar availability or rainfall patterns. It does not refer to the extreme weather events such as flooding and drought associated with climate change.

Next we discuss particular policy developments that instead influence the spatial allocation of various land uses (the spatial pattern of where land use types are allocated).

With respect to the CAP, changes to the Multi-annual Financial Framework (MFF) are looking to reduce the overall CAP budget with different impacts on each of the two Pillars. Under the recent MFF negotiating agreement the Pillar 1 allocation has decreased by 13% whereas the Pillar 2 has decreased by 15% (Little et al. 2013)[59]. In contrast, under the V-A2 scenario the subdivision of the CAP budget over the first and second Pillar is kept constant over time. To reflect the recent policy developments we adjust the V-A2 model policy scenario to resemble the changes in the subdivision of the CAP budget over the Pillars.

With respect to biofuels, the current mandate from the Renewable Energy Directive requires Member States to meet 10% of transport energy from renewable resources. This can come from several sources including conventional and advanced[60] biofuels. The V-A2 scenario includes a mandate of 10% in the EU-27 from conventional biofuels only, which is not in line with current policy. Therefore, the V-A2 scenario is adapted to better match the current mandate for bioenergy by including both sources of biofuels.

With adaptations based on policy options analysed in VOLANTE taken into account, we expect that the demand for particular land uses will reflect the on-going trends until 2020.

In addition to changes in the areas of land use, changes in the actual pattern of land allocation are expected. Within the V-A2 scenario and the DG Environment reference scenario, three policy elements require further definition and alignment with the BaU. These are (i) the extent of Less Favoured Areas (LFA); (ii) the protection of vulnerable soils, both supported under the CAP, and (iii) the impact of Natura2000 on land use changes.

Under the CAP there is on-going support to farming in LFAs. The current reforms to the current CAP will replace LFA's with Areas of Natural or other specific Constraints (ANC) which will be newly defined. However, these areas will not be defined until 2018 therefore it is not possible to account for this change in the scenario. As the LFA's are partly based on natural constraints we continue modelling on the basis of the existing LFA boundaries in the BaU scenario as was the case in the DG Environment 2010 reference scenario.

Second, CAP payments exist that aim to avoid soil erosion, amongst support for other types of environmental management. In some situations Member States may choose to offer support to remove arable cultivation from areas sensitive to erosion. Further policies exist, such as the current maintenance of permanent pasture requirement (at Member State level) under cross compliance that discourage the conversion of such land into arable production. These measures are included in the DG Environment 2010 reference scenario (but not in the V-A2 scenario) and thus to ensure such practices are modelled we built on the DG Environment reference scenario settings.

[59] These changes are apparent after the budget allocations for the expansion of the EU to include Croatia are removed.

[60] Conventional biofuels being those based on food and feed crops, or derived primarily from land; advanced biofuels being those based on feedstocks other than food and feed crops, including agricultural and forestry residues, municipal waste and other sources.

Third, nature policies influence the spatial allocation of land use changes by prohibiting certain changes in specific protected areas. Most importantly, in Natura2000 areas several restrictions apply. In order to incorporate such restrictions in the BaU scenario we built on the criteria used in the DG Environment reference scenario, as the V-A2 scenario settings do not reflect the current nature protection policies. Consistent with the DG Environment reference scenario, in the BaU scenario, the conversion of land within Natura2000 areas to agriculture is not allowed while conversion of Natura2000 land into urban areas is strongly discouraged. Additionally, due to favourable management and environmentally compatible afforestation strategies, the succession of abandoned farmland into semi-natural land and forest is assumed to be faster within Natura2000 sites. Outside of Natura2000 areas there are a range of different rural development measures, such as forest-environment-climate payments, that can provide important environmental benefits and protection to specific forest areas. However, it is not possible within the scope of this study to identify the areas subject to these measures currently or those areas that may become subject to such measures by 2020. Therefore for forest areas outside the Natura2000 areas no specific policies for protection have been applied in the model under the BaU scenario.

Table 3-5: Overview of main Business as Usual scenario settings

Aspect	BaU	Source	Explanation
Global population 2020	8.2 billion	Volante A2	
Annual GDP growth	1.5%	Volante A2	
Trade of agricultural products	Continuous trade patterns	Volante A2	
EU enlargement	No changes	Volante A2	*Although Croatia enters the EU in 2013, currently no data are available to support land use change simulations.*
Product quota		Volante A2	
Farm payments		Volante A2	
Biofuel mandates	5%	Volante A2 policy option	
LFA policies	No change	DG Env Reference	
Natura2000 protection	Conversion of nature into agriculture not allowed, conversion of semi-natural vegetation and forest into built-up area discouraged.	DG Env Reference	
Policies to control urban sprawl	No specific measures	Volante A2	
Soil protection measures	Incentives to decrease area of arable land in erosion sensitive areas	DG Env Reference	
Pillar 1 Greening measures	Ecological Focus Areas and Permanent Grassland protection to be included. Mixed cropping cannot be modelled	Commission proposals	

3.3.3 Business as Usual Scenario Results

This section summarises the main results of the BaU scenario, detailed results are presented in Annex 3, where they are presented along with the results of the policy options, to facilitate comparison. Results are presented for 2020, which is the final year of the simulation consistent with the targets from the Biodiversity Strategy. As a reference year, the status in 2000 is used because this is the base year of the simulations. This comparison provides the most accurate results due to the data issues discussed in section 3.3.1.

Land use change

Under the BaU scenario continuous increases of built-up areas are indicated, with a modelled increase over 2000-2020 of 16% (Figures 3.3, 3.4, 3.5, 3.6, Table 3 6).

Arable land and pastures are projected to decrease by 2% and 3% respectively. The largest decrease is for semi-natural habitats, which are projected to decline by 16% between 2000 and 2020, although increases are expected in some countries due to some arable abandonment. It should be noted that in many cases the semi-natural losses are caused by succession to forest (see Table 3-7). Accordingly, forest cover is projected to increase in most countries, amounting to an overall 4% increase across the EU.

As no arable, permanent crops and pastures were indicated as recently abandoned in the base map of 2000, there were only increases in recently abandoned farmland. Projected recent abandonment levels in 2020 are 1% for arable land, 1% for permanent crops and 2% for pasture, amounting to about 1% of these farmland types overall. Abandonment of arable is likely to provide biodiversity and ecosystem service benefits. In contrast the abandonment of traditional extensive agricultural management of pastures, permanent crops and semi-natural habitats will typically have significant detrimental nature conservation impacts in many areas, although in the longer term it may provide opportunities for the restoration of some natural vegetation types and the enhancement of associated ecosystem services.

Figure 3-7 highlights hotspots of changes of the most important processes that were expected to result in the most pronounced changes in the extent and quality of ecosystems and their services (Pérez-Soba et al., 2010). These are abandonment of arable and pasture and expansion of agricultural land and expansion of urban areas. Some expansion of agricultural land is seen in the North-western part of the EU and in Spain. Urbanization is mainly seen in the EU15 countries. Abandonment is concentrated in the south and east of the EU, with some hotspots in Portugal.

Overview tables of the ecosystem coverage changes are given in Annex 3.

Figure 3-3 Land use in 2000

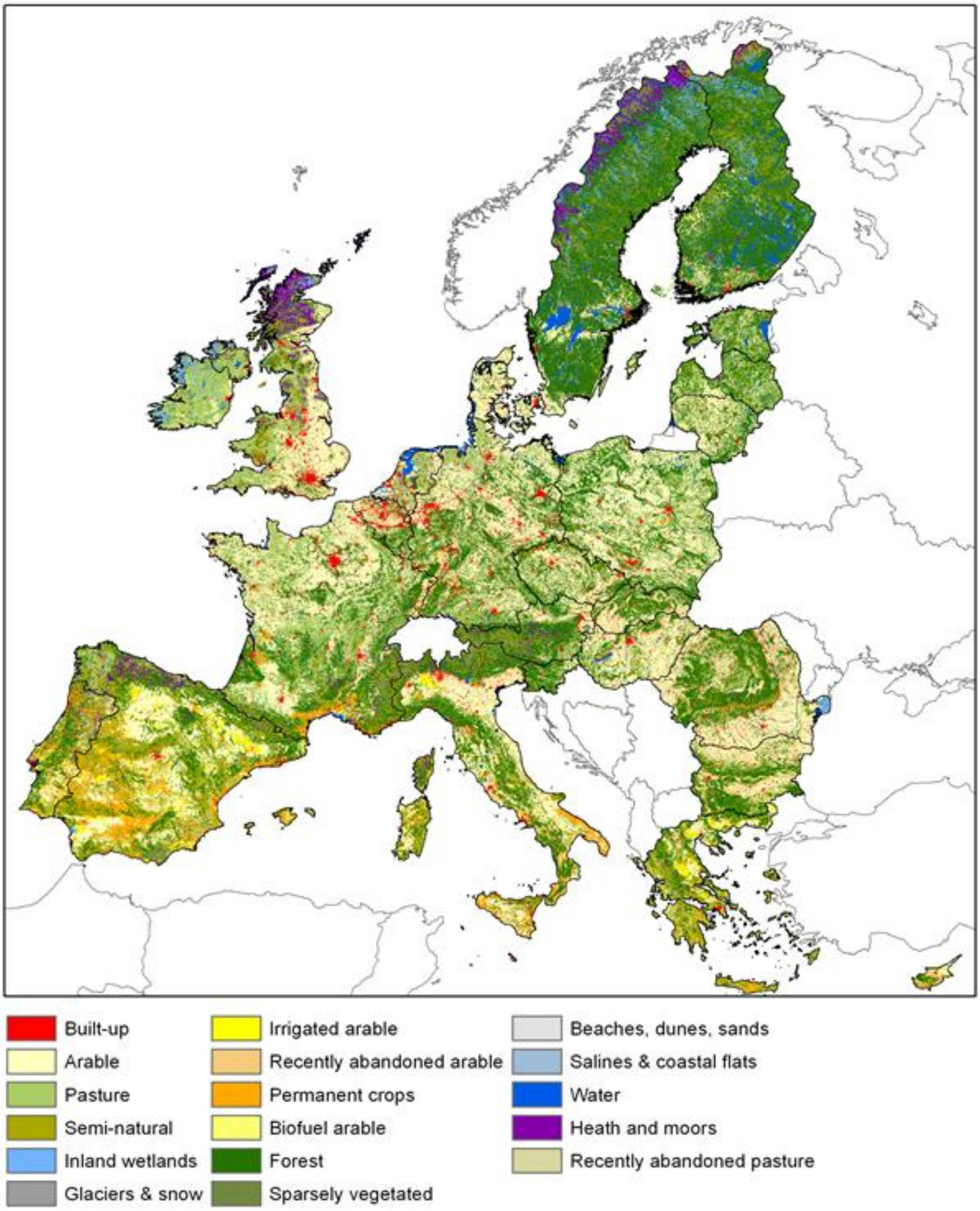


Figure 3-4 Projected land use in 2020 under the BaU scenario (see above for key)

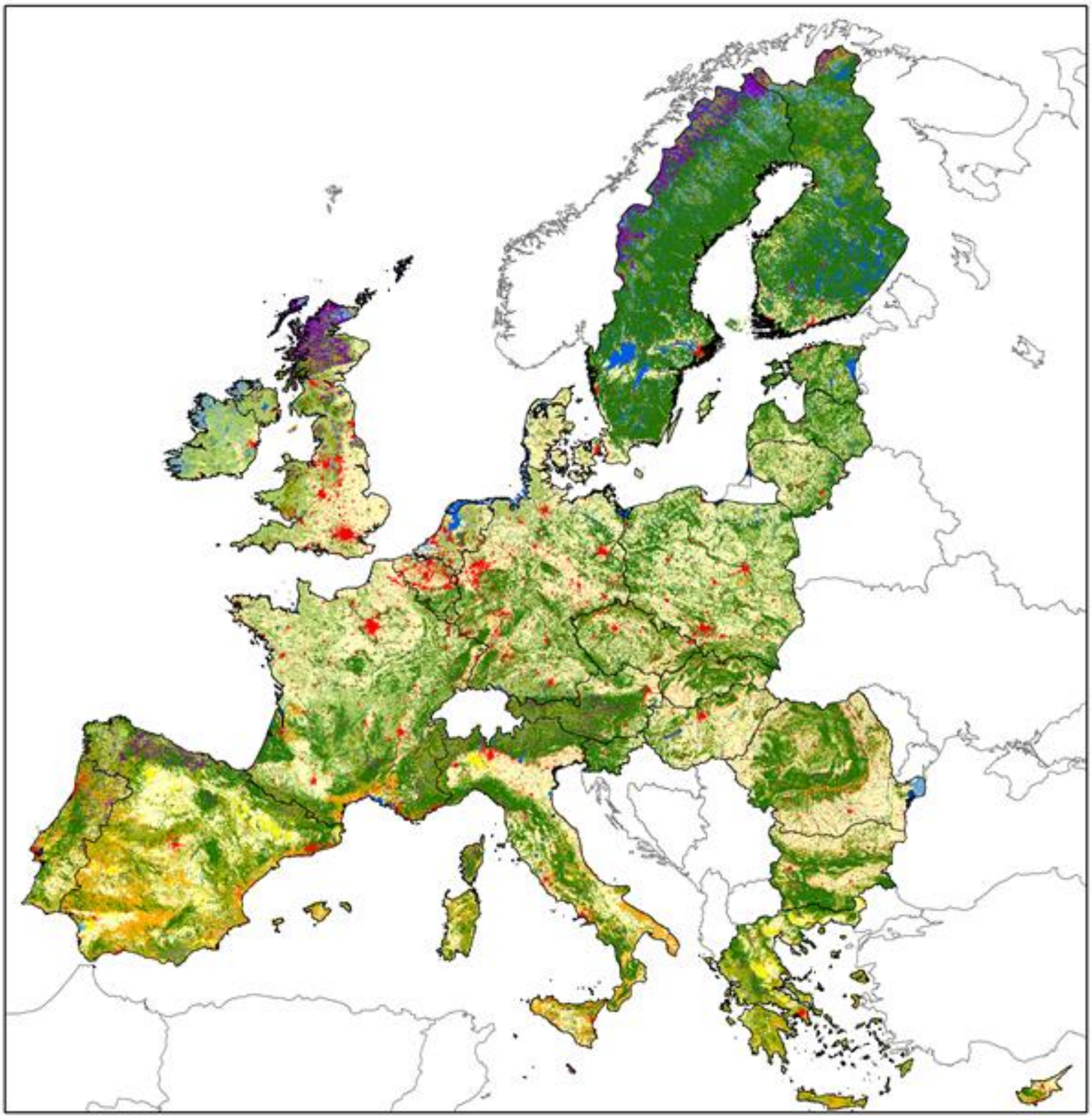


Figure 3-5 Areas of land use in 2000 and 2020 under the BaU scenario

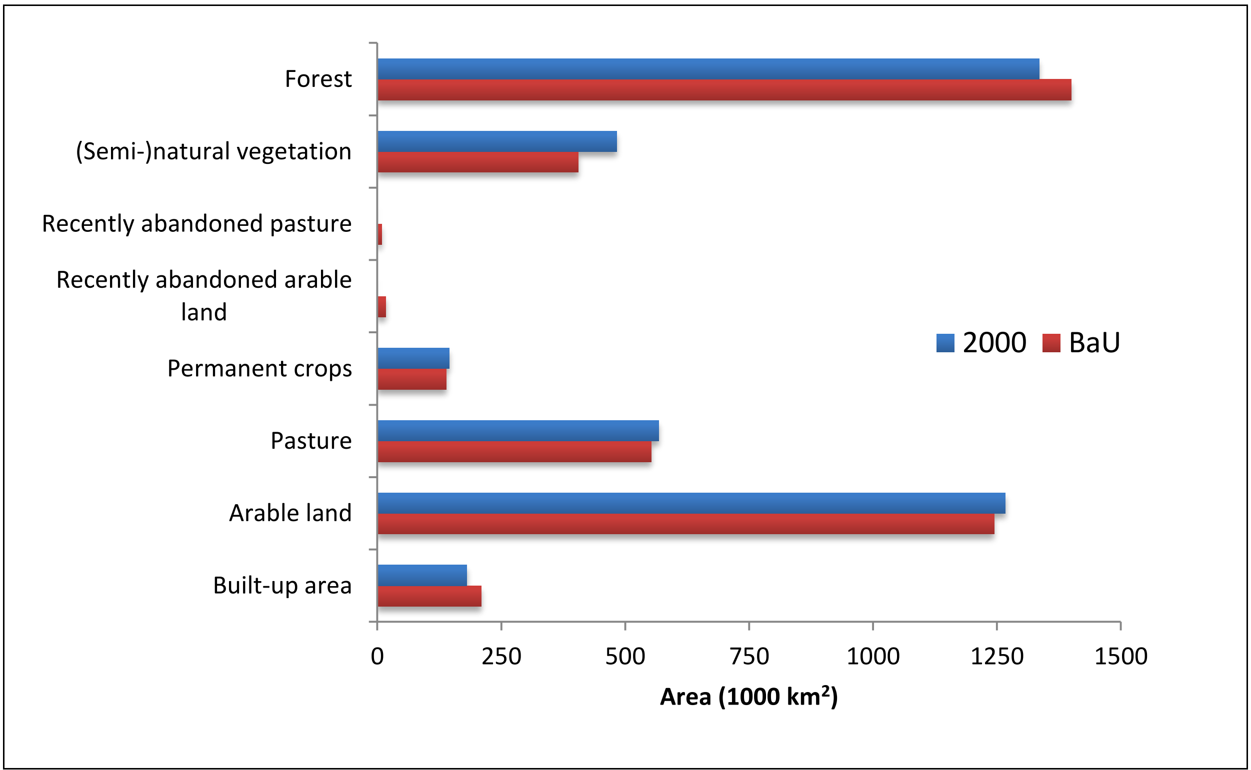


Figure 3-6 Changes in land use under the BaU scenario to 2020 relative to the land use in the base year (2000)

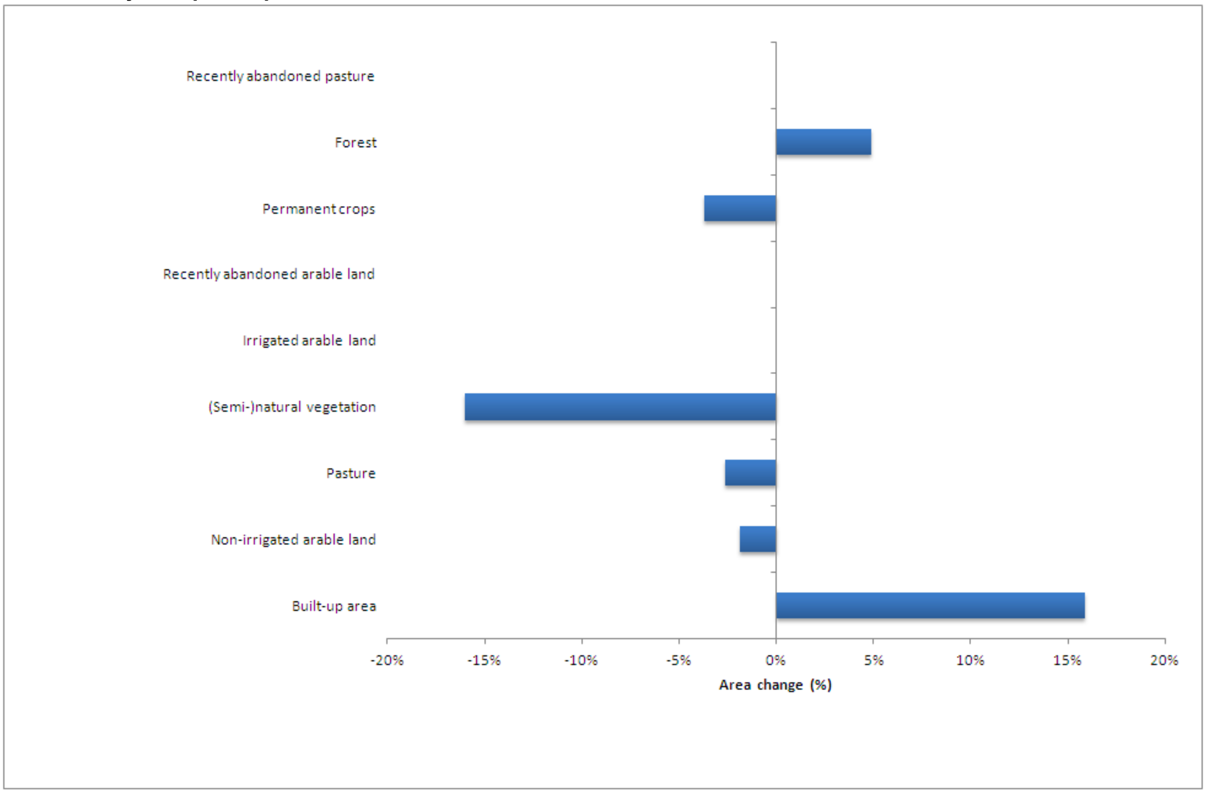


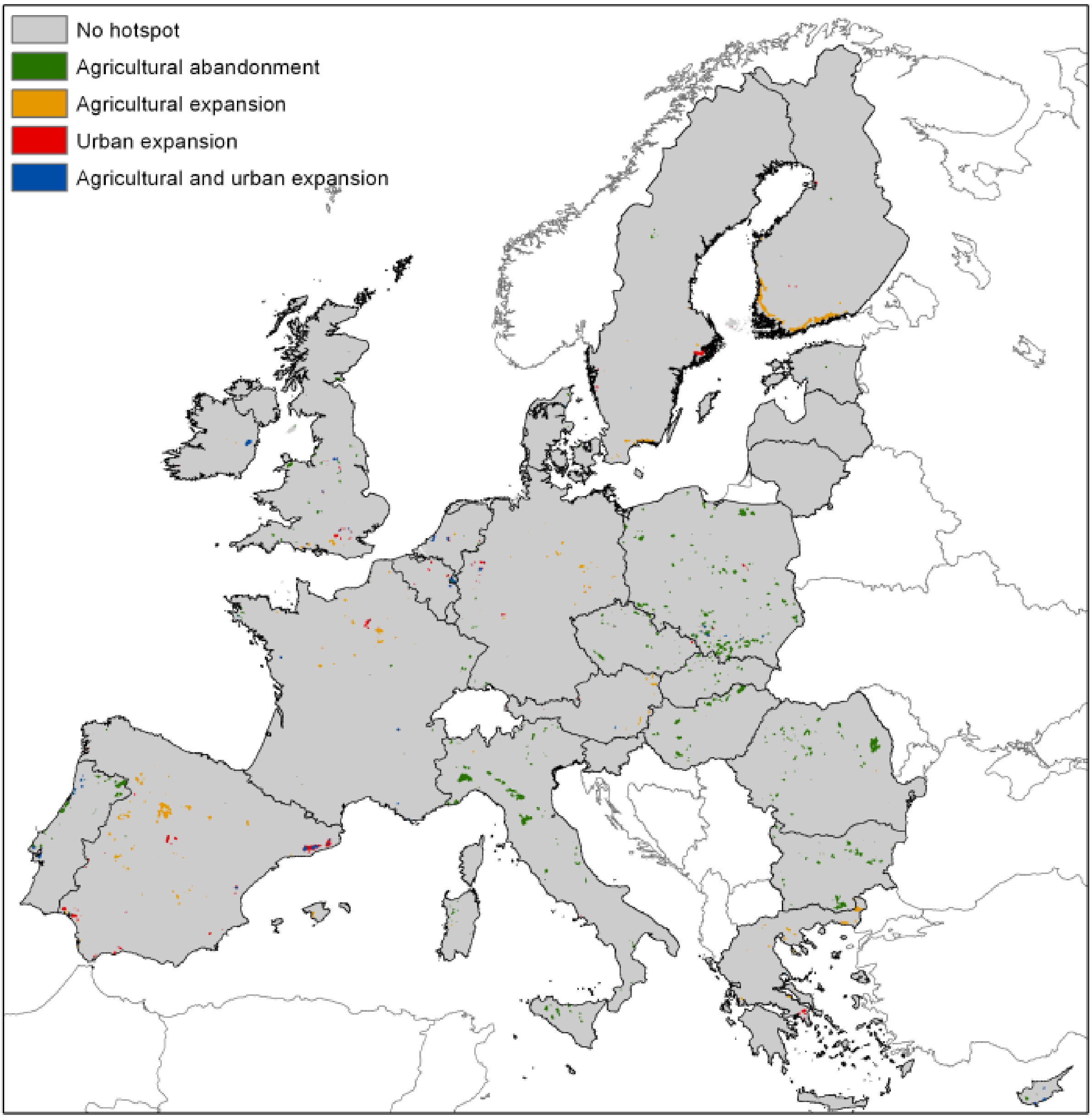
Table 3-6 Changes in land use under the BaU scenario to 2020, relative to the land use in the base year (2000)

Land use	% change
Built-up area	16%
Non-irrigated arable land	-2%
Pasture	-3%
(Semi-)natural vegetation	-16%
Irrigated arable land	0%
Recently abandoned arable land	n/a
Permanent crops	-4%
Forest	5%
Recently abandoned pasture	n/a

Table 3-7 Land use change matrix for the year 2020 compared to the year 2000, under the BaU scenario (area in km²)

	Land use 2020								
Land use 2000	Built-up area	Non-irrigated arable land	Pasture	(Semi-)natural vegetation	Irrigated arable land	Recently abandoned arable land	Permanent crops	Forest	Recently abandoned pasture
Built-up area	180,829								
Non-irrigated arable land	7,669	1,165,185	7,948	26,673		16,093	6,673	55	
Pasture	10,257	5,994	533,807	5,271			3,442	26	9,094
(Semi-)natural vegetation	2,646	7,307	4,014	371,449			69	97,206	
Irrigated arable land					36,887				
Permanent crops	1,103	6,860	4,677	1,946		988	129,146	4	
Forest	7,086	22,196	2,544				64	1,303,135	

Figure 3-7 Hotspots of land use change between 2000 and 2020 under the BaU scenario



Ecosystem coverage and quality

The main changes in ecosystem coverage and quality under the BaU scenario, as measured through four headline indicators, are summarised here. Detailed changes in each of the indicators are provided in Annex 3, while here we underline the main shifts in ecosystem quality and spatial patterns of these shifts, as projected under the scenario. The main shifts are summarised in Table 3-8, and illustrated in Figure 3-7, Figure 3-8 and Figure 3-9.

Table 3-8 Summary of the main changes in ecosystem quality under the BaU scenario

Ecosystem quality indicator	Overall changes	Spatial patterns	Comments
Land take	There is twice as much land take than land gain in the EU27. 18 countries suffer net land take, while 9 countries experience net gain of natural land cover[61]. Land take covers 65,000 km^2, of which 44% is built up.	The net amount of land take (in proportion to the country's area) is highest in Malta, followed by Belgium, Greece and Cyprus. Countries with the largest net land gain (in proportion to the country's area) are Slovakia, Czech Republic and Bulgaria. In Natura 2000 areas the land take is minor (54km^2), compared to land gain (nearly 4,000 km^2)	Due to its small area, the proportional land take at Malta is relatively high, but is only 6 km^2 in absolute terms.
Land cover connectivity potential	Regions with relatively high proportions of built-up land use and/or large scale farmland have low connectivity, which declines further under the BaU scenario.	North western Europe and eastern Romania show the strongest decreases in connectivity. Improvements in connectivity are seen in large parts of eastern Europe, UK, Spain and Denmark. Northern Europe and the Baltic countries are stable with high connectivity.	
Bird species richness - Total species - Annex I species - Farmland species	There are 14% more areas where bird species richness drops to zero. Patterns are consistent for the different groups of bird species.	Strongest decreases occur in the capital regions of Finland, Sweden, Spain, Greece and the Czech Republic, and in several urban regions in the Netherlands, Belgium and the UK. Increases occur predominantly in Portugal, Italy, and parts of Spain.	
Mean Species Abundance	Overall, the MSA index shows a slight increase in large parts of Europe, with an average increase from 43 to 46 (5.44%), mostly due to forest maturation.	Only Slovenia and Malta have decreasing MSA values on average. Improvements by 15% or more (average per country) are seen in Luxemburg, Austria, Portugal and Romania.	

There is twice as much *land take* compared to *land gain* in the EU27 by 2020 under the Business as Usual scenario (see Annex 3). Total land take is approx. 65,000 km^2, of which almost 30,000 km^2 (an area about the size of Belgium) comprises new built-up area. One-third of these newly built up areas were covered by forest or semi-natural vegetation in the year 2000. Approximately 36,000 km^2 is new farmland, which was forest or (semi-) natural vegetation in the year 2000. A similar amount of farmland is turned into (semi-) natural

[61] Throughout section 3.3 and section 6.2.5, "nature" refers to the combined area of the land use types forest and (semi-) natural vegetation following Table 3-4. "Farmland" refers to the combined area of the land use types non-irrigated arable land, irrigated arable land, permanent crops, pasture, and recently abandoned arable land and pasture following Table 3-4.

vegetation or forest by 2020 (“land gain”). While land take occurs in all EU countries (Figure 3-8), in some countries land gain exceeds land take, mostly in Eastern Europe, due to land abandoment (Annex 3, Figure 3-9).

Under the BaU scenario, many areas that experienced poor connectivity in the year 2000 remain poorly connected and even become further isolated (Figure 3.9). Exceptions exist in some regions with medium connectivity levels, such as Poland, Southern Portugal, Denmark and parts of the UK, which improve somewhat.

Figure 3-8 The type of land take that countries experience under the BaU scenario

Colours in the pie diagrams are identical to the colours used in Table 6-5: *yellow* refers to a loss of forest and (semi-)natural vegetation due to agricultural expansion. *Orange* refers to a loss of agricultural land due to expansion of built-up areas. *Red* refers to a loss of semi-natural vegetation and forest due to expansion of built-up areas. Note that pie-charts are not scaled in size.

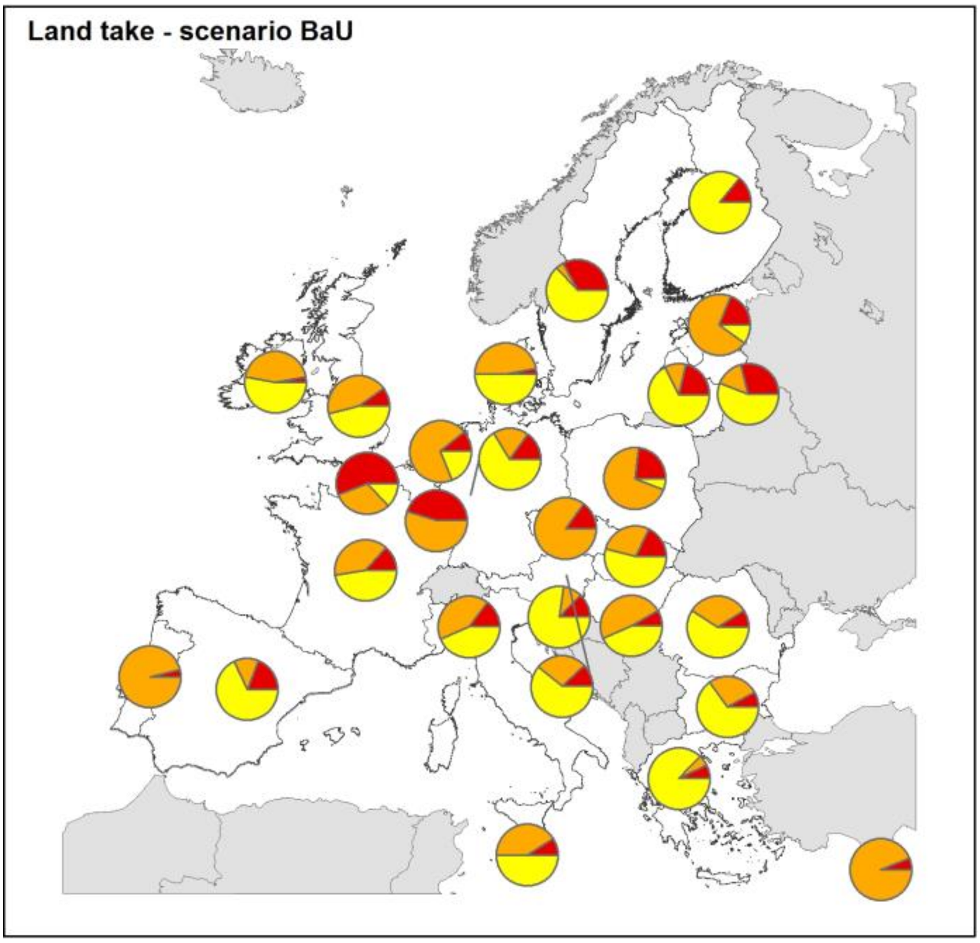
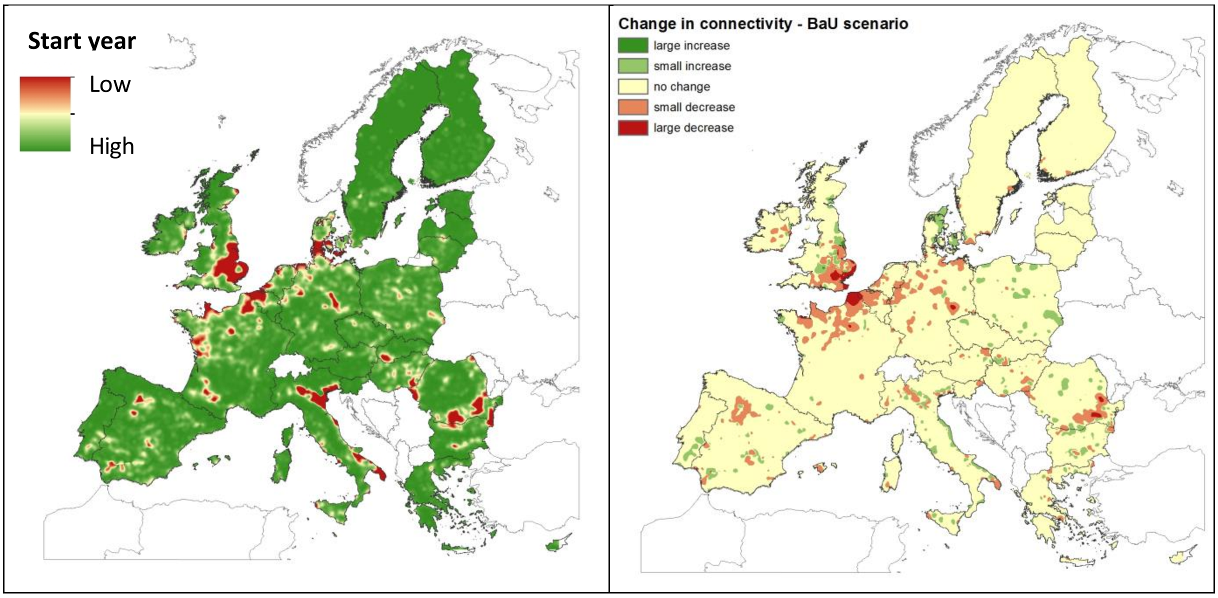


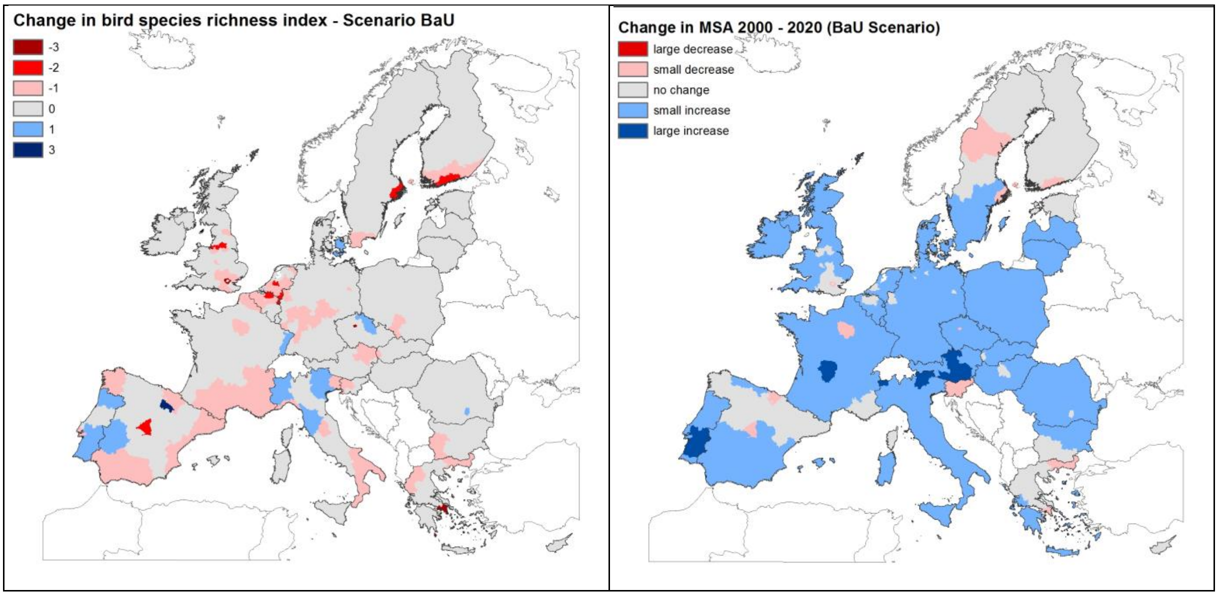
Figure 3-9 Connectivity to the nearest large area of natural habitat in the year 2000, and the changes therein under the BaU scenario



Bird species richness decreases under the BaU scenario by 0.21% overall. Although this may seem a small figure, the area for which bird species richness is projected to be zero by 2020 increases by 14%. For farmland bird species stronger losses are expected. Overall, farmland bird species richness decreases by 1.23% (393,413) compared to the starting year, equalling an area slightly bigger than Germany to lose one farmland bird species by 2020. The area for which farmland bird species richness is projected to be zero increases by 12%. For Annex 1 species, expected losses are 0.18%, which would compare to an area twice the size of Belgium losing one Annex 1 species. The area for which Annex 1 bird species richness is projected to be zero increases by 14%. The strength of losses and gains in species richness differs per area (see Figure 3-10, left panel, average values over Nuts2 regions). The strongest decreases are found in the regions of land take: urbanising regions and regions with agricultural expansion. Increases are most pronounced in central Europe and the Iberian peninsula (Figure 3-10, left panel).

Mean Species Abundance (MSA) levels are expected to increase on average under the BaU scenario, from an average MSA value of 43 to 46 (i.e. 5.44% increase towards more pristine conditions (index=100)). The MSA index is an aggregated index that pools several pressures. This makes it hard to discern the root causes of the changes, but overall, processes of land gain are positive, while land take has negative effects. Furthermore, the MSA index takes forest maturation into account as a positive effect, which is likely to be the driver behind the overall increase in MSA (Figure 3-10, right panel). Despite the average positive trends, severe losses of MSA are also encountered: losses are concentrated at locations of urban expansion such as capital regions. In the country averages, Slovenia and Malta show relative strong decreases in MSA also due to urbanisation and little land gain (Annex 3). Improvements by 15% or more (average per country) are seen in Luxemburg, Austria, Portugal and Romania (Annex 3).

Figure 3-10 Average changes in bird species richness (left panel) and Mean Species Abundance (right panel) per NUTS2 region, under the BaU scenario

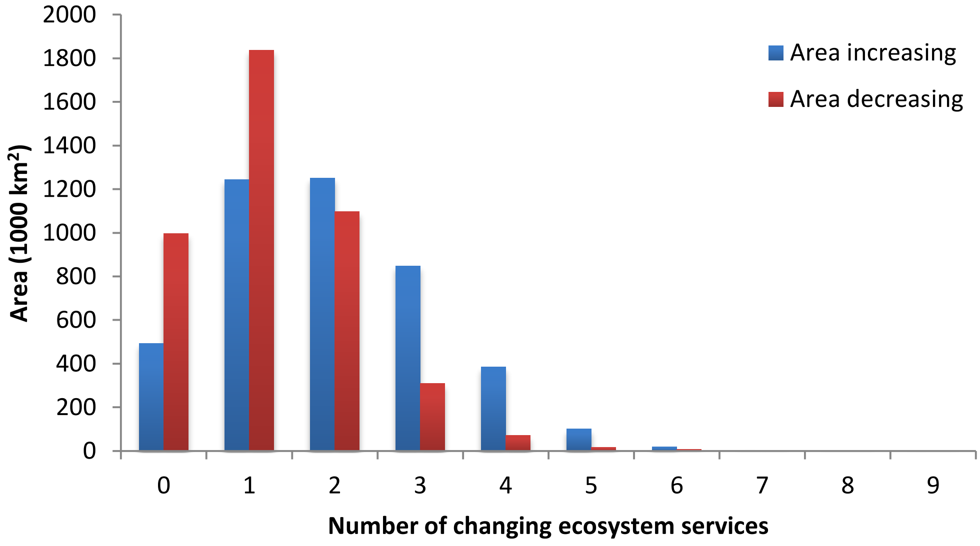


Ecosystem services

Analogous to the ecosystem quality indicators, we summarise here the main shifts in ecosystem services. Details on each of the ecosystem services are provided in Annex 3. Table 3.9 provides a concise overview of the major changes in ecosystem services under the BaU scenario.

The overall change in the provision of ecosystem services is visualised at NUTS2 level (Figure 3-12). To do this, we counted the number of ecosystem services that are expected to decrease or increase on a cell-by-cell ($1km^2$) basis. This is done for increasing services and decreasing services separately, resulting in an overview of gross changes. Figure 3-11 shows the overall statistics of this indicator at European scale. There are many locations where the provision of one ecosystem service increases. For instance, between 2000 and 2020, 1244,000 km^2 has one ecosystem service that increases. Also losses of ecosystem services are widespread. Additionally, losses of ecosystem services are concentrated at specific locations. As many ecosystem services are correlated, the loss of one ecosystem service is often accompanied by the loss of several other services. For the full EU27, 1,510,000 km^2 is expected to face a decrease of two or more ecosystem services between 2000 and 2020 (Figure 3-11).

Figure 3-11 Areas of increasing / decreasing number of ecosystem services



In all NUTS2 regions, one or more ecosystem services show a decrease (Figure 3-10). As each ecosystem service is supported by different land use types, each land use change can lead to loss of some services together with gain of other services. This trade-off needs to be considered when estimating if no net loss is achieved. Basically, to achieve no net loss at a regional or national scale, each land use change should be compensated for by the opposite change (ie the same type of land use conversion but opposite direction of change) at another location in the same spatial unit. In the BaU scenario such a pattern is not seen.

Generally, built-up areas support few ecosystems while forest and other natural vegetation provide many ecosystem services. Agricultural lands have an intermediate position with grasslands providing more services than arable land. Consequently, decreases of multiple ecosystem services are concentrated in areas where urban expansion takes place. This happens for example in Belgium and parts of Austria and the Netherlands. Additionally, expansion of cropland leads to the decrease of multiple services. This is the case in southern France and northern Italy (Figure 3-12).

Figure 3-12 Overall changes in the provision of ecosystem services over 2000-2020. The maps show the maximum number of services that increase (left) and decrease (right)

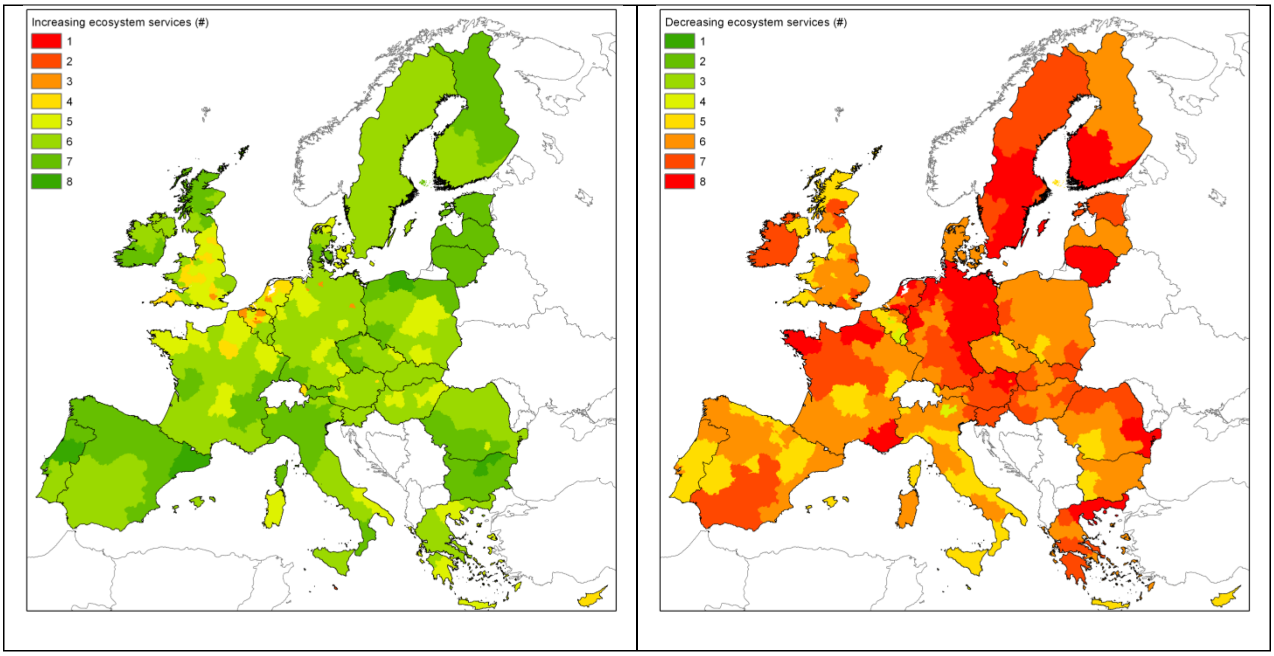


Table 3-9 Summary of the main changes in ecosystem services under the BaU scenario. Trends are given in as area (1000 km^2) per trend direction per ecosystem service. Areas were calculated on a NUTS2 basis to ensure comparability among the services. Not all areas per service-scenario combination add up to the same area because not all ecosystem services are relevant throughout the EU, and due to data gaps.

Ecosystem service	Trend 2000-2020	Area (1000 km^2)	Spatial patterns	Comments
Provisioning services				
Food crop production	Increase	1189	Decreases are scattered throughout the EU. Increases tend to be concentrated in the North-western half of the EU.	
	Neutral	1183		
	Decrease	1693		
Forest biomass stock	Increase	3772	Throughout all countries increases are seen. Decreases are concentrated in NL, BE, nw FR and se England.	Increases are due to the expanding forest cover and slight increases in biomass / km^2
	Neutral	128		
	Decrease	341		
Potable water	Increase	1208	Decreases are seen in areas with strong increases of built-up area (NL, FR, IE ES Mediterranean coast) and areas with expansion of cropland (eastern DE).	
	Neutral	1491		
	Decrease	1543		

Ecosystem service	**Trend 2000-2020**	**Area (1000 km^2)**	**Spatial patterns**	**Comments**
Regulating services				
Air quality regulation	Increase Neutral Decrease	1208 1491 1543	Increases are concentrated in the southern and northern EU, decreases in northwest EU and parts of Spain.	Urban expansion causes an increase in areas needing air quality regulation. Land take from forest or nature to arable or built-up results in a lower capacity to capture pollutants.
Carbon sequestration	Increase Neutral Decrease	1375 205 2668	Increases occur in PT, DE and Scandinavia, decreases occur elsewhere throughout the EU.	Unless the forest expands, decreases occur. This is due to land take from forest or nature to arable or built-up. These land use changes result in large losses of biomass carbon.
Erosion prevention	Increase Neutral Decrease	2577 567 1107	Decreases are concentrated in NW Europe and Spain; Increases in Eastern Europe and Scandinavia.	
Flood protection	Increase Neutral Decrease	2202 1065 974	Decreases >3% are seen in NL, CY and BE due to increasing built-up area. Elsewhere very small changes are expected.	
Storm protection	Increase Neutral Decrease	13 629 58	In NL, UK and FR strong decreases are seen. Increases are expected in DK and PT, while the remainder of the EU is near-neutral.	
Pollination	Increase Neutral Decrease	1006 629 2599	Increases are seen in DK, CZ and PL. Furthermore, scattered areas with increases are seen throughtou the EU. Decreases are concentrated in NL, DE, ES and northwest FR.	Where decreases occur, both some expansion of cropland is seen as well as homogenization of the landscape. Agricultural abandonment (PL, CZ) or expansion of seminatural vegetation (DK) favours pollination.
Soil quality regulation	Increase Neutral Decrease	914 3021 300	Some increases can be expected in Spain. Some decreases can be seen in scattered parts of central EU. Changes are very small.	Nature expansion favours this indicator, expansion of arable land causes decreases. However, changes of this indicator occur on timescales of several decades to centuries. Consequently, hardly any changes are observed.

Ecosystem service	Trend 2000-2020	Area (1000 km^2)	Spatial patterns	Comments
Cultural services				
Recreation capacity	Increase	1974	Some decreases are expected in parts of NL, DK, PL. Increases are expected throughout north and south EU.	Decreases are due to urban or agricultural expansion. Increases are related to heterogenization of the landscape or due to expansion of nature areas.
	Neutral	2147		
	Decrease	121		

3.4 Conclusions

From this analysis of previous studies and the modelling carried out for this study, it seems possible to identify reasonably reliably the land use related impacts on biodiversity and ecosystem services that are most likely to be significant according to the BaU scenario to 2020, although quantifying them accurately is much more difficult. These impacts and their underlying pressures and sectoral sources are therefore summarised in Table 3-10, Table 3-11 and Table 3-12 below.

Table 3-10: Summary of the main types and overall significance of biodiversity impacts expected up to 2020 from sectoral activities in the EU that need to be addressed to achieve no net loss of biodiversity

The assessment is based on the above text, as well as the listed references relating to the impacts of land / sea use, and takes into account expected changes in drivers of environmental change, and the implantation of existing and expected EU policies in the EU. The assessment excludes the direct impacts of climate change.

Significance: Impacts that are most likely to significantly contribute to further biodiversity losses to 2020 are highlighted in bold red type.

Impact source / impact type	Intentional exploitation and accidental mortality	Direct habitat loss (footprints)	Habitat fragmentation	Within habitat degradation (eg from management change)	Disturbance[*a]	Pollution (external)	Invasive alien species	References relating to Impact Source
Housing and non/light-industrial commerce: Buildings and associated lighting[*1]	Construction phase losses. Tall glass and illuminated buildings can be significant hazards for birds	Moderate	Can form barriers to movement for some sensitive species, causing fragmentation	Very low as mostly an artificial habitat, but loss of gardens and parks etc can cause local biodiversity impacts	Disturbance from people nearby, and some species avoid buildings, and lighting can affect nocturnal species	Low	Gardens and parks are important sources of IAS	(McKinney, 2008)
Recreation, sports and leisure: buildings, playing fields , stadia, tracks, marinas etc	Insignificant	Low	Low	Very low as mostly an artificial habitat,	Disturbance from people nearby, and some species avoid buildings, and lighting can affect nocturnal species	Mostly low, but anti-fouling paint in marines & waste	Marinas can be a source of IAS	(EEA, 2010c)
Terrestrial transport and infrastructure: roads & vehicles, railways	Some collisions may occur esp where roads cross flight-lines & animal crossing points, but impacts relatively low	Relatively low, but can be concentrated along biodiverse coastal strips (causing coastal squeeze), lakes and river valleys	**Often significant, especially where new infrastructure occurs in otherwise unfragmented landscapes, and where disturbance sensitive species occur that require large areas of habitat**	Hydrological disruption of adjacent habitats	Often substantial disturbance impacts, but some species become habituated especially if people are not visible	NOx contributing to eutrophication, and VOCs (creating toxic ozone), can disrupt sensitive ecosystems especially in areas with high traffic density	IAS carried in vehicles and often spread along transport routes	(Forman et al, 2003), (Temple and Terry, 2007), (European Commission, 2010a), (EEA, 2010a)
Air transport: aircraft and airports	Insignificant due to	Generally low, but some may	Insignificant	Not applicable as artificial habitat	As other transport – see above	NOx contributing to eutrophication, and VOCs	Source of new IAS	(Dise, 2011), (Drewitt,

Impact source / impact type	Intentional exploitation and accidental mortality	Direct habitat loss (footprints)	Habitat fragmentation	Within habitat degradation (eg from management change)	Disturbance [*a]	Pollution (external)	Invasive alien species	References relating to Impact Source
	proactive air safety measures	be located in sensitive / important areas, eg coastal areas				(creating toxic ozone), can disrupt sensitive ecosystems especially in areas with high traffic density de-icing chemicals in some locations.		1999)
River transport:			Locks etc can cause significant fragmentation of river ecosystems and associated habitats	River engineering for navigation leads to profound morphological changes and disruption of flow regime and river morphology	Disturbance of riverside habitats can be significant	Fuel spills, waste-water, sewage and anti-fouling paint	Can spread IAS	(Kroes et al, 2006), (Tockner et al, 2009)
Marine transport: shipping and ports	Some mortality of whales, but population impacts negligible	Small area but often affect important habitats	Developments can be barriers to movement eg along the shore (eg between river mouths and inner estuarine habitats.	Dredging may remove subtidal benthic species and communities, & cause re-suspension of sediments, nutrients and contaminants	Some disturbance impacts, but some species become habituated especially if people are not visible	NOx contributing to eutrophication. Fuel spills, waste-water, anti-fouling: can be significant if port facilities are poor and/or regulations are not enforced. Marine litter.	**Landed goods and ballast water exchange is a major source of IAS**	(Lambdon et al, 2008), (Hulme et al, 2008)
Industrial / energy built developments: chemical plants, incinerators and power stations etc		Generally relatively moderate	Can form barriers to movement for some sensitive species, causing fragmentation	Ecosystem disruption from pollutants can reduce food resources	As buildings	**Acidification from SO2 declining but still a problem in some areas, other toxic pollutants can cause local impacts, NOx can cause eutrophication; discharges into water bodies.**		(EEA, 2010e)
Terrestrial extraction sites: mines open cast / underground, aggregate extraction & spoil heaps etc	Most individuals within extraction site likely to be lost, unless translocated	Relatively low, but can affect important habitats, eg gravel from floodplains	Relatively low, but can affect important habitats, eg gravel from floodplains		Often substantial disturbance impacts, but some species may become habituated	Dust impacts on surrounding vegetation		(IPIECA, 2011), (Grigg et al, 2011)
Marine extraction sites: marine oil & gas exploration and production, marine aggregate & mineral extraction; dredging	Most individuals within extraction site likely to be lost,	Relatively low, but can affect important habitats	Relatively low, but can affect important habitats, eg gravel from floodplains					(Sutton and Boyd, 2009 (eds))
Flood control and	Some impacts	**Can lead to**	May fragment floodplain	**Can have large-scale**	Disturbance during			(Pettifer and

Impact source / impact type	Intentional exploitation and accidental mortality	Direct habitat loss (footprints)	Habitat fragmentation	Within habitat degradation (eg from management change)	Disturbance[*a]	Pollution (external)	Invasive alien species	References relating to Impact Source
coastal protection: flood embankments, washlands, land reclamation	in flood storage areas	**significant loss of upper tidal habitat (coastal squeeze) – likely to increase with climate change**	/ coastal habitats	**impacts on coastal geomorphology and adjacent habitat and profound hydrological impacts on adjacent floodplains**	construction and maintenance works			Kay, 2012)
Water treatment (raw and waste) infrastructure: plants, drains & outfalls	Significant detrimental impacts are unlikely	Normally small	Significant detrimental impacts are unlikely	Pollution of water-courses and coastal areas, near to outfalls, but higher levels of treatment reduce overall ecosystem impacts	Normally small			
Water supply - impounded reservoirs: for hydro-power or water storage, and water abstraction	Losses of some species, eg ground-nesting birds from flooding	Increases open water but at the expense of other habitats (eg mires).	Causes significant fragmentation of river ecosystem and associated habitats	**Disruption of down-stream flow regime (eg causing low summer flows and reduced flooding of adjacent wetlands)**	Disturbance during construction and maintenance works			(Keder and McIntyre Galt, 2009), (Young and Cane, 2004)
Waste disposal: land fill sites and at sea dumping		Relatively low, but can affect important habitats				Pollution from at sea dumping, but small-scale generally limits impacts, from sewage etc, but marine litter is growing		(Jeftic et al, 2009)
Communication structures: telephone lines, aerials and masts	Bird and bat collisions can be significant, especially where inappropriately placed	Insignificant	Insignificant		Some species avoid structures. Some disturbance during maintenance			(Janss, 2000)
Terrestrial energy production structures: wind turbines, hydro-power pipelines, solar farms	Collisions but very location dependent; potentially significant impacts for some vulnerable species	Normally insignificant from turbines, but service roads can be significant	Can form barriers to movement for some sensitive species, causing fragmentation	Can cause some hydrological disruption, eg as a result of service roads	Some species avoid turbines. Some disturbance during maintenance			(Hötker et al, 2013), (Bertzky et al, 2010), (Birdlife International, 2011)

Impact source / impact type	Intentional exploitation and accidental mortality	Direct habitat loss (footprints)	Habitat fragmentation	Within habitat degradation (eg from management change)	Disturbance[*a]	Pollution (external)	Invasive alien species	References relating to Impact Source
Marine energy production structures: wind turbines, wave power, tidal flow turbines, tidal impoundments	Bird collisions, but location dependent; fish mortality from some turbines. Some benefits from reduce fishing	Impoundments may have major impacts, depending on site. Other technologies have insignificant footprints	Potentially major fragmentation from impoundments that result in barriers between marine, inter-tidal and freshwater ecosystems		Disturbance during construction, and possible on-going disturbance from impoundments that are combined with roads / railways			(Keder & McIntyre Galt, 2009), (Wilson et al, 2007), (Birdlife International, 2011)
Energy supply: Overhead electricity transmission lines	Collisions but very location dependent; potentially significant impacts for some vulnerable species	Generally insignificant	Generally insignificant effects, but lines can form barriers to movement for some vulnerable species, causing habitat fragmentation	Normally no significant impact likely	Potential disturbance during construction			(Bevanger, 1998)
Energy supply: Underground electricity transmission lines, gas and oil pipelines and storage	Normally no significant impact likely	Impacts are normally low and reversible, but can lead to habitat loss of some sensitive habitats	Normally no significant impact likely	Excavation can lead to pollution of water courses from run-off	Potential disturbance during construction			
Energy supply: Dedicated bioenergy crops		Increasing although rate is uncertain as dependent on changing policy drivers	Uncertain as will depend on types, location and scale	Uncertain – further research is required		Can reduce pollution compared to conventional intensive agriculture due to less frequent ploughing and reduced fertiliser and pesticide use		(Rowe et al, 2009)
Agriculture: food, biofuels etc	Losses of some species and habitats significant due to farming operations	Agricultural land use accounts for ~44% of the EU land area or 186 Mha (2009 area data from LUCAS, 2009)	**Semi-natural habitats remain fragmented by intensive farming in some areas across the EU. Additional fragmentation is expected especially Eastern Europe.**	Continued intensive management practices have continuing impacts on biodiversity and ecosystem services in currently intensive farming areas. Agricultural improvements, intensification and	Can be significant during farming operations	**Agriculture is the main source of atmospheric nitrogen pollution in areas with high livestock densities, which causes significant widespread eutrophication. Water pollution can also be significant from nutrient rich**		(Kleijn et al, 2009; Poláková et al, 2011; Stoate et al, 2001; Stoate et al, 2009)

Impact source / impact type	Intentional exploitation and accidental mortality	Direct habitat loss (footprints)	Habitat fragmentation	Within habitat degradation (eg from management change)	Disturbance[*a]	Pollution (external)	Invasive alien species	References relating to Impact Source
			Some semi-natural habitats are fragmented or lost through abandonment of agricultural management, particularly in mountain and upland areas.	specialisation lead to profound habitat changes and major widespread biodiversity losses in certain Member States.		**run-off, spray drift and poor waste management.**		
Forestry	Losses of some species significant due to forestry operations and expansion of management operations into previously unharvested areas	Major and increasing. Forestry account for ~ 30% of the EU land area or 125 Mha (2009 area data from LUCAS)	Plantation forests, and intensive forest management, can lead to fragmentation of remaining natural/semi-natural old-growth forests	**Ongoing intense forestry management practices continue to degrade ecosystems. Increasing intensity of forest management leads to major changes in habitat condition and diversity, with significant biodiversity impacts**	Significant during site preparation, planting and felling operations, but these can be reduced by appropriate timing and different management approaches.	Nutrient rich-run off from forestry operations can impact water bodies, but can be controlled through mitigation measures.	Forestry is a source of many IAS	(FAO, 2013), (EEA, 2008; Forest Europe et al, 2011)
Fisheries	**Major factor affecting many marine fish populations, and by-catch can be significant**	Minimal		**Bottom trawling causes major habitat degradation**	Possible impacts on some sensitive species	Fuel spills, waste-water, sewage and anti-fouling paint.	Can spread IAS	(Tillin et al, 2006), (EEA, 2010f)
References relating to impact type	(Birdlife International, 2012), (Steiner, 2006)	(Airoldi and Beck, 2007), (Temple and Cox, 2009), (van Swaay et al, 2010), (Kalkman et al, 2010), (Temple & Terry, 2007)	(EEA and FOEN, 2011), (Kettunen et al, 2007)	(Poláková et al, 2011)	(Frid and Dill, 2002), (Beale and Monaghan, 2004), (Wauters et al, 1997), (Stankowich, 2008)	(Bobbink et al, 1998), (Maskell et al, 2010), (Dise, 2011), (Sutton et al, 2011)	(DAISIE, 2009; EEA, 2012c)	

Table 3-11: Summary of the main types and overall significance of ecosystem service impacts expected up to 2020 from sectoral activities in the EU

The assessment is based on the above text and cited references, and takes into account expected changes in drivers of environmental change, and the implantation of existing and expected EU policies in the EU. The assessment excludes the direct impacts of climate change. The service typology follows version 4.3 of The Common International Classification of Ecosystem Services (CICES)[62]. See below for a list of services included under each heading type. Red text indicates a decrease in the service, green indicates an increase.

Impact source / impact type (see Table 3-10 for details)	Provisioning	Regulation and maintenance	Cultural	References relating to Impact Source
Housing and non/light-industrial commerce	Moderate losses (mainly agricultural products) due to land take	Moderate declines: soil sealing results in loss of water storage and purification functions, and loss of flood storage if in flood plains	Reduced aesthetic values of natural / cultural landscapes	(Larondelle and Haase, 2013)
Recreation, sports and leisure	Small losses (mainly agricultural products) due to land take	Small impacts if grassland is retained, rather than artificial surfaces	Reduced aesthetic values of natural / cultural landscapes	(EEA, 2010c)
Terrestrial transport and infrastructure	Small / moderate losses (mainly agricultural products) due to land take	Small declines: soil sealing results in loss of water storage and purification functions,	Reduced aesthetic values of natural / cultural landscapes	(Forman et al, 2003),
Air transport	Small losses of agricultural products) due to land take	Small impacts as airports retain most grass areas	Reduced aesthetic values of natural / cultural landscapes	(Drewitt, 1999)
River transport	Pollution may prevent abstraction of water for domestic use; upstream impacts on rivers where structures prevent fish passage	Impoundments to allow navigation may reduce flood storage capacity	Reduced aesthetic values of natural / cultural landscapes,	(Environment Agency, 2010)
Marine transport	No significant impacts	No significant impacts	Port developments and pollution may reduce cultural values of	(European Commission,

[62] http://cices.eu/

Impact source / impact type (see Table 3-10 for details)	Provisioning	Regulation and maintenance	Cultural	References relating to Impact Source
			coasts	2011b)
Industrial / energy built developments	Small / moderate losses (mainly agricultural products) due to land take	Small / moderate declines: loss of water storage and purification functions, and loss of flood storage if in flood plains	Reduced aesthetic values of natural / cultural landscapes	(Winn et al, 2011)
Terrestrial extraction sites	Small / moderate losses (mainly agricultural products) due to land take, although impacts may be temporary in some areas if rehabilitation is possible	Small / moderate; losses of soils and their water storage and purification functions	Reduced aesthetic values of natural / cultural landscapes, although creation of water bodies after completion of works can increase recreation and landscape values	(IPIECA, 2011), (Grigg et al, 2011)
Marine extraction sites	Temporary impacts on fish breeding / habitats	No significant impacts	No significant impacts	(Sutton & Boyd, 2009)
Flood control and coastal protection	Small / moderate increase in agricultural production due to expanded / less flood prone agricultural land	Loss of water purification from flood plain ecosystems	Variable: can increase access and recreation opportunities but may reduce aesthetic values of natural coasts and rivers	(Environment Agency, 2010)
Water treatment (raw and waste) infrastructure	Increases availability of water clean resources	Reduced point source pollution increases capacity for ecosystems to absorb and purify diffuse pollutants	Local impacts around treatment works, but overall beneficial for recreation and aesthetic values	(Pascual et al, 2012)
Water supply	Large reservoirs reduce agricultural and forest production	Reduced flood storage capacity when reservoirs are full	Mixed impacts: recreation opportunities from reservoirs and aesthetic benefits, but can be at expense of valued landscapes,	
Waste disposal	Small losses of agricultural land for land fill and disposal facilities, although may be temporary if rehabilitation possible	Small / moderate; losses of soils and their water storage and purification functions	Reduced aesthetic values of natural / cultural landscapes	
Communication structures	No significant impacts	No significant impacts	Reduced aesthetic values of natural / cultural landscapes	

Impact source / impact type (see Table 3-10 for details)	Provisioning	Regulation and maintenance	Cultural	References relating to Impact Source
Terrestrial energy production structures	No significant impacts	No significant impacts	Reduced aesthetic values of natural / cultural landscapes	(SDC, 2005)
Marine energy production structures	Reduces areas that can be trawled, but this may be compensated for by increased fish recruitment from these areas	No significant impacts	Reduced aesthetic values if visible from coasts	(Wilson and Elliott, 2009), (Inger et al, 2009)
Energy supply: Overhead electricity transmission lines	No significant impacts	No significant impacts	Reduced aesthetic values of natural / cultural landscapes	
Energy supply: Underground lines and pipes	No significant impacts	No significant impacts	No significant impacts	
Energy supply: Dedicated bioenergy crops	Moderate trade-offs with food production due to competition for agricultural land. Pollution may affect waters supplies.	Variable depending on former use: eg increases in soil stability, carbon sequestration and storage, water purification and nutrient cycling compared to arable	Reduced cultural / aesthetic values from mono-culture crops, reduced landscape diversity and loss of traditional landscape features	(Rowe et al, 2009)
Agriculture (food, biofuels an biomaterials) etc	Moderate trade-offs with biofuels due to competition for agricultural land. Pollution may affect waters supplies.	Reductions in soil condition (eg stability) and functions, including carbon sequestration and storage, water purification and nutrient cycling.	Reduced cultural / aesthetic values from mono-culture crops, reduced landscape diversity and loss of traditional landscape features	(Turbé et al, 2010), (Lavelle et al, 2005)
Forestry	Forestry practices increase food timber / biomass for energy production; low trade-offs with agricultural land	Forest expansion increases carbon sequestration and storage, but other impacts are variable depending on former use, forest type and management	Reduced cultural / aesthetic values from mono-culture plantations / even-age forest stands, especially if non-native species	(FAO, 2013), (Forest Europe et al, 2011)
Fisheries	High due to declines in many fish stocks due to overexploitation	No significant impacts	Port developments and pollution eg from fish processing may reduce cultural values of coasts	(Tillin et al, 2006), (EEA, 2010f)

NB. Services included under each heading. Provisioning services include: cultivated crops, reared animals and their outputs, wild plants, algae and their outputs, wild animals and their outputs, plants and algae from in-situ aquaculture, animals from in-situ aquaculture, surface water for drinking, ground water for drinking, fibres and other materials from plants, algae and animals for direct use or processing, materials from plants, algae and animals for agricultural use, genetic materials from all biota, surface water for non-drinking purposes and ground water for non-drinking purposes. **Regulation and maintenance services include**: bio-remediation by micro-organisms, algae, plants, and animals, filtration/sequestration/storage/accumulation by micro-organisms, algae, plants, and animal, filtration/sequestration/storage/accumulation by ecosystems, dilution by atmosphere, freshwater and marine ecosystems, mediation of smell/noise/visual impacts, mass stabilisation and control of erosion rates, buffering and attenuation of mass flows, hydrological cycle and water flow maintenance, flood protection, storm protection, ventilation and transpiration, pollination and seed dispersal, maintaining nursery populations and habitats, pest control, disease control, weathering processes, decomposition and fixing processes, chemical condition of freshwaters, chemical condition of salt waters, global climate regulation by reduction of greenhouse gas concentrations, micro and regional climate regulation. **Cultural services include:** experiential use of plants, animals and land-/seascapes in different environmental settings, physical use of land-/seascapes in different environmental settings, scientific, educational, heritage, cultural entertainment, aesthetic, symbolic, sacred and/or religious, existence and bequest.

Table 3-12: Overall extent and magnitude of the main types of biodiversity and associated ecosystem service impacts from sectoral activities in the EU expected up to 2020 according to the business as usual scenario

The assessment is mainly expert judgement drawing on the above text and cited references, and takes into account expected changes in drivers of environmental change, and the implantation of existing and expected EU policies in the EU

Key:

% footprint change: ↓/↑ = < 1%; ↓↓/↑↑ = 1-10%; ↓↓↓/↑↑↑ = >10%. ↑= Increase; ↓ = decrease. **% impacted**: ● = < 1%; ●● = 1-10%; ●●● = >10%. **Impact magnitude**: ● = low detrimental (ie some ecosystem disruption and declines in some species / services); ●● = moderate detrimental (ie severe ecosystem disruption with substantial declines in most species / services); ●●● = high detrimental (ie ecosystem destroyed and most associated species / services lost). ○ = beneficial. **Value of impacted ecosystems and services**: ● = low (impacted ecosystems and associated species and services are normally widespread and not threatened / not in short supply); ●● = moderate (threatened habitats and species and important ecosystem services are sometimes impacted); ●●● = high (threatened habitats and species and important ecosystem services generally often impacted).

Impact source / impact type	% footprint change to 2020	% of EU land / sea area impacted* in 2020	Impact magnitude	Value of impacted ecosystems & services	Overall impacts in 2020	Comments
Housing and non/light-industrial commerce	↑	●●●	●●	●	●●	
Recreation, sports and leisure	↑↑	●	●●	●	●	
Terrestrial transport and infrastructure	↑↑	●●	●●●	●●	●●	
Air transport	↑	●	●●	●●	●	
River transport		●	●●	●●●	●●	Footprint unlikely to increase significantly
Marine transport	↑	●●	●	●●●	●●	
Industrial / energy built developments	↑↑	●●	●●●	●●	●●	
Terrestrial extraction sites	>↑	●	●●●	●●	●●	Scale uncertain
Marine extraction sites	>↑	●	●●	●●	●●	
Flood control and coastal protection	?	●●	●●●	●●●	●●●	Some are now being removed
Water treatment (raw and waste) infrastructure	↑?	●●	○	●●●	○	Scale uncertain
Water supply	↑	●●	●●●	●●●	●●●	Footprint is from reservoirs and

Impact source / impact type	% footprint change to 2020	% of EU land / sea area impacted* in 2020	Impact magnitude	Value of impacted ecosystems & services	Overall impacts in 2020	Comments
						abstractions
Waste disposal	↑	●	●●	●	●	Rehabilitation often possible
Communication structures	↑↑	●	●	●●	●	
Terrestrial energy production structures	↑↑↑	●	●	●●	●●	
Marine energy production structures	↑↑↑	●	Variable	●●	?	Can be beneficial due to absence of fishing
Energy supply: Overhead electricity transmission lines	>↑	●	●	●●	●	Scale uncertain
Energy supply: Underground lines and pipes	>↑	●	●	●●	●	Scale uncertain
Energy supply: Dedicated bioenergy crops	?	●●	Variable		●?	Scale depends on policy decisions
Agriculture (food, biofuels an biomaterials) etc	↓↓	●●●	●●●	●●	●●●	Impacts vary: highest for conversion of semi-natural habitats
Forestry	↓↓	●●●	●●	●●	●●	Impacts vary: highest for logging / conversion of old-growth semi-natural forest

Note: * ie taking into account the local impacts of the development, eg relating to disturbance, hydrological changes and local pollution.

This analysis indicates that there are a very wide range of sources and types of impacts, and although many of these may be relatively low they all need to be adequately addressed to achieve NNL of biodiversity and ecosystem services. It is also important to point out that some localised small-scale environmental changes can have disproportionality high biodiversity impacts, eg if they affect a particularly important area (such as Natura 2000 site). Furthermore, many low level impacts are commonplace, and therefore can lead to more significant cumulative impacts, such as through habitat fragmentation and wide-scale pollution. Site related impacts therefore can be more significant than may appear from Column 2 of Table 3-10.

Nevertheless, it is also apparent that some expected economic activities are likely to lead to the most significant impacts on biodiversity under the BaU scenario, and will therefore prevent the achievement of the biodiversity target unless they are addressed by new or enhanced environmental measures. These key impacts can be further summarised as:

- Local impacts (eg from the footprint of the development, and the disturbance and pollution of surrounding areas) of built developments (eg housing, industry, transport infrastructure) and extractive industries (eg coal mining, gravel extraction).

- Wide-scale pollution impacts from urban areas, transport, industry and agriculture, and in particular eutrophication of sensitive terrestrial habitats (from air-borne nitrogen deposition) and pollution of fresh and marine waters from sewage and waste-water (although declining) but also nutrient rich-run off that is increased as a result of agricultural and forestry activities.

- Creation of river and coastal flood defence structures that result in direct habitat loss and wider hydrological and geo-morphological impacts on ecosystems.

- Creation of large reservoirs for water supplies and the abstraction of water from rivers, lakes and aquifers that supply wetlands.

- Expansion of forest plantations (especially where these replace or fragment semi-natural habitats, many of which are habitats of Community interest under the Habitats Directive), and intensification of forest management, which may increase in response to rising demands for energy from wood biomass.

- Agricultural improvements (eg drainage and reseeding of grasslands), specialisation (resulting in reduced landscape diversity and larger fields and farm units) and intensification (eg increased frequency of cultivations and higher use fertilisers and pesticides), particularly in eastern Europe.

- Agricultural abandonment, leading to the loss of traditionally managed semi-natural habitats such as some grasslands, heaths and pastoral woodlands (many of which are habitats of Community interest under the Habitats Directive)

- Continued high levels of commercial fishing, with direct impacts on target species, and by-catch (fish, invertebrates, birds and cetaceans) and habitat damage from bottom dredging/trawling. Although there are measures under the reformed CFP that will ban discarding and aim to ensure all fisheries are under sustainable management to achieve a maximum sustainable yield, ongoing negative impacts to 2020 are highly likely.

It is therefore suggested that these pressures should be the focus of policy measures to achieve NNL. However, it is not feasible within this single contract to consider all of these pressures or all of the policies that affect them. Therefore, as discussed in Section 5.1 the development of policy options is further restricted to those that are considered most likely to provide the greatest added value from this contract.

4 KEY PRINCIPLES AND CONSIDERATIONS FOR THE DEVELOPMENT OF AN EU NO NET LOSS POLICY

4.1 Interpretation of the no net loss objective and its potential benefits and risks

As stated in the Biodiversity Strategy Action 7 is to 'ensure NNL of biodiversity and ecosystem services'. Action 7b, which is the focus of this contract then states that 'the Commission will carry out further work with a view to proposing by 2015 an initiative to ensure there is NNL of ecosystems and their services (eg through compensation or offsetting schemes).' This intention appears to be entirely beneficial for biodiversity and ecosystem services and essential to achieve the EU's 2020 headline biodiversity target. This is particularly the case given the observed recent and continuing declines in biodiversity and many ecosystem services (as discussed in the previous chapter) and the observation that there are few policy instruments, beyond those under the Habitats Directive and Environmental Liability Directive (ELD) that require compensation for unavoidable residual impacts (see Annex 4).

However, the NNL policy objective was not defined in detail in the Biodiversity Strategy and, as debated by the NNL Working Group (NNLWG, 2013a), it leaves much room for interpretation, such as regarding its relationship to other approaches to conserving biodiversity, the appropriateness of biodiversity and ecosystem service trade-offs, the scale over which NNL needs to be measured, the species and habitats and levels of impacts on them that should be addressed and its sectoral coverage. Although the initiative undoubtedly aims to improve the status of biodiversity and ecosystem services, as discussed below, some interpretations of the NNL objective could potentially have perverse and damaging consequences, particularly if larger absolute losses were accepted on the basis that they could be offset.

4.2 Implications for the protection of existing biodiversity and ecosystem services

There is a risk that trade-offs in the pursuit of the EU's NNL objective could result in unintended biodiversity losses by weakening the protection of biodiversity and ecosystems from damaging activities. Well-established general ecological knowledge, and some supportive evidence, indicates that a policy shift that allows losses of particular biodiversity components to be systematically offset by gains in different biodiversity components (or even ecosystem services), without appropriate safeguards, could entail a significant net loss of biodiversity and ecosystem services, and associated human benefits. The main reasons for this are the:

- Difficulties, or sometimes impossibilities, of restoring or creating ecosystems, habitats for species and ecosystem services adequately in other locations (BBOP, 2012a; Hossler et al, 2011; Mack and Micacchion, 2006; Maron et al, 2012; Palmer and Filoso, 2009; Quigley and Harper, 2006; Suding, 2011).

- Problems with ensuring and demonstrating additionality (ie that activities that are taken to compensate for impacts provide outcomes that are additional to those that would have occurred anyway (EFTEC & IEEP, 2010).

- Difficulties of ensuring equitable outcomes when biodiversity and ecosystems are changed or moved, as many benefits will be lost if their sources are relocated, even over short-distances (Ruhl and Salzman, 2006).

- Time-lags that commonly occur between impacts and the outcomes of compensation measures (Gibbons and Lindenmayer, 2007; Maron et al, 2012; Morris et al, 2006).

- Difficulties with reliably measuring the complex multi-dimensional, context-specific and dynamic values of biodiversity and ecosystem services in a practical and transparent way that can ensure damage is properly measured and then fully and equivalently compensated for (BBOP, 2012b; Gardner and von Hase, 2012; Maron et al, 2012; McCarthy et al, 2004; Quétier and Lavorel, 2011; Salzman and Ruhl, 2000)(see further discussion on metrics in Section 5.10).

Such problems can to some extent be overcome by strong regulations, appropriate exchange rules and the use of adequate metrics for assessing gains and losses (Bull et al, 2013; Gardner & von Hase, 2012; Gardner et al, 2013). But there is also evidence of governmental antipathy towards strong environmental regulations in some Member States, as for example shown in the Red Tape Challenge in the UK[63]. This is because regulations are often considered by governments to be barriers to economic growth – although there is little evidence of this, as for instance found in a review of the implementation of the Habitats and Birds Directive in England (DEFRA, 2012). Furthermore, Walker et al (2009) point out that requirements for viable trading through habitat banks are at odds with the need for stringent regulations with complex standards, exchange rules, measurements and oversight. As a result they predict that commercial and governmental motivations will result in a relaxation of safeguards for biodiversity trading and conclude that 'delivery of no net loss or net gain through biodiversity trading is thus administratively improbable and technically unrealistic'.

Concerns over the potential weakening of protection are clearly taken into account in the June 2011 Council conclusions, which provided the following preliminary definition of the NNL concept: ***'that conservation/biodiversity losses in one geographically or otherwise defined area are balanced by a gain elsewhere provided that this principle does not entail any impairment of existing biodiversity as protected by EU nature legislation*'.** This definition focuses on the treatment of residual impacts and therefore suggests that it is envisaged that the promotion of offsetting is the primary means of achieving the NNL objective. However, it explicitly notes that measures should not impair existing biodiversity that is 'protected by EU nature legislation'. Thus, there is a clear indication that the protection afforded under the Birds and Habitats Directives, including the need to carry out Appropriate Assessments in accordance with Article 6.3 and avoid impacts as much as possible should not be weakened by the NNL initiative.

[63] http://www.redtapechallenge.cabinetoffice.gov.uk/themehome/environment-2/

Broader considerations and evidence from international experience (eg see Annex 10) also indicates that to achieve the EU's NNL objective, in a way that is consistent with higher biodiversity policy goals, requires the careful development of policy measures, such as biodiversity offsetting, based on adequate evidence, clear principles and standards that protect biodiversity and ecosystem services. To be effective, compliance with the standards will need to be ensured through adequate regulations, monitoring and where necessary enforcement measures. This appears to be recognised by the European Parliament, in their Resolution on 20 April 2012 which '*Urges the Commission to develop an effective regulatory framework based on the 'No Net Loss' Initiative, taking into account the past experience of the Member States while also* ***utilising the standards applied by the Business and Biodiversity Offsets Programme*** *[emphasis added]; notes, in this connection, the importance of applying such an approach to all EU habitats and species not covered by EU legislation*.' It is not entirely clear what the Parliament is referring to here, but it is assumed to be BBOP Principles, as presented in Box 4.1 and the accompanying Standard on Biodiversity Offsets[64], which is intended to help determine whether an offset has been designed and subsequently implemented in accordance with the BBOP Principles.

Box 4.1 The BBOP Principles on Biodiversity Offsets

Biodiversity offsets are measurable conservation outcomes resulting from actions designed to compensate for significant residual adverse biodiversity impacts arising from project development* after appropriate prevention and mitigation measures have been taken. The goal of biodiversity offsets is to achieve NNL and preferably a net gain of biodiversity on the ground with respect to species composition, habitat structure, ecosystem function and people's use and cultural values associated with biodiversity. These principles establish a framework for designing and implementing biodiversity offsets and verifying their success. Biodiversity offsets should be designed to comply with all relevant national and international law, and planned and implemented in accordance with the Convention on Biological Diversity and its ecosystem approach, as articulated in National Biodiversity Strategies and Action Plans.

1. **No net loss:** A biodiversity offset should be designed and implemented to achieve in situ, measurable conservation outcomes that can reasonably be expected to result in no net loss and preferably a net gain of biodiversity.
2. **Additional conservation outcomes:** A biodiversity offset should achieve conservation outcomes above and beyond results that would have occurred if the offset had not taken place. Offset design and implementation should avoid displacing activities harmful to biodiversity to other locations.
3. **Adherence to the mitigation hierarchy:** A biodiversity offset is a commitment to compensate for significant residual adverse impacts on biodiversity identified after appropriate avoidance, minimization and on-site rehabilitation measures have been taken according to the mitigation hierarchy.
4. **Limits to what can be offset:** There are situations where residual impacts cannot be fully compensated for by a biodiversity offset because of the irreplaceability or vulnerability of the biodiversity affected.
5. **Landscape context:** A biodiversity offset should be designed and implemented in a landscape context to achieve the expected measurable conservation outcomes taking into account available information on the full range of biological, social and cultural values of biodiversity and supporting an ecosystem approach.
6. **Stakeholder participation:** In areas affected by the project and by the biodiversity offset, the effective participation of stakeholders should be ensured in decision-making about biodiversity offsets, including their evaluation, selection, design, implementation and monitoring.

[64] http://www.forest-trends.org/documents/files/doc_3078.pdf

7. **Equity:** A biodiversity offset should be designed and implemented in an equitable manner, which means the sharing among stakeholders of the rights and responsibilities, risks and rewards associated with a project and offset in a fair and balanced way, respecting legal and customary arrangements. Special consideration should be given to respecting both internationally and nationally recognised rights of indigenous peoples and local communities.
8. **Long-term outcomes:** The design and implementation of a biodiversity offset should be based on an adaptive management approach, incorporating monitoring and evaluation, with the objective of securing outcomes that last at least as long as the project's impacts and preferably in perpetuity.
9. **Transparency:** The design and implementation of a biodiversity offset, and communication of its results to the public, should be undertaken in a transparent and timely manner.
10. **Science and traditional knowledge:** The design and implementation of a biodiversity offset should be a documented process informed by sound science, including an appropriate consideration of traditional knowledge.

*While biodiversity offsets are defined here in terms of specific development projects (such as a road or a mine), they could also be used to compensate for the broader effects of programmes and plans.

One particularly important and widely held principle is that actions to achieve NNL (or a positive gain) should follow the mitigation hierarchy and accordingly be considered in the following order:

1. **Avoidance**: measures taken to avoid creating detrimental impacts from the outset, such as careful spatial or temporal placement of elements of infrastructure, in order to completely avoid impacts on certain components of biodiversity.

2. **Minimisation**: measures taken to reduce the duration, intensity and / or extent of detrimental impacts (including direct, indirect and cumulative impacts, as appropriate) that cannot be completely avoided, as far as is practically feasible.

3. **Rehabilitation/restoration**: measures taken to rehabilitate degraded ecosystems or restore cleared ecosystems following exposure to impacts that cannot be completely avoided and/ or minimised.

4. **Offset**: measures taken to compensate for any residual significant, adverse impacts that cannot be avoided, minimised and / or rehabilitated or restored, in order to achieve NNL or a net gain of biodiversity. Offsets can take the form of positive management interventions such as restoration of degraded habitat, arrested degradation or averted risk, protecting areas where there is imminent or projected loss of biodiversity.

In other words, emphasis should be given to avoidance of significant adverse impacts at source as the first objective (as well as seeking opportunities to enhance biodiversity). This should normally be followed by efforts measures to reduce or minimise unavoidable impacts and finally use of compensation or offsets to remedy residual damage or loss. In practice, however, it is often appropriate to carry out these steps iteratively to some extent.

The importance of ensuring the NNL initiative is consistent with the mitigation hierarchy was also reiterated by NNL Working Group (NNLWG, 2013a; NNLWG, 2013b), who noted that 'Any new proposed policy, aiming to protect and enhance biodiversity and ecosystem services, should thus strongly adhere to the mitigation hierarchy, enforcing the recognition that developers and land-users should not be allowed to carry out an activity leading to a loss of biodiversity by simply paying for the damage caused.' They also note that 'The NNL initiative must not undermine existing legislation and must in no way legitimise projects that would normally be rejected as a result of measures in existing environmental legislation'.

Despite the wide acceptance of the mitigation hierarchy a common concern over the development of NNL policies is that in practice mitigation measures to avoid and reduce impacts are reduced and offsets are then undertaken instead, thereby undermining the hierarchy. The offsetting of impacts that could be avoided or reduced, which is sometimes referred to as a 'licence to trash', is often seen as a key problem[65], and this does appear to occur with respect to wetlands in Canada (Clare et al, 2011). However, there does not appear to be much evidence to suggest that it occurs frequently elsewhere or has significant overall impacts. In Germany, adherence to the mitigation hierarchy is clearly and strongly included in the legal framework for offsetting (see Annex 6). Nevertheless, there are concerns amongst some that some developments have led to offsetting impacts that could have been avoided, but evidence that this is commonplace and has a significant impact on biodiversity is lacking (see Annex 6).

In fact there are arguments that the development of effective and well regulated requirements for compensation implements the polluter-pays principle and therefore increases the incentive for activities to avoid and reduce impacts in the first place – thereby supporting the mitigation hierarchy, rather than undermining it (Eftec and IEEP, 2010). This is because under current policies the compensation of residual impacts is generally not required and therefore there is little economic incentive to reduce them. If new policy measures introduce a compensatory requirement then it is in the developer's interest to avoid and reduce impacts as much as possible – to minimise costs. On the other hand, in some cases compensation measures will have lower costs than mitigation measures, in which case there is an incentive for the developer to adopt these instead – that is to say not to following the mitigation hierarchy. Furthermore, it seems likely that the limited evidence of this is most likely due to a general lack of monitoring and scrutiny rather than a reliable indication that the problem is insignificant.

It is important to note that actions within the mitigation hierarchy **must be appropriate**, and therefore in some cases it may be justifiable to undertake compensation rather than carry out feasible avoidance or mitigation actions if this results in a better and more reliable biodiversity outcome. For example, in some cases, avoidance or reduction measures may not be as reliable or as effective as compensation measures. This is not to say that the mitigation hierarchy should not be followed, just that in some cases avoidance or reduction measures may be infeasible or ineffective and that this will result in residual impacts that need to be compensated for. In fact evidence of beneficial population level impacts of some

[65] Eg Friends of the Earth UK, Press Release September 2013 http://www.foe.co.uk/resource/press_releases/govt_plans_for_biodiversity_05092013

commonly used mitigation measures, such as the use of 'green' bridges over roads and railways to mitigate habitat fragmentation, is often lacking (Clevenger and Wierzchowski, 2006; Mazza et al, 2012). Such uncertainty therefore needs to be taken into account in the calculation of residual impacts. In other words, in accordance with the precautionary principle, claimed reductions in impacts resulting from mitigation measures need to be supported by reasonable proof before they are taken into account in the calculation of residual impacts.

Consequently, to ensure the mitigation hierarchy is adhered to in practice it needs to be applied with careful thought, but always in a transparent manner and with adequate scrutiny by environmental authorities. Thus, where adverse impacts cannot be avoided, convincing reasons for such unavoidability should be provided.

4.3 Potential biodiversity and ecosystem service trade-offs

Another aspect of the NNL objective that could also have detrimental impacts on biodiversity and ecosystems is the degree to which it may be achieved through trade-offs. A wide interpretation could imply that unprotected biodiversity and ecosystem services are exchangeable commodities, and that losses are *de facto* deemed acceptable as long as they are adequately compensated for by another service and/or elsewhere. Figure 4-1 below illustrates this in relation to two axes: the specificity of the NNL objective (ie whether it is a general one or applies to biodiversity and specific ecosystem services), and its geographic scale (see further discussion in the next section).

If the requirement for NNL is defined in terms of a general NNL of biodiversity and ecosystem services combined then it would effectively allow potentially significant trade-offs, for instance biodiversity loss for ESS provision. However, consideration needs to be given to whether losses of some biodiversity components (such as particular habitats or species) or ecosystem services could be balanced by gains in other biodiversity components or ecosystem services.

Such biodiversity (and ecosystem service) exchangeability issues are not discussed in the Biodiversity Strategy or its impact assessment or are commented on in the Council's or European Parliament's statements on the initiative. Nevertheless, a wide exchange of biodiversity components would not seem to be appropriate because it would conflict with current international and EU nature conservation aims and principles, which clearly intend to maintain the range and populations of all native species and habitats. Although indicators adopted under the SEBI[66] process of the achievement of the biodiversity target (ie for birds and butterflies) use indexes that taken into account population increases and declines, this is merely meant to reflect overall patterns of change. The use of such indices is not an indication that declines in some species are acceptable as long as equivalent increases are occurring in others. Thus, in conclusion, to be consistent with higher EU biodiversity goals, in principle the NNL objective would need to relate to individual habitats and species. Therefore, the appropriate default position would appear to be that impacts on one species

[66] http://biodiversity.europa.eu/topics/sebi-indicators

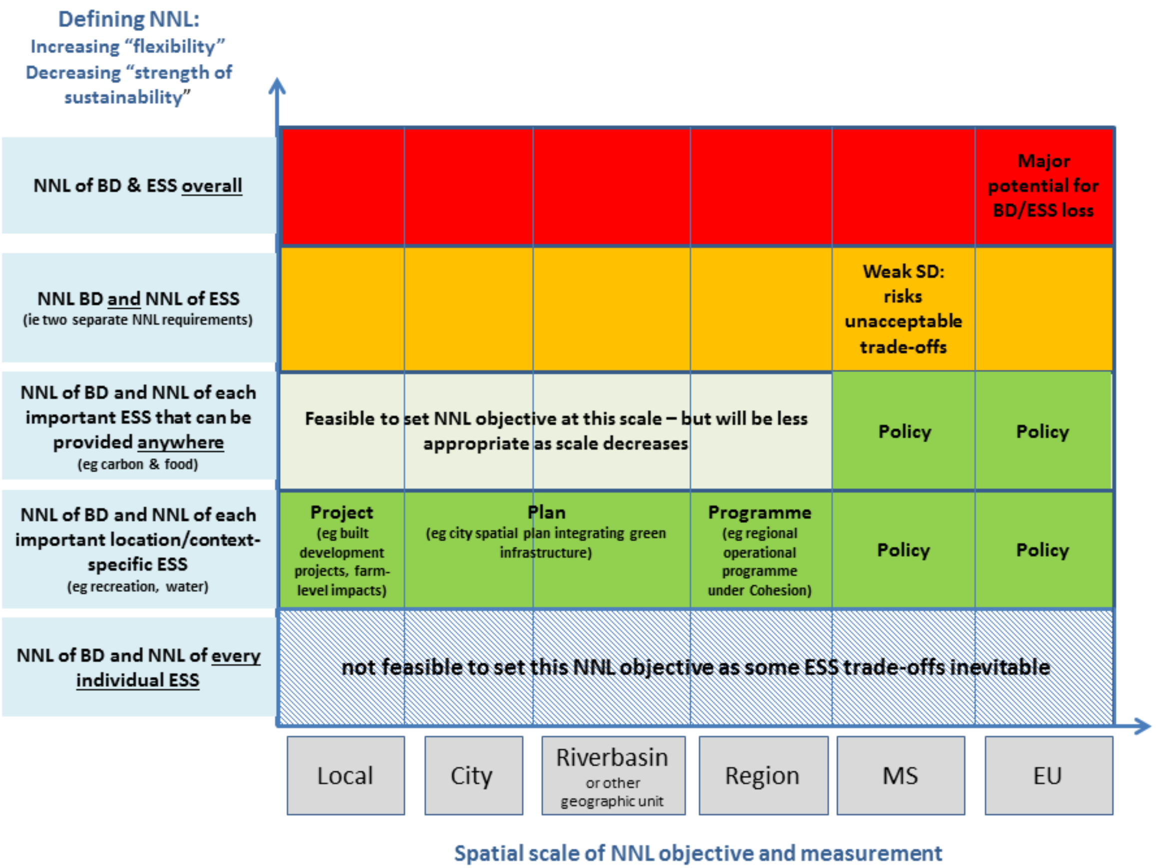
or habitat should be offset by equivalent gains in the same species or habitat – ie by 'like-for-like'.

However, it is important to note that in practice individual impacts on some species and habitats may not be compensated for (ie be like-for-like) and instead biodiversity measures may be intentionally applied to others where they are considered to be of higher biodiversity importance and/or at greater overall risk of declines. This 'trading up' should aim to ensure at least an equivalent biodiversity gain as would have occurred if the compensation was for the impacted habitat type or species. Clearly this is a sensible approach that allows offsetting resources to increase their efficiency and added value by focusing on species and habitats of high value that are subject to widespread impacts and undergoing overall declines. Further discussion of the principles and methods of measuring and ensuring assessing biodiversity and trading-up rules is provided in section 5.10.4.

As regards ecosystem services there is a choice over whether there should be NNL for each ecosystem service, for bundles of services or for ESS overall. Setting NNL objectives for combined ecosystem services would risk inappropriate trade-offs, such as the loss of cultural services for a gain in provisioning services such as timber provision, or regulating services such as carbon storage. In principle one could define NNL for each service, but in practice this would be impossible to achieve as some trade-offs amongst services are nearly always inevitable. Therefore it would seem appropriate to identify and set objectives for the most important ecosystem services individually, which will need to be done on a case-by-case basis as their value and replaceablility is generally context specific (ten Brink, 2011). However, it could be facilitated by linkages to spatial land uses plans (see discussion in section 0).

Figure 4-1 No net loss options in terms of scale and biodiversity / ecosystem service trade-offs

Key: Red = unacceptable trade-offs; Orange = high risk of detrimental trade-offs causing losses of biodiversity and ecosystem services; Light green = NNL objectives may be appropriate at these scales; Green = NNL objectives likely to be required at these scales.



4.4 The scale of the no net loss objective

A further fundamental factor of relevance to policy design, governance, practicability and enforceability is interpretation of the NNL policy in terms the scale over which objectives may be set and assessed. NNL can be applied at the project, plan, programme level and policy level. Similarly in principle the term can be applied at different spatial scales: local/city level, region, river basin, county or EU level (see Figure 4-1). Extreme interpretations of the policy objective, and the Council's definition, might be that NNL could apply to the EU as a whole, such that overall losses of biodiversity and ecosystem services (that are not protected by EU legislation) in regions or even Member States are balanced by gains elsewhere.

However, current EU nature conservation objectives and legislation aim at the very least to maintain habitats and species populations within their existing range, and to maintain the extent of their range. This is in recognition that habitats will differ in their composition and other characteristics over their range, and species will differ in their genetic make-up. Thus losses of habitats and species in any location, even if balanced by gains elsewhere would result in overall biodiversity losses. Furthermore, as discussed below, habitats and species underpin ecosystems services that are often location-specific and therefore these losses often need to be replaced in situ. Consequently, for the NNL objective to contribute to the headline target of halting the loss of biodiversity, it would seem to be appropriate to aim to achieve NNL of biodiversity at local levels. Thus where biodiversity offsets are required to address residual impacts they would normally need to be implemented locally, where this is ecologically appropriate and practical, which may then lead to NNL at larger regional and national scales.

Such a preference for setting a local frame for the NNL objective would also be consistent with the European Commission's guidance on compensatory measures for impacts on Natura 2000 sites (European Commission, 2000; European Commission, 2007), which states that locating the compensation within, or as close to, the effected Natura site is the preferred option. There is also often a presumption in the EU to carry out offsetting measures on-site if this is possible. But this is not always possible and in some situations it can lead to ineffective compensation, for instance through the creation of poor quality, fragmented or disturbed habitats. As noted in the Commission's guidance the overall aims should be to maximise the benefits with respect to the overall coherence of the Natura 2000 network. Therefore it may sometimes be better to implement the offsetting in a more suitable but ecologically appropriate off-site location (eg ensuring it is functionally connected to existing wider viable populations) where, for example, the viability of the habitat may be greater and where it may contribute to restoring habitat connectivity. Thus, as with other biodiversity issues the optimal location of offsets is not always straightforward, and needs to be carefully considered. Whilst NNL of biodiversity may often be appropriately achieved through local-scale approaches it is also appropriate to set NNL objectives at larger spatial scales, such as through city plans, regional programmes and even at policy levels (Figure 4-1). This enables better planning, which is a key means of avoiding potential impacts. It also enables the provision of compensation for cumulative impacts (which are individually too small to appropriately deal with at local levels), which can be facilitated through good practice SEA.

The consideration of the appropriate scale of the NNL objective is more complex for ecosystem services, for example because the provision of one service often affects others, and therefore trade-offs are normally involved. Furthermore, the need for ecosystem services varies from location to location and their context. The main exceptions are carbon sequestration and storage services, for which there is a clear global level NNL requirement. In other words it is possible to offset reductions in carbon sequestration and storage anywhere in theory. However, in accordance with international climate instruments and GHG accounting processes, NNL of carbon related ecosystem services is in practice most appropriately carried out at a national level.

For other ecosystem services, the ideal objective is to achieve NNL for each service where this is required in terms of providing a human welfare benefit. Furthermore, as discussed in the previous section, interchangeability would appear to be inappropriate normally – unless the actual end human benefit is the same. Thus for example, if a project results in a reduction of water storage capacity within a catchment it only seems necessary to compensate for this IF there is a need for the maintenance of the service because the service is already in short supply, or might become so in the foreseeable future. In this situation the appropriate scale for achieving NNL would be the catchment in question. Thus as with biodiversity it would seem appropriate to set NNL objectives through an approach that relates to the local needs for each ecosystem service, in order to ensure that the human benefits of the services are maintained in an equitable way as required. But unlike for biodiversity, it will normally be necessary to consider trade-offs amongst the ecosystem services.

4.5 The levels of biodiversity importance that the no net loss objective applies to

The NNL objective as written in the Biodiversity Strategy, and its role in supporting the 2020 headline target of halting biodiversity losses and ecosystem degradation, implies that all species and ecosystem services should be taken into account in the initiative. This is clearly an ambitious objective. Nevertheless, the Council conclusions make it clear that NNL objective should apply to ‘areas and species not covered by existing EU nature legislation’. But this is ambiguous in terms of whether it should apply to all or some of these areas and species. The European Parliament’s Resolution is clearer in this respect in that it refers to the ‘importance of applying such an approach to **all** [emphasis added] EU habitats and species not covered by EU legislation’.

It would therefore seem correct to assume that the NNL objective does relate to all habitats and species and ecosystems, and seeks to identify policy options that, as a whole, will achieve this. However, it is also acknowledged that there will be major challenges in achieving this goal. Therefore, as further discussed in the next two chapters, some policy options and the policy packages are set out, containing measures that will address differing levels of biodiversity importance and making distinctions between them. Only one policy package, scenario (D), would achieve full NNL for all species (see 6.1).

4.6 Sectoral coverage

Measures that aim to achieve NNL (such as offsetting) tend to be aimed towards the treatment of residual impacts from built developments and extractive industries etc, partly because of the practicalities involved. Agriculture, forestry and other land uses often tend to be explicitly excluded, as for example under specified detailed requirements related to the Mitigation Regulation in Germany. However, as indicated in the preceding chapter, a wide range of pressures are leading to biodiversity declines, amongst the most important of which are those associated with agriculture, forestry and fisheries. Therefore, if NNL is actually to be achieved in the EU then NNL policy measures need to include these three sectors as well as all other activities that have significant impacts on biodiversity and ecosystem services.

A similar conclusion was drawn at the NNL policy workshop (see Annex 11) and by the majority of the members of the NNL Working Group. In the final version (12th July 2013) of the Group's document describing the 'Scope and objectives of the no net loss initiative, it is noted from the industrial sectors that 'it might be argued that a NNL Initiative which targets development impacts but not the impacts of agriculture and fisheries is not treating all sectors equitably (NNLWG, 2013a). A strong rationale is therefore required for excluding them from the No Net Loss Initiative. A majority of working group participants argue that there is no such strong rationale and that the impacts of agriculture, forestry, fisheries and alien species, should be included within the Initiative.'

5 DEVELOPMENT OF KEY EU POLICY OPTIONS FOR IMPLEMENTING NNL GOALS

5.1 Introduction

This chapter identifies and describes key policy options that could contribute significantly to the achievement of the NNL target, in response to the most significant impacts expected to 2020 as identified in Chapter 3 and the considerations and principles discussed in Chapter 4.

It is evident that to achieve the NNL objective, a wide range of policy measures will need to be taken. Logically this should start with significant steps towards reducing the overall scale and intensity (ie footprint) of human activities in Europe. This requires the further development of demand related policy measures such as those contributing to the Resource Efficiency Roadmap (European Commission, 2011c). However, a detailed assessment of such policy instruments is not possible within this study.

The focus of this chapter is on key EU policy instruments that the study team (drawing on the results of the NNL Stakeholder Workshop – see Annex 6) consider to have the greatest potential to significantly contribute to the NNL objective. Furthermore, although this study considers instruments that address all stages of the mitigation hierarchy, it considers in greatest depth measures that aim to address unavoidable residual impacts (ie those that remain after thorough avoidance, minimisation and rehabilitation measures have been taken). This is because, as discussed below, this is where the main policy gaps are with respect to the achievement of NNL. Furthermore, the recent *Biodiversity Proofing Study* has assessed avoidance and minimisation measures in relation to EU funding instruments in detail and provided recommendations for biodiversity proofing (eg through stronger consideration of biodiversity needs in objective setting at fund and programmes levels, in *ex ante* and *ex post* assessments, in project selection criteria and in key supporting instruments such as SEA and EIA)[67].

Due to the complex technical nature of the issues and current policy reform negotiations that are underway this study does not consider policies concerning air pollution impacts, invasive alien species and the sustainable management of fisheries. But it does assume that necessary actions are taken such that they are no longer a constraint on the achievement of the NNL objective.

5.2 Overview of measures that may contribute to NNL

To help with the identification of policy options that are likely to provide the greatest contribution to the achievement of the NNL goal this contract firstly undertook a policy audit. This used recent studies and existing policy documents (taking into account recent reforms and proposals) to identify existing instruments that can be used to achieve NNL, through their potential to avoid, reduce, rehabilitate or offset biodiversity and ecosystem service impacts. The focus is primarily on EU policies and some relevant Member State policies, and measures that may address the most significant expected impacts on

[67] Biodiversity Proofing is defined in the study as a structured process of ensuring the effective application of tools to avoid or at least minimize harmful impacts of EU spending and to maximise the biodiversity benefits.

biodiversity and ecosystem services to 2020 under the BaU scenario, as summarised in Chapter 3. This policy audit firstly identified existing and expected EU measures that may help to avoid, reduce or if necessary offset residual impacts, thereby contributing to the NNL objective, and then secondly identified measures that could be potentially improved (eg by strengthening them, widening their scope and / or better enforcement) and major policy gaps.

The results of the policy audit are summarised in Annex 4, and the strengths and weaknesses of the most important instruments and other approaches that may contribute to the NNL objective are described in further detail below, together with opportunities to address the most important weaknesses. Each account is then followed by related policy options that aim to address the weaknesses. Many of these options provide potential benefits for all biodiversity and a broad range of ecosystem services. However, where relevant, policy options explicitly consider their scope with respect to ecosystem services and the level of biodiversity that may addressed.

With respect to biodiversity three levels are considered:

1) EU threatened biodiversity, ie habitats and species of Community interest requiring conservation under the Birds and Habitats Directives.
2) Nationally threatened biodiversity, ie species requiring conservation under national legislation or identified in national biodiversity priority setting initiatives (eg species listed in National Biodiversity Strategies and Actions Plans).
3) All in situ (ie wild) native biodiversity.

Where necessary, policy options and scenarios include variations to address the differing requirements for each level of biodiversity.

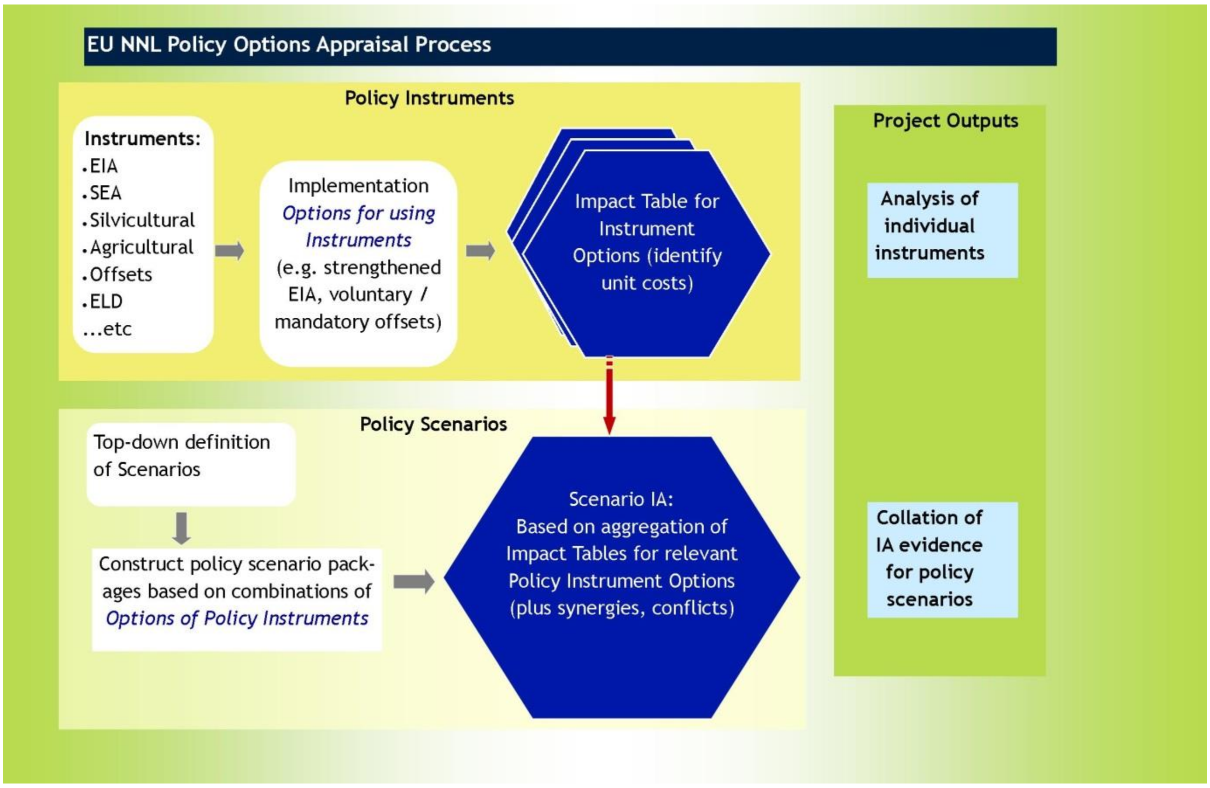
The identification of importance levels for ecosystem services is not attempted because of the complex issues involved and because there is no categorisation of ecosystem services into EU and national importance levels that can be referred to. This is primarily because the need for ecosystem services (ie the human benefits provided) depends on supply and demand and is often context specific. For example, an activity might lead to a decline in water retention within a catchment, thus potentially reducing water resource related ecosystem services, but whether or not this matters in terms of ecosystem benefits will depend on whether water resources are in short supply within the impacted area. For example, it might be that the catchment is sparsely populated, and / or receives high levels of rainfall, in which case water resources could be abundant and far in excess of requirements. Thus, the activity may have no significant impact with respect to this ecosystem service. In other areas, the activity may exacerbate or lead to water shortages, in which case NNL of the service is an appropriate objective.

One exception is carbon storage and sequestration because, given current climate change mitigation requirements, it is always desirable to maximize these services where it is possible without significant impacts on biodiversity and other required ecosystem services.

Consequently, where necessary, each policy option considers how this context specific characteristic of ecosystem services may be addressed.

In accordance with Commission Impact Assessment guidelines[68] each option is then evaluated with respect to its efficiency, effectiveness and wider policy coherence. To facilitate this, a standardised framework was used as outlined in Figure 5-1 using criteria listed and described in Table 5-1. As part of the evaluation of enforceability the issues outlined in Table 5-2 are given particular consideration.

Figure 5-1 Overview of evaluation procedure for individual policy options and scenario packages



[68] http://ec.europa.eu/governance/impact/commission_guidelines/commission_guidelines_en.htm

Table 5-1 Evaluation criteria for individual policy options

Evaluation criteria	Description of the criterion with respect to the assessment of the policy option's potential contribution to NNL
1. Effectiveness	
Mitigation hierarchy stages	The stages that the policy will principally address
Land use impacts	Quantification of (using expert judgement if necessary) the potential impacts on key land use changes (eg % reduction in urbanisation or loss of permanent grasslands)
Potential coverage and impacts on biodiversity:	Indication of which biodiversity levels will be potentially impacted: ie 1) EU threatened biodiversity (ie habitats and species of Community interest requiring conservation under the Birds and Habitats Directives); 2) nationally threatened biodiversity (ie other species requiring conservation under national legislation or initiatives); and 3) all in situ wild native biodiversity. Impacts quantified for each biodiversity level (assuming the measures are properly implemented) using the following standard impact levels: **low** = losses of some species or habitats likely to be reduced; **moderate** = losses of many species or habitats likely to be reduced OR losses of some species or habitats likely to be prevented; **high** = losses of many species and habitats likely to be prevented.
Potential coverage and impacts on ecosystem services	Indication of which ecosystem services will be potentially impacted. Impacts are given for overall ecosystem service benefits if all similar, or separated out for those that may be very different. Standard impact levels: **low** = losses of some ecosystem services likely to be reduced; **moderate** = losses of many ecosystem services likely to be reduced OR losses of some ecosystem services likely to be prevented; **high** = losses of many ecosystem services likely to be prevented.
Clarity	Consideration of whether the instrument option will be understood
Measurability	Consideration of whether it is possible to measure with reasonable certainty the contribution to NNL
Feasibility	The practicability of the option: eg are there sufficient trained staff, available information, etc, to implement the policy?
Enforceability (see also Table 5-2 below)	Consideration of: Costs of non-compliance: The tangible/intangible advantages and disadvantages of breaking or complying with the rule, expressed in time, money and effort Degree of acceptance: The degree to which those required to comply regard the policy and the rules as acceptable. Risk of reporting: estimated by the target group, of a violation detected by others than the authorities being reported to the authorities (eg by an NGO)
2. Efficiency	
Unit costs	Direct costs and where possible an indication of separate opportunity costs
Distribution of costs	Distribution by social group/sector, and in relation to the 'polluter pays' (ie damager pays) principle
3. Coherence	Consideration of the extent to which the option is coherent with overarching objectives of EU policy and limits necessary trade-offs across economic, social and environmental domains.

Table 5-2 Checklist for policy, legislation and instrumentation: Spontaneous compliance dimensions

Title of Question		Explanation	General assessment re: NNL initiatives
1	Knowledge of the Rules	Familiarity and clarity of legislation among the target group	Probably low, needs education, hired expertise. Public info on cases will help
2	Costs/Benefits	The tangible/intangible advantages and disadvantages of breaking or complying with the rule, expressed in time, money and effort	Potential high costs of offsets, can be avoided by non-compliance, but time/CSR advantage of compliance
3	Degree of acceptance	The degree to which the target group regards the policy and the rules as acceptable	Lower if NNL not comprehensive (eg if not covering agriculture, other sectors will feel they are treated unfairly)
4	Target group's respect for authority	The extent to which the target group is willing to respect governmental authority	Generally fine, may be lower on environmental laws
5	Non-governmental control (social control)	The risk, as estimated by the target group, of positive or negative sanctions on their behaviour other than by the authorities	Likely through 3rd sector (NGOs, investors), improved by transparency
6	Risk of reporting	The risk, as estimated by the target group, of a violation detected by others than the authorities being reported to the authorities	High by 3rd sector
7	Risk of inspection	The risk, as estimated by the target group, of being inspected by the authorities for possible violations	Depends on regulatory regime, improved by transparency, as this will reduce transaction costs to authorities of inspection
8	Risk of detection	The risk, as estimated by the target group, of a violation being detected if the authorities inspect	High, as Member State authorities already have BD expertise. Maybe lower on ES
9	Selectivity	The perceived increased risk of inspection and detection of a contravention resulting from selecting the businesses, persons, actions or areas to be inspected	Unclear until track record established, aided by transparency which will reduce transaction costs and speed up filtering of lower-risk cases (with input from 3rd sector).
10	Risk of sanction	The risk, as estimated by the target group, of a sanction if a violation is detected in an inspection	High, improved by transparency as this will allow 3rd sector to observe regulators/planning process
11	Severity of sanction	The severity and type of sanction associated with the violation and additional disadvantages of being sanctioned	Unclear what penalties will be, chances of proportionate penalty improved by transparency/3rd sector scrutiny

5.3 Birds and Habitats Directives

5.3.1 Strengths

Existing measures for identifying, avoiding and reducing potential impacts

The Birds Directive and Habitats Directive are the main EU instruments with a specific focus on biodiversity conservation (see Box 5.1). With their broad objectives and scope, which cover the whole of the EU territory and a wide range of species and habitats (and not just protected areas) their full implementation would contribute substantially to the envisaged aims of achieving the NNL objective; indeed it is essential. In particular Member States should increase their efforts to ensure their Natura 2000 sites, together with other protected core areas, provide adequate, coherent and resilient networks that are adequately protected and appropriately managed.

Box 5.1: Key aims of the Birds and Habitats Directive and Member State obligations regarding the assessment of potential impacts of activities

The principal aim of the Birds Directive (Article 2) is to ensure that '*Member States shall take the requisite measures to maintain the population of the species referred to in Article 1*[69] *at a level which corresponds in particular to ecological, scientific and cultural requirements, while taking account of economic and recreational requirements, or to adapt the population of these species to that level.'*

The Habitats Directive includes a number of requirements for Member States to implement conservation measures for habitats and species of Community interest[70]. The general purpose of such measures should be to achieve the overall aim of the Directive, which as stated in Article 2(1) '*shall be to contribute towards ensuring biodiversity through the conservation of natural habitats and of wild fauna and flora in the European territory of the Member States to which the Treaty applies*.'

Article 2(2) then states that '*Measures taken pursuant to this Directive shall be designed to maintain or restore, at favourable conservation status, natural habitats and species of wild fauna and flora of Community interest*.' Favourable conservation status can be described as a situation where a habitat type or species is prospering (in both quality and extent/population) and with good prospects to do so in future as well'.

These directives give the legal EU basis for the protection and management of sites of particular importance for species and habitats of Community Interest. These comprise Special Protection Areas (SPAs) designated under Article 4 of the Birds Directive (for birds listed in Annex I of the Directive and for migratory species) and Special Areas of Conservation (SACs) designated under Article 4 of the Habitats Directive (for habitats and species of Community interest). These SACs and SPAs are combined under Article 3(1) of the Habitats Directive with the intention of forming 'a coherent ecological network' referred to as the Natura 2000 network. However, it is important to note that FCS has to be achieved across each species' and habitat's natural range, and not just within the Natura 2000 network.

An important strength of the Habitats Directive is that it does not just seek to protect individual sites, but aims to form 'a coherent ecological network' (ie the Natura 2000 network in accordance with Article 3.1). The term 'coherence' is of key importance as it

[69] All species of naturally occurring birds in the wild state in the European territory of the Member States to which the Treaty applies.
[70] These are habitats and species that are listed in Annex I and II of the Directive respectively.

indicates that Natura 2000 sites may not be seen as isolated ecological hot spots that can survive on their own, but as elements of a broader network with numerous functional links amongst sites. Furthermore, Article 3.1 states that 'where they consider it necessary, Member States shall endeavour to improve the ecological coherence of Natura 2000 by maintaining, and where appropriate developing, features of the landscape which are of major importance for wild fauna and flora, as referred to in Article 10'. Article 10 states that 'Member States shall endeavour, where they consider it necessary, in their land-use planning and development policies and, in particular, with a view to improving the ecological coherence of the Natura 2000 network, to encourage the management of features of the landscape which are of major importance for wild fauna and flora. Such features are those which, by virtue of their linear and continuous structure (such as rivers with their banks or the traditional systems for marking field boundaries) or their function as stepping stones (such as ponds or small woods), are essential for the migration, dispersal and genetic exchange of wild species'.

Article 2 of the Birds Directive requires Member States to take the requisite measures to maintain the population of wild birds at a level which corresponds to ecological, scientific and cultural requirements, whilst taking account of economic and recreational requirements, or, to adapt the population of these species to that level. Article 4(3) of the Birds Directive refers to the need for Special Protection Areas (SPAs) to 'form a coherent whole which meets the protection requirements of these species in the geographical sea and land area where this Directive applies.' Thus, it is necessary to take measures to ensure the coherence and connectivity of sites, where this is necessary to achieve the aims of the Directive. In addition, Article 3 indicates that measures need to be taken both within and outside protected areas. Moreover, it should be remembered that SPAs form part of the Natura 2000 network (under Article 7 of the Habitats Directive). Therefore, the coherence of the SPA network is also promoted through the measures in the Habitats Directive.

Where developments significantly affect the Natura 2000 network, risks to biodiversity are managed in practice through the requirements and provisions in place under the Habitats Directive (which replace similar provisions in the Birds Directive) that require the precautionary principle and mitigation hierarchy to be followed. Of key relevance to the avoidance and reduction of impacts is Article 6(3) under which plans or projects which individually or in combination with others are likely to have a significant effect on a site, but are not directly connected to their management (for nature conservation), are to be subject to an 'Appropriate Assessment' of the implications in view of the site's conservation objectives. Competent authorities can only agree to the plan or project after having ascertained that it will not adversely affect the integrity of the site concerned.

The terms 'plan' and 'project' are not defined in the Habitats Directive, but the meaning of 'project' was clarified by the European Court of Justice in relation to cockle finishing on the Waddenzee. It stated that the term had been defined in the EIA Directive (see 0) as 'the execution of construction works or of other installations or schemes; other interventions in the natural surrounding and landscape including those involving the extraction of mineral resources' and that this should accordingly apply under the Habitats Directive. Thus a broad interpretation of plans and projects is appropriate.

Article 6(4) includes provisions that allow projects or plans that may have adverse impacts to go ahead if they are of overriding public interest, but importantly this is provided there are no alternative solutions. Furthermore, for Natura 2000 sites that host a priority habitat type or species the only overriding public interest considerations that may be raised are those relating to human health and public safety, unless other considerations are agreed to in an opinion from the Commission.

Initially Member States had some problems with implementation of Article 6.3, particularly regarding interpretation of the precautionary principle and 'imperative reasons of overriding concern'. Appropriate Assessments were also often too general in nature. However, these issues were clarified through a number of important legal cases (European Commission, 2006) and the publication of European Commission guidance (European Commission, 2001).

Existing measures identifying and addressing residual impacts

In cases where projects and plans that have adverse impacts on a Natura site are allowed to go ahead, under provisions in Article 6.4, then the Member State 'shall take all compensatory measures necessary to ensure that the overall coherence of the Natura 2000 Network is protected'. Thus there are clear legal requirements to address residual negative impacts through measures that would appear to contribute to achieving NNL at least at the network level, but not necessarily at a site level. However, the meaning of compensatory measures and network coherence is not defined in the Directive, and as a result compensation measures were initially found to be inadequate or not targeted to the species and habitats of Community interest that are the subject of impacts (IEEP, 2010).

Early problems with the implementation of compensatory measures were partly addressed through the Commission's 2001 guidance on Articles 6.3 and 6.4, and more specifically in detailed guidance on Art 6.4 in 2007 (European Commission, 2007). The 2007 guidance clarified the meaning of compensatory measures, stating that 'They aim to offset the negative impact of a project and to provide compensation corresponding precisely to the negative effects on the species or habitat concerned.' It also emphasises the need to ensure the measures are in accordance with the mitigation hierarchy noting that 'compensatory measures constitute the "last resort".' In order to ensure the overall coherence of Natura 2000, compensatory measures should 'a) address, in comparable proportions, the habitats and species negatively affected; b) provide functions comparable to those which had justified the selection criteria of the original site, particularly regarding the adequate geographical distribution.'

The guidance also indicates that compensatory measures taken in accordance with Article 6.4 should:

- Ensure the maintenance of the contribution of a site to the conservation at a favourable status of natural habitat types and habitats of species within the biogeographical region concerned. Within this region measures should be located to accomplish the highest effectiveness in maintaining the overall coherence of the Natura 2000 network, which where possible and appropriate should normally be within or nearby the impacted Natura 2000 site.

- Provide effective compensation before impacts occur if this is possible. Where this is not possible, and interim losses occur, then additional compensation should be provided.

- Ensure that compensation is additional to the measures taken to establish the Natura 2000 network in accordance with the requirements under the Birds and Habitats Directives.

- Not only include the protection of additional site (eg as Natura sites), but also include measures that re-create, restore or enhance habitats.

- Be funded by the project proponent in accordance with the 'polluter pays' principle.

- Underpinned by sound legal and financial measures to provide and monitor compensation in the long-term.

- Address all issues, whether technical and/or legal or financial, necessary to ensure the compensatory measures preserve the overall coherence of the Natura 2000 network (eg through tight coordination and cooperation between authorities and the project proponent, the setting of clear objectives and target values according to the conservation objectives of the site, technical, legal and financial feasibility assessments, adequate budgeting, public consultation and monitoring and reporting according to progress indicators).

Although the Birds and Habitats Directives have some weaknesses and implementation problems (as described below) the Directives are widely considered to provide a strong science-based protection and management framework, which is also flexible and proportionate. Accordingly there is evidence that the Birds Directive has had significant measurable benefits for birds that are the focus of its protection measures (ie listed in Annex I) and some birds and mammals are responding well to conservation actions under both Directives (Deinet et al, 2013). Yet, at the same time the Birds and Habitats Directives do not appear to have been a significant constraint on necessary developments and economic growth (eg DEFRA, 2012), but instead provide legal certainty and an effective framework for avoiding and managing conflicts, which result in the maintenance of valuable ecosystem services (as acknowledged in a letter from European Commission President Barroso to Prime Minister Balkenende of the Netherlands, in October 2009).

5.3.2 Weaknesses

Existing measures for identifying, avoiding and reducing potential impacts

Despite clear obligations for Member States to avoid impacts on Natura 2000 sites and Commission guidance on their interpretation, some proposed developments do still threaten Natura sites. Some of these threats lead to the European Commission sending reasoned opinions to Member States and referral of some cases to the EU Court of Justice, as for instance concerning the potential impacts of wind turbines and other projects on Kaliakra SPA in Bulgaria[71]. It can be anticipated that such legal responses will deal with some threats, but other damaging impacts probably go unnoticed or unreported and are not taken up by the Commission.

A particular weakness concerns the assessment of potential cumulative impacts on the Natura 2000 network as a whole, as Appropriate Assessments tend to focus on site-level impacts. Such impacts are best dealt with at high strategic levels, and therefore Strategic Environmental Assessments (SEAs) of plans have a major role to play in this respect (see section 0 below). Consequently, the requirement for an Appropriate Assessment of a plan also triggers a requirement for an SEA of the plan in question. Furthermore, project-level Environmental Impact Assessments (EIAs) should consider cumulative impacts to the degree that it is feasible. However, in practice the treatment of cumulative impacts is weak because the current guidance document on the assessment of plans and projects significantly affecting Natura 2000 sites (European Commission, 2001) focuses on site-level impacts, and practical methods for defining functional ecological networks and their needs have yet to be established (Arcadis and IEEP, 2010).

Although the Directives require Member States to maintain the coherence of the Natura 2000 network (eg through measures that protect landscape features in the wider environment), reports for the Commission found that these requirements have been weakly implemented in many places in recent years (Kettunen et al, 2007; IEEP & Alterra 2010). Furthermore there is little evidence that the situation has changed since, despite the new EU Biodiversity Strategy and the increasing recognition of the value of green infrastructure and its potential to deliver economic benefits whilst also helping to maintain and increase ecological connectivity (Mazza et al, 2011).

Existing measures identifying and addressing residual impacts

There are significant concerns over the degree to which compensatory measures actually offset impacts on the Natura 2000 network as a result of inappropriate compensatory objectives, poor quality measures and inadequate implementation. Such concerns were raised by the Commission in its report on compensatory measures over 2004-2006, which noted the 'remarkable lack of understanding of the purpose of compensatory measures and the very common low quality of the measures proposed' (European Commission, 2008). According to the most recent assessment of compensatory measures (for 2007-2011) the Commissions' 2007 guidance (European Commission, 2007) appears to have improved

[71] http://europa.eu/rapid/press-release_IP-12-654_en.htm?locale=en

matters, especially regarding the provision of information by Member States on undertaken measures (European Commission, 2013a). But the Commission notes that it is still often 'difficult to assess, in some cases, the relation between the compensatory measures and the site's conservation objectives and its role in the Natura 2000 network. Therefore, it is not always possible to assess how the proposed measures will compensate the adverse effects on the integrity of the site and how the coherence of the Natura 2000 network will be preserved.' The report also notes that information on the methods used to compensate for impacts is insufficient to assess their actual feasibility and possible effectiveness. One possible reason for this is that the European Commission's 2007 guidance does not indicate how losses/gains should be measured, such as through the use of metrics and how equivalency of gains and losses should be determined.

There is evidence from a study by Regnery et al (2013), as discussed further in Annex 5, that in France compensatory measures do not always result in adequate offsetting of all species of Community interest. They found that only 35% of development projects considered all affected species in their offset measures, and even some impacts on endangered species were not offset. Species richness was much lower in offset sites than in developed sites even after offset proposals. Importantly, this was especially the case where the developed site had a high species richness, in which case the species richness at the offset site was 5-10 times lower. Thus, although compensatory measures under Article 6.4 of the Habitats Directive should result in like-for-like offsetting, this does not appear to be occurring consistently in France at least.

Despite the European Commission's stated concerns over the effectiveness of Article 6.4 related compensatory measures a recent study indicates that the problems are being exacerbated by weak enforcement by the Commission (McGillivray, 2012). The study analysed 15 publically issued opinions by the Commission in relation to Article 6.4 and found that the opinions lacked transparency and that there were concerns regarding the Commission's responses to compensation functionality, proponent bias, monitoring and enforceability and economic influence. As a result McGillivray concludes that 'If the Commission cannot demonstrate, through its published opinions, that it is itself faithful, in letter and spirit, to all aspects of the compensation obligation, its leverage over the Member States in relation to the wider range of cases where the compensation obligation applies, and across the Habitats Directive regime as a whole, is diminished.'

Another weakness is that, although the aims of the Habitats and Birds Directives relate to the entire area of habitat and overall populations of species of Community interest, their strongest measures focus on the protection of habitats and species populations within the Natura 2000 network. Consequently, there is no requirement for compensatory measures for residual impacts outside Natura 2000 sites, even where such impacts would result in a species' or habitat's conservation status changing from favourable to unfavourable. The rationale for this is that the designated Natura 2000 network should be sufficient within each Member State to ensure that favourable conservation status of each habitat and species of Community interest can be achieved through the protection and management of Natura sites alone. However, there is little evidence that this level of coverage is achieved in most, if any, Member States.

Perhaps the most fundamental weakness of the EU Birds and Habitats Directives is that they focus on habitats and species that are threatened at an EU level. Therefore, whilst in this context mitigation and compensation for displaced or impacted habitats and species covered by the Directives is a legal requirement, there is no similar requirement for addressing those impacts on species and habitats that are not covered by EU nature legislation, which leads to net biodiversity losses. Whilst some may indirectly benefit from the protection given to habitats and species covered by the Directives, the distribution and ecological requirements of many more widespread and common species do not overlap greatly; therefore such species will benefit little from the Directives.

5.3.3 Opportunities

The European Commission announced on 2nd October 2013 that as part of its REFIT – Fitness for growth initiative it will carry out a fitness check on a number of environmental regulations including those concerning Natura 2000[72]. At the time of writing this report, the scope of this fitness check is not known, but it could provide an opportunity to improve and strengthen some components of the Birds and Habitats Directives to address the weaknesses referred to above. However, although a detailed analysis of options for improving the Directives themselves has not been carried out, most of the weaknesses are related to the need for better implementation of the existing measures. Thus they can be tackled now through, for example, the policy options described below.

Although a policy option could be to extend the coverage of the Directives to other less threatened species and habitats this would clearly require fundamental changes to the Directives and their measures that would be beyond the expected scope of the fitness check. Such reforms would be complex and challenging because new measures would need to be introduced to address issues affecting widespread and common species, and these would need to be proportionate to the biodiversity importance of the added habitats and species and the threats facing them. Consequently, this is not put forward as a policy proposal, but instead it is suggested that the required measures for widespread and common species can be better implemented through other existing instruments, including SEA and EIA processes, the ELD, reform of sectoral policies and where necessary offsetting, as described further below.

5.3.4 Policy options

On the basis of the issues described above, it is suggested that options to achieve NNL of biodiversity, should give a high priority to the following two policy options relating to the Birds and Habitats Directives.

Birds and Habitats Directive Policy Option 1 (BHD 1): Improved and wider Appropriate Assessments and compensatory measures for unavoidable impacts, including improved metrics

It should be ensured that Articles 6(2) and 6(3) are properly applied to all activities (including agricultural and forestry management improvements) that may potentially have a

[72] http://europa.eu/rapid/press-release_IP-13-891_en.htm

significant impact on designated habitat and species features within Natura 2000 sites. In particular, robust systems should be established for screening proposed activities with respect to the need for an Appropriate Assessment (eg by publishing lists of operations within the Natura 2000 site that would definitely require an Appropriate Assessment, or a screening opinion from a competent authority).

Further guidance and clarification on compensatory measures could also be provided, to ensure that they achieve NNL through, for example, offsetting. Most obviously key principles and standards of best practice could be outlined for the use of metrics for measuring impacts and the expected gains from compensatory measures, to ensure NNL is achieved. The need for measures to ensure like-for-like compensation could also be strengthened.

Lastly, to ensure standards are raised it will be necessary to increase the capacity of EU Institutions and Member State competent authorities (and assisting organisations) so that they can provide screening and scoping opinions and increase the scrutiny of Appropriate Assessments and, where necessary, proposed compensation measures within suitable time-frames. This will probably require an increase in staff in involved institutions combined with further awareness raising, training and guidance.

Policy Option Evaluation

Table 5-3 Evaluation of the effectiveness, efficiency and policy coherence of option BHD1: Improved and wider Appropriate Assessments and compensatory measures for unavoidable impacts

Evaluation criteria	Assessment of policy option's potential contribution to NNL
1. Effectiveness	
Mitigation hierarchy stages	All would be addressed.
Land use impacts	Would primarily affect forests, semi-natural grasslands & shrublands, and wetland habitats.
Potential coverage and impacts on biodiversity	High: beneficial impacts focussed on EU threatened habitats and species biodiversity mainly within the Natura 2000 network, but moderate indirect benefits for other species.
Potential coverage and impacts on ecosystem services	Moderate/high benefits for ecosystem services associated with natural and semi-natural ecosystems within the Natura 2000 network (which comprises >18% of EU land area).
Clarity	Good as this is an extension of existing activities, but history suggests careful guidance and test cases will be required.
Measurability	Moderate. Appropriate assessments are publically available and Member States must report on compensation measures undertaken (although these sometimes lack detail) that can be used as a baseline for future comparison.
Feasibility	Yes, existing system for implementing requirements can be expanded.
Enforceability	Moderate. Some requirements supported through ECJ rulings, but in practice some existing rules/guidance not always accepted and/or respected, authorities may not have enforcement capacity and penalties for non-compliance can be low.
2. Efficiency	
Unit costs	

Public: 1-off (€)	Minimal, to implement improved Directive language/guidance, establish new assessment systems.
Public: Recurring (€/yr)	Additional but not quantifiable costs of increased scrutiny of Appropriate Assessments and proposed compensatory measures and enforcement of more detailed requirements.
Private: 1-off (€)	Additional but not quantifiable costs of improved compensatory measures.
Private: Recurring (€/yr)	Additional but not quantifiable costs of improved long-term protection and management of compensatory measures.
Distribution of costs	Largely in line with polluter pays, but some costs to benign projects simply for assessments. In some cases where large assessments and compensation actions are required, costs could be disproportionate to impacts or to scale of activity.
Benefits (other than NNL)	
Economic activity	Variable. Variable losses in activities facing opportunity costs; but some protection/gains in nature-based tourism and other commercial activities although often likely to be smaller in magnitude.
Jobs	Variable. Variable losses in activities facing opportunity costs; but some protection/gains in nature-based tourism and other commercial activities although often likely to be smaller in magnitude.
Health/quality of life	Low-moderate increase in benefits of natural area, eg recreational activities, clean air/water leading to health benefits.
Other	
3. Coherence	This option will strengthen the Birds and Habitats Directives, which are at the heart of EU nature conservation policy. Ensuring their effectiveness is essential to meeting the EU's biodiversity targets, and wider environmental and social goals, and will facilitate design of other policies, which will no longer be considered about filling gaps in these Directives.

Birds and Habitats Directive Policy Option 2 (BHD 2): Improve the implementation of Birds Directive Article 3 and Habitats Directive Articles 3 and 10 to maintain bird populations and the coherence of the Natura 2000 network

In this option Member States would increase their efforts to ensure their Natura 2000 sites, together with other protected core areas, provide adequate, coherent and resilient networks at biogeographical scales. Where necessary the resilience of individual Natura sites would be improved, as appropriate, by expansion, improved management and enhanced functional connectivity, taking into account wider Green Infrastructure objectives and the provision of other ecosystem services.

As suggested in another recent study for DG Environment (IEEP/Alterra, 2010) it is particularly recommended that: Member States should implement Article 10 of the Habitats Directive (and similar measures implied in Article 3 of the Birds Directive), through the establishment of national frameworks for assessing functional connectivity needs, and planning, integrating and implementing necessary actions, as recommended in the fragmentation guidance report for DG Environment (Ketunnen et al., 2007).

This framework suggests that Members States should:

- Identify species and habitats of Community interest that are already impacted by, or vulnerable, to fragmentation and/or changes in suitable climate space.
- Assess the functional connectivity requirements of vulnerable species and habitats, taking into account likely habitat fragmentation and climate change impacts where necessary.
- Integrate functional connectivity requirements into ecological networks and generic habitat measures across the wider environment.
- Implement connectivity measures through existing mechanisms, such as protected area management plans, spatial planning and SEA, agri-environment and other similar incentive payments and targeting of offsetting (see relevant policy options elsewhere in this chapter).

Policy Option Evaluation

Table 5-4 Evaluation of the effectiveness, efficiency and policy coherence of option BHD2: Improve the implementation of Birds Directive Article 3 and Habitats Directive Articles 3 and 10 to maintain bird populations and the coherence of the Natura 2000 network

Evaluation criteria	Assessment of policy option's potential contribution to NNL
1. Effectiveness	
Mitigation hierarchy stages	Mainly the avoidance and reduction of impacts, but also residual impacts.
Land use impacts	Wide-ranging impacts on many terrestrial habitats, but probably mainly in agricultural ecosystems.
Potential coverage and impacts on biodiversity	Moderate impacts on all species.
Potential coverage and impacts on ecosystem services	Moderate: some ecosystem services associated with landscape features (eg erosion prevention from hedges and terraces) and cultural benefits.
Clarity	Low-moderate as this involves new activities and landscape scale concepts; history suggests careful guidance and test cases will be required.
Feasibility	Yes with time, existing system for implementing requirements can be expanded, but may need to develop new skills.
Enforceability	Low-moderate? Existing rules not always accepted and/or respected, authorities may not have enforcement capacity to handle new concepts, and penalties for non-compliance can be low.
2. Efficiency	
Unit costs	
Public: 1-off (€)	Costs of identifying and planning functional connectivity requirements. More SEA for sectors/land planning, but this may be offset by reductions in project planning disputes.
Public: Recurring (€/yr)	Some additional costs of enforcing more detailed requirements, but most actions integrated with existing measures, eg agri-environment measures.
Private: 1-off (€)	Low as most direct costs would be through public funded incentive measures.
Private: Recurring (€/yr)	Opportunity costs of not exploiting resources that affect ecological coherence.

	More SEA for sectors/land planning, but this may be offset by reductions in project planning disputes.
Distribution of costs	Strategic proactive measures largely public funded; costs of losses of connectivity features largely in line with polluter pays principle.
Benefits (other than NNL)	
Economic activity	Losses in activities facing opportunity costs. Gains in nature-based tourism and other commercial activities offer alternative development options, but may be insufficient to compensate, in which case overall net loss.
Jobs	Losses in activities facing opportunity costs. Gains in nature-based tourism and other commercial activities offer alternative development options, but may be insufficient to compensate, in which case overall net loss.
Health/quality of life	Increase, possibly significant, as a result of improvement in ecosystem services (particularly regulating services on air/water) and recreational services, but of which are determinants of human population health.
Other	
3. Coherence	As BHD1

5.4 Environmental Liability Directive

The purpose of the Environmental Liability Directive (ELD) is to establish a framework of environmental liability, based on the polluter-pays principle, to prevent and remedy environmental damage. The strict liability standard of operators is based on a list of dangerous substances, including for example industrial activities covered by the IED, waste management activities, use, transport, and discharge of dangerous polluting substances, un-authorised discharges into surface or groundwater, and transport of dangerous substances.

The ELD covers damages to land, water and biodiversity (ie protected species and habitats). In relation to biodiversity, it is effectively a no net loss mechanism for the specific types of damage covered under the Directive. It can contribute to achieving NNL of biodiversity in four major ways. They are presented here using language that relates them to the mitigation hierarchy:

1. Long-term **avoidance** of environmental damage is incentivised by the ELD.
2. *Preventative action* is action required to **avoid** imminent threats of environmental damage.
3. *Primary remediation* is nearly equivalent to **rehabilitation/restoration** of the affected site.
4. *Complementary* and *compensatory remediation* (see below) is offsetting **residual impacts** in space and time, respectively.

The effectiveness of each of these aspects of the ELD depends on the scope and strength of implementation of the Directive[73]. For example, while biodiversity resources are included in the definition of 'environmental damage' in the ELD, exactly which habitats and species this covers depends on the transposition of the Directive by a given Member State. ELD text requires that it covers the habitats and species covered by the Birds and Habitats Directives. Member States can choose to extend this definition to include biodiversity resources defined under national laws or non-protected species too.

In order to ensure that responsible parties (eg companies) have the sufficient funds to remediate damage to biodiversity (and other types of damage), the ELD requires – as a minimum – that Member States encourage operators to take financial security. ELD does not make it compulsory at EU level for responsible parties to set aside or purchase financial security, however, Member States may decide to introduce mandatory financial security. Whether mandatory or not, several options are being explored by Member States to implement financial security in practice. Insurance has proven to be the most popular instrument to cover environmental liability (insurance pools are present in Spain, France, Italy and the Netherlands). The second most popular instrument is bank guarantees (used in Austria, Belgium, Cyprus, Czech Republic, the Netherlands, Poland, Spain, and the UK). Other Market Based Instruments (MBIs) such as funds, bonds, etc, are being discussed in Austria, Belgium, Bulgaria, Cyprus, Poland and Spain (EC, 2010). The discussions about the feasibility of different instruments for financial security, and creating new insurance products are active between the insurance industry, competent authorities and the operators. Therefore, this information may already be out of date but a more recent official reference could not be found at the time of writing.

Inclusion of a wider variety of biodiversity resources in the definition of damage, and implementation of stronger financial security provision, can each increase the contribution of the ELD to achieving NNL of biodiversity in the EU.

5.4.1 Strengths

Existing measures for identifying, avoiding and reducing potential impacts

The ELD follows the polluter pays principle, and was initially designed to induce polluters to avoid damaging the environment, and if they did, to ensure that they would remediate that damage. In relation to avoidance, the Directive makes any operator (ie operator of particular business or sectoral activities as listed in Annex III of the ELD) whose activity damages the environment, financially liable for that damage. It is often overlooked, but the ELD was designed to and can act as a deterrent to polluting/impairing activities, or to taking risks in the design of activities, that risk damaging biodiversity. A key aim, as stated in the Directive, is to "induce operators to adopt measures and develop practices to minimise the risks of environmental damage so that their exposure to financial liabilities is reduced." (Recital (2), ELD).

[73] European Commission (2010) Report on the Effectiveness of the Environmental Liability Directive, Brussels, 12.10.2010, COM (2010) 581 final. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:0581:FIN:EN:PDF

More explicitly in relation to avoidance and remediation, the ELD requires that 1) if there is an imminent threat of damage to the environment, the operator must take the necessary measures to prevent that damage, and 2) where environmental damage has occurred, the operator must take all practicable steps to limit or prevent further environmental damage. The overarching objective with remediation of damage to nature, as stated in Annex II of the ELD, is to return protected habitats or species back to their baseline condition. In some cases, it may not be feasible or prudent to return nature to its baseline condition on the damaged site, or return to baseline takes time. In these instances, where residual impacts remain, the ELD provides for two other remediation options (see below).

Existing measures identifying and addressing residual impacts

Beyond *preventative action* of imminent threats and *primary remediation* of damages to the environment, the ELD introduces two mechanisms for addressing residual impacts. *Complementary remediation* occurs on a different site when *primary remediation* of the affected site is not achievable. That is effectively spatially addressing residual impacts via offsetting, similar to measures introduced in BHD (see Section 5.3.). *Compensatory remediation* involves actions taken to compensate for interim losses that occur from the date of damage until *primary remediation* has achieved full effect. That is effectively temporally addressing residual impacts. It does not involve any form of financial compensation, but refers to additional improvements to nature or water at either the damaged or an alternative site before *primary remediation* has achieved full effect.

Both *complementary* and *compensatory remediation* require equivalence approaches. At first instance, a like-for-like approach is preferred, where the same type, quality and quantity of damaged or lost *resources* or benefits to nature or the public (*services*) is replaced. If that approach is not possible, a monetary valuation approach can be used. The practicalities of these approaches have led to a hierarchy of four specific equivalency methods. In order from first that should be considered to last, they are (adapted from eftec and Stratus Consulting, 2013):

- **Resource-to-resource –** Measures losses from damage and gains from remediation in terms of resource units, such as stocks (numbers) of fish or birds or litres of groundwater.

- **Service-to-service –** Losses from damage are expressed in terms of services lost from habitats. Those losses are offset by remediation of habitat that is similar in area and level of services it provides.

- **Value-to-value –** Where it is not possible to use either the resource-to-resource or service-to-service equivalencies, the monetary value of lost resources and services can be estimated. Remediation is considered equivalent when an increase in resources and services of the same value as the losses is achieved.

- **Value-to-cost –** Where it is possible to estimate the monetary value of the damage but not possible to estimate the monetary value of the remediation benefits, the budget (cost) of remediation should equal the value of the damage.

These methods have been used in different contexts in the EU and/or in other parts of the world.

5.4.2 Weaknesses

A number of weaknesses, challenges and barriers to the ELD and its implementation have been described elsewhere (BIO Intelligence Service, 2013; EC, 2010; EC, 2013), many of which relate to the complexity of and key omissions of clarity within the Directive. That has led to a lengthy process of transposition with noticeably varied outcomes across MS. A report on implementation of the ELD was commissioned by DG Environment, and a summary of the key challenges to ELD application it identified are presented in Box 5.2. Beyond general issues related to the ELD, there are some weaknesses that are specifically pertinent to achieving NNL of biodiversity and ecosystem services.

Existing measures for identifying, avoiding and reducing potential impacts

A gap in protecting against minor, but often prolific damages to biodiversity remains across much of Europe. Legislation in Member States related to the prevention and remediation of damage to water and land are much more developed than that related to biodiversity. The ELD was designed similarly for all three, however, as a complement to Member State legislation for significant damages, meaning minor damages to biodiversity remain less regulated. BIO Intelligence Services (2013; pg. 79) states, "…the ELD does not supplement national legislation for biodiversity [as it does for water and land]; it is the *only* detailed legislation for biodiversity damage in most Member States." Similarly, the ELD is set up primarily to cope with unforeseeable or unregulated incidents. It is not a tool to prevent biodiversity loss from predictable impacts approved during project permitting procedures. So while, for example, permits and fees could be used to manage predictable water discharges, and legislation may be in place to manage unpredictable, but minor water damages, the same tends not to be true for biodiversity impacts.

A further complicating factor is that the ELD only applies to biodiversity damage that is 'significant', but significance is not clearly defined in the Directive. Rather, criteria to assess significance are presented and those criteria are not well understood by all stakeholders. That means the effective threshold of the level of damage that is deemed significant qualitatively increases. Without clear assessment criteria and costly remediation, operators have space and incentive to lobby for a narrower interpretation and application of the assessment criteria. Indeed, there is a broad misinterpretation of "significant" impacts as "severe" impacts (BIO Intelligence Services, 2013), evidence of a qualitative increase of the threshold in application.

Finally, the ELD only applies to EU protected habitats and species. Member States can voluntarily extend it to their nationally protected biodiversity, which has occurred in 14 MS. The combination of these weaknesses — not adapted to the lack of complementary national legislation, unclear definition of when it applies, and mandatory application only to nature of EU protection — has led to a policy that is relatively narrow in implementation and is applied inconsistently across the EU.

Existing measures identifying and addressing residual impacts

Complementary and compensatory remediation, to reduce residual impacts, require measurements of equivalency between the losses from environmental damage and the gains from remediation action. For both types of remediation, better guidance on approaches for measuring equivalency is needed. Although some Member States have provided national guidance on equivalency, and the EU project REMEDE (Resource Equivalency Methods for Assessing Environmental Damage in the EU[74]) supports design, testing and dissemination of equivalency methods, more coherent guidance across the EU is called for by stakeholders.

Box 5.2. Key Challenges to the Application of the ELD
Source: BIO Intelligence Services, 2013

Conditions of application:

- Difficulty in assessing when damage to a natural resource exceeds the threshold for biodiversity damage, water damage and land damage;
- Lack of effective mechanisms to encourage comments and observations from environmental NGOs and other interested parties in MS.

Expertise and knowledge:

- Large number of competent authorities in some MS, making it difficult for them to gain experience or expertise of the ELD;
- Lack of detailed knowledge — and sometimes lack of any knowledge — of the ELD by many stakeholders in all Member States (environmental NGOs, competent authorities, operators, insurance brokers, etc.);
- Lack of guidance document in many Member States to assist in understanding the legislation that transposed the ELD (environmental NGOs, competent authorities, operators, etc).

Legislative environment:

- Wide variation between the legislation transposing the ELD between Member States which has led to a patchwork of environmental liability regimes across the EU;
- Difficulty in determining when the ELD applies or when existing national environmental legislation applies, that is which legislation is more stringent;
- Overlaps in preventive and remedial measures between the ELD and Annex III legislation leading competent authorities to apply existing legislation rather than the ELD;
- Determining the interface between biodiversity damage under the ELD and the BHDs
- Conflict in the ELD between requirements to prevent environmental damage “without delay“ and emergency remedial actions “immediately“ versus the lack of specificity of thresholds for an imminent threat of, and actual, environmental damage.

[74] http://www.envliability.eu/

5.4.3 Opportunities

In April 2013 Member States had a deadline to report on ELD implementation to the Commission. The Commission is due to publish these reports and its response in April 2014. In 2014, it is also due to consider revision of the ELD based on the upcoming report and the resulting reactions by the European Parliament, the Council, and other stakeholders. Based on work already carried out on reviewing the ELD, there are some improvements that have some likelihood of being proposed, or at least considered carefully, including:

- **Improved information** – Better information exchange, communication and awareness raising among key stakeholders would aim to increase the quality of implementation of the ELD. That would inherently have at least a small benefit towards NNL.

- **EU-level guidance** – Coherent guidance on interpreting the ELD, including clarification on unclear definitions and concepts, is demanded by stakeholders. A handbook on ELD implementation has been developed, and linking this to the latest thinking on defining NNL of biodiversity (eg in the use of metrics) could assist with ELD implementation.

- **Register of ELD cases** – A central database of records on all ELD cases would help Member States fulfil their reporting obligations and facilitate lessons to be learned. That could help policy makers identify the actual impacts of ELD in relation to NNL and areas for improvement.

- **Harmonised financial security** – The costs associated with remediation are managed by operators through risk-management products provided by financial institutions. Some Member States implemented financial security by establishing a level of maximum liability (expressed as costs of remediation), and there is some interest in implementing financial security across the EU (BIO Intelligence Service et al, 2012) financed by contributions from target industry sectors. Such an initiative could be expanded to provide a template for broader NNL policy.

Beyond these specific actions that have already received attention, the review and potential revision of ELD implementation provides a broad opportunity to better integrate NNL considerations, or at minimum, to better harmonise ELD implementation with other policies that support NNL.

5.4.4 Policy options

Three policy proposals are discussed here, ranging from enhanced implementation of current requirements through better communication, guidance and enforcement, to extensions of the liability regime. It is noted that further extensions to those considered are theoretically possible (eg to include all ecosystem services and/or all biodiversity). However, this would go beyond current national classifications of protected biodiversity, and therefore might involve significantly higher administration costs. The options proposed are considered the most feasible given current policy approaches and political objectives.

ELD Policy Option 1: Enhancement of the implementation of the Directive, through awareness raising, improved guidance and enforcement

This measure would include better coordination of biodiversity NNL and ELD policies within Governments. Coordination could be improved through using a single system, or more similar systems, for assessing biodiversity impacts in ELD and other biodiversity policies (such as biodiversity offsetting). ELD experts usually have awareness of the Habitats Directive but otherwise limited biodiversity knowledge, and biodiversity experts usually have limited knowledge of the ELD. It could utilise the guidance currently under development and/or the planned proposals for revision of the ELD in 2014 to introduce greater harmonisation.

The implementation of the ELD could be enhanced through better guidance and promotion of its requirements within Member States. This could both increase awareness in implementing authorities leading to more efficient detection and handling of ELD cases, and in potentially liable companies. These companies can then be encouraged to take preventative action to avoid damages, increasing the deterrent effect of the Directive.

Policy Option Evaluation

Table 5-5 Evaluation of the effectiveness, efficiency and policy coherence of option ELD 1: Enhancement of the implementation of the Directive, through awareness raising, improved guidance and enforcement

Evaluation criteria	Assessment of policy option's potential contribution to NNL
1. Effectiveness	
Mitigation hierarchy stages	Avoidance of imminent threats, and mitigation of residual impacts. Long-term avoidance is also incentivised, though indirectly.
Land use impacts	Low impacts on land use.
Potential coverage and impacts on biodiversity	Moderate benefits for EU threatened biodiversity (primarily outside N2k sites) and low indirect benefits for other biodiversity.
Potential coverage and impacts on ecosystem services	Variable benefits from the restoration of habitats that provide ecosystem services and reduced incidents
Clarity	Good. This is an extension of existing activities and the policy option is specifically designed to improve understanding of ELD.
Measurability	Low. There is evidence of cases not being regulated under ELD due to lack of clarity on how ELD should be implemented. Any chance in rate of cases under ELD after this policy option is implemented, along with expert review, should allow at least a reasonable qualitative assessment of contribution to NNL.
Feasibility	High feasibility. Work towards this policy option is already underway through actions to support, review and improve ELD implementation.
Enforceability	No change from present.
2. Efficiency	
Unit costs	
Public: 1-off (€)	Low costs of developing and publicising guidance materials.
Public: Recurring (€/yr)	Additional costs of administering increased ELD activity.

Private: 1-off (€)	Low costs to revise internal management procedures.
Private: Recurring (€/yr)	Where greater deterrent effect, additional opportunity costs of not exploiting resources, but additional benefits of avoiding costs of compensating for damage, so potentially net gain.
Distribution of costs	ELD follows polluter-pays principal, and focuses on sectoral activities defined in Annex III of the Directive, primarily those involving dangerous or polluting substances.
Benefits (other than NNL)	
Economic activity	Limited impacts.
Jobs	Limited impacts.
Health/quality of life	Low-moderate benefits. Any damage with proven effects on human health are immediately deemed "significant" and remediation is required. Additional benefits arise from reduction in damage to environment that would reduce service beneficial to the public.
Other	
3. Coherence	The policy option is coherent with EU aims, but does not improve coherence across EU policies, which is still needed.

ELD Policy Option 2: Extension and clarification of damage significance threshold and equivalency methods to reflect NNL biodiversity objectives

The ELD only applies to impacts that are 'significant', but does not precisely define this term. It provides guidance on how to assess significance, but no guidance on what magnitude of damage constitutes the threshold for significant. As a result, various cases of environmental damage in the EU did not apply the ELD due to difficulty in demonstrating that the threshold was met (BIO Intelligence Services, 2013). Providing clear guidance on what constitutes significant damage would improve ELD implementation (and could be part of policy Option ELD 1). However, a major opportunity also exists to strengthen ELD's contribution to NNL by linking this definition of 'significance' to the definitions of NNL of biodiversity being developed in implementing the EU biodiversity strategy (including in this study). That is Policy Option ELD 2 discussed here.

ELD significance could be defined in relation to how objectives to achieve NNL of biodiversity are defined. Similar challenges in defining which biodiversity losses are most significant and therefore require stricter application of policy instruments are encountered in other policy instruments discussed in this study. For example, there are often thresholds of biodiversity damage above which certain types of biodiversity offsets methods should be applied. Consistency in defining these thresholds and ELD significance could both assist ELD implementation and assist with creating a level playing field in the use of policy instruments for NNL of biodiversity.

Additionally, to better align ELD with the other policy instruments that might be implemented for NNL, equivalency methods could be standardised. Specifically, the methodologies (eg the REMEDE Toolkit[75]) for assessing compensation under the ELD could be improved to reflect more international experience in NNL metrics, developed primarily

[75] http://www.envliability.eu/pages/about.htm

through offsetting and banking policies. Greater consistency across policy instruments would better support achieving NNL objectives.

Policy Option Evaluation

Table 5-6 Evaluation of the effectiveness, efficiency and policy coherence of option ELD2: Extension and clarification of damage significance threshold and equivalency methods to reflect NNL biodiversity objectives

Evaluation criteria	Assessment of policy option's potential contribution to NNL
1. Effectiveness	
Mitigation hierarchy stages	Avoidance of imminent threats, and mitigation of residual impacts. Long-term avoidance is also incentivised, though indirectly.
Land use impacts	Low impacts on land use
Potential coverage and impacts on biodiversity	Moderate benefits for EU threatened biodiversity (primarily outside N2k sites) and low indirect benefits for other biodiversity.
Potential coverage and impacts on ecosystem services	Variable benefits from the restoration of habitats that provide ecosystem services and reduced incidents.
Clarity	Good. The aim of this policy option is to increase clarity of the language in the ELD reported as most difficult to interpret. Additionally, harmonisation across instruments would increase clarity across entire policy scenario.
Measurability	Low-moderate. With additional effort reporting could include an assessment of whether cases under ELD2 would have been assessed as significant under the ELD. Additionally, old and revised equivalency methods could both be used to assess the difference in remediation due to choice of metric.
Feasibility	Possible with time. There is ample experience with ELD to draw on to improve definition of significance threshold, and that could be aligned with broader NNL instruments and objectives. For equivalency, there is ample experience in Europe and internationally to draw on in defining consistent method across NNL policy instruments.
Enforceability	Clarity should improve enforceability, but risk that strengthened requirements not accepted by stakeholders, including in private sector and certain political agencies.
2. Efficiency	
Unit costs	
Public: 1-off (€)	Low costs of adjusting regulations and developing and publicising guidance materials.
Public: Recurring (€/yr)	Additional costs of administering increased ELD activity, and enforcing higher standards.
Private: 1-off (€)	Low costs to revise internal management procedures.
Private: Recurring (€/yr)	Moderate additional opportunity costs of not exploiting resources for activities where damage is captured due to stronger significance threshold.
Distribution of costs	Polluter pays. Costs broadly in proportion to level of risk activities pose to the environment. Costs may be greater than activities posing risk.
Benefits (other than NNL)	
Economic activity	Low-moderate additional costs from loss of activities where damage is captured due to stronger significance threshold
Jobs	Low-moderate additional costs from loss of activities where damage is captured

	due to stronger significance threshold
Health/quality of life	Low-moderate benefits from reduction in damage to environment, and from reduction of perceived risks to quality of life.
Other	
3. Coherence	Policy option is specifically designed to increase coherence across biodiversity regulation (eg Birds and Habitats Directives, offsetting practice) through alignment of implementation rules (eg damage thresholds) and equivalency metrics.

ELD Policy Option 3: Extension of coverage of the Directive to include nationally protected biodiversity

This option would mandate Member States to apply the ELD to nationally protected biodiversity (habitats and species). This would have the advantage of complementing other national biodiversity protections. It could lead to inconsistencies in ELD implementation (with the same species being covered in some Member States but not others), although this can be argued to be appropriate in reflecting differences in biodiversity status and threats in different locations. Approximately half of Member States already apply ELD to national protected biodiversity (BIO Intelligence Services, 2013), so this simple policy option would increase the level and consistency of application of the ELD across the EU.

Policy Option Evaluation

Table 5-7 Evaluation of the effectiveness, efficiency and policy coherence of option ELD 3: Extension of coverage of the Directive to include nationally protected biodiversity

Evaluation criteria	Assessment of policy option's potential contribution to NNL
1. Effectiveness	
Mitigation hierarchy stages	Avoidance of imminent threats, and mitigation of residual impacts. Long-term avoidance is also incentivised, though indirectly.
Land use impacts	Low impacts on land use.
Potential coverage and impacts on biodiversity	Moderate to high benefits for nationally threatened species, low indirect benefits for other biodiversity.
Potential coverage and impacts on ecosystem services	Variable benefits from the restoration of habitats that provide ecosystem services and reduced incidents.
Clarity	Moderate. Although the policy option itself would be clear, new activities or authorities that might be involved would still have to grapple with the lack of clarity in the ELD itself.
Measurability	Moderate. An assessment of contribution to NNL should be feasible by comparing either 1) current Member States that apply ELD to nationally protected biodiversity and those that do not, or 2) cases of environmental damage before and after implementation of ELD3 in Member States that previously did not apply ELD to nationally protected biodiversity.
Feasibility	Possible with time, existing national biodiversity/environmental management expertise will need to expand as additional competent authorities are included.
Enforceability	Risk that expanded coverage will not be accepted by stakeholders, including in

	non-environmental/political governance.
2. Efficiency	
Unit costs	
Public: 1-off (€)	Low costs of adjusting regulations and developing and publicising guidance materials.
Public: Recurring (€/yr)	Additional costs of administering increased ELD activity, and enforcing higher standards.
Private: 1-off (€)	Low costs to revise internal management procedures.
Private: Recurring (€/yr)	Moderate additional opportunity costs of not exploiting resources for activities where damage is captured due to wider biodiversity coverage.
Distribution of costs	Polluter pays. Costs broadly in proportion to level of risk that activities pose to the environment. Costs may be greater than value of activities posing risk.
Benefits (other than NNL)	
Economic activity	Low-moderate additional costs from loss of activities where damage is captured due to broader coverage of ELD.
Jobs	Low-moderate additional costs from loss of activities where damage is captured due to broader coverage of ELD.
Health/quality of life	Low-moderate benefits from reduction in damage to environment, and from reduction of perceived risks to quality of life.
Other	
3. Coherence	Policy option will mean ELD is applied more evenly across the EU, reducing the “uneven playing field” of ELD implementation to which stakeholders currently refer.

5.5 Impact assessments and spatial planning

The Environmental Impacts Assessment (EIA) and Strategic Environmental Assessment (SEA) Directives both establish procedural requirements that aim to ensure that all projects, plans and programmes likely to have significant effects on the environment are subject to an environmental assessment prior to their authorisation. The EIA applies to projects (see definition in section 5.3 above) and the SEA applies to plans and programmes. Thus the two Directives are to a large extent complementary: the SEA is "up-stream" and identifies the best options at an early planning stage, and the EIA is "down-stream" and refers to the projects that are coming through at a later stage. The Directives do not *per se* require the avoidance or reduction of impacts, but this is the practical result to some extent.

Spatial planning is the public process for analysing and allocating the spatial and temporal distribution of human activities across a landscape or region. The aim is to use an ecosystem approach to develop a multi-sector strategy that balances and achieves environmental, economic and social objectives. Regarding EIAs and SEAs, spatial planning develops a high level plan that provides better context and direction to both.

5.5.1 Strengths

Existing measures for identifying, avoiding and reducing potential impacts

The **EIA Directive** on the assessment of the effects of certain public and private projects on the environment requires a systematic assessment of the likely environmental impacts of projects in a wide range of sectors. The typical steps taken in an EIA are shown in Box 5.3. This assessment must include consideration of impacts on flora and fauna, as well as other environmental components that form part of their habitat. It therefore provides an opportunity to recognise risks to flora and fauna due to a proposed development and to propose suitable measures to avoid or reduce them. The main benefit of the EIA process is that environmental considerations are taken into account in decision-making processes in a transparent way (COWI, 2009). Furthermore, EIAs (and SEAs – see below) normally identify potential mitigation measures, and sometimes offsetting measures, and although there is no obligation from the EIA itself to implement them, they can help to ensure that biodiversity losses are avoided or minimised. It is also possible for competent authorities to reject projects whose likely impacts are considered unacceptable or to require implementation of offsets through conditions on consent or other similar mechanisms. The EIA Directive has been reviewed and a proposal to amend it was published in October 2012[76].

Box 5.3. The principal steps in an Environmental Impact Assessment process

Source: EFTEC and IEEP et al (2010)

EIA Step	**Tasks**
1: Project screening	Determine whether significant impacts are likely and whether these merit formal impact assessment.
2: Scoping	Set terms of reference for the assessment. Review proposed project activities and likely implications in order to design an impact assessment which captures the main issues. Confirm consultation requirements.
3: Consideration of alternatives	Consider alternative locations, designs, methods, timeframes to avoid or minimise adverse effects.
4: Baseline review and population assessments	Define biodiversity distributions (temporal and spatial) and baseline conditions. Baseline = state and condition of biodiversity in the absence of the proposed project and accommodates trends, ie not just a static 'snapshot'.
5: Identification and prediction of main impacts	Identify ways in which the proposed project activities will drive changes in baseline conditions. Focus on key issues and provide evidence if possible.
6: Evaluation and assessment of impact significance	Apply the precautionary principle and consider criteria/set thresholds (adopted from existing legislation and policy where possible & appropriate) for determining significance.
7: Recommendations for mitigation and offsetting/compensation	Make suggestions in order to achieve 'no-net-loss' of biodiversity. Seek avoidance ahead of damage limitation or offsetting/compensation.
8: Production and review of Environmental Impact Statements	Produce a report documenting the results of the assessment. Ensure the EIA framework allows for consultation on the draft/peer review.
9: Decision making	Use the results of the EIA to support decision making.
10: Post-decision monitoring, auditing and follow-up	Ensure that the results of the EIA are built into environmental management systems for project implementation and operation. Review performance against any objectives and ensure mitigation measures have been implemented as proposed. Ensure there is a mechanism for remedial action if necessary.

[76] http://ec.europa.eu/environment/eia/pdf/com_628/1_EN_ACT_part1_v7.pdf

The **SEA Directive** extends EIA procedures and principles from projects to plans and programmes. It applies to a wide range of public plans and programmes that relate to activities covering specific sectors such as land use, transport, energy, waste, and agriculture. As a general rule, SEA is meant to inform higher level decision making at earlier stages of the policy planning process: it contributes to the systematic and structured consideration of environmental concerns in planning processes and better integration of environmental considerations upstream[77]. The process involves a number of steps and the most relevant ones for the inclusion of biodiversity consist of screening, scoping (including the development of the Environmental Report), consultation and monitoring (including data availability). A strength of SEA is that it has the potential to overcome many of the limitations of project-based EIA by providing opportunities for conservation and sustainable use of biodiversity to be considered as a fundamental part of strategic decision-making, rather than as a single specialist topic that needs considering on a more reactive basis. It also includes an explicit requirement to consider impacts on biodiversity.

For example, SEA can support and enhance EIA processes by:

- building biodiversity objectives into land-use, urban or sectoral policies, plans and programmes, at any point between international and local levels;
- identifying and managing cumulative impacts, which would be considered insignificant if assessed in isolation, but which may pose severe threats to biodiversity if assessed in combination with other similar impacts;
- identifying biodiversity-friendly alternatives and mitigation strategies that would be compatible with sustained delivery of ecosystem services;
- ensuring effective monitoring programmes are in place to provide information about biodiversity to inform baseline assessments carried out for EIA; and
- allowing biodiversity specialists and decision-makers and/or planners to engage and to develop a shared understanding of biodiversity requirements.

Importantly with respect to the achievement of NNL, the process of identifying and developing mitigation measures, including offsets, can normally be carried out in the first instance as part of the SEA process. SEA provides the best opportunities to consider alternatives that locate developments in areas that avoid significant impacts as much as possible, and if necessary to identify sites where offsetting could provide valuable benefits (South West Ecological Services et al. 2004). Detailed proposals for project-specific mitigation and offsetting should be identified and described in EIA (see Box 5.3) or an Appropriate Assessment as required under the Article 6.3 of the Habitats Directive (see section 5.3).

A further important value of SEA is that it complements other Directives and therefore provides scope for a coordinated approach. The SEA Directive has formal and explicit links with the Habitats and EIA Directives (see section 5.3 above). SEA is required (Article 3 (2a)) for any plan or programme which sets the framework for future development consent of projects listed in Annex I and II of the EIA Directive. It is also required for plans and

[77] http://ec.europa.eu/environment/eia/pdf/study0309.pdf

programmes which, in view of their likely effect on Natura 2000 sites, have been determined to require an assessment pursuant to Article 6 or 7 of Directive 92/43/EEC.

The SEA Directive is also closely linked to other directives (WFD, Nitrates, Waste, Noise and Air Quality Directives) which contain requirements for the establishment and assessment of plans and projects in sectors covered by the SEA (COM(2009) 469) and can be used to streamline other assessments. Article 11 of the SEA Directive, for example, stipulates that Member States may provide for coordinated and joint procedures in situations where an obligation to carry out assessments of the effects on the environment arises from both the SEA Directive and other Community legislation. The SEA Directive can therefore contribute to the systematic and structured consideration of environmental concerns (including biodiversity) in planning processes and better integration of environmental considerations upstream. In addition, by means of its requirements (environmental report, consultation and information of the authorities and public concerned etc.) it can help to harmonise planning procedures, contributing to more transparent and participatory decision making.

In an ideal situation, SEA and EIA processes are informed by high level **spatial plans**, which aim to support sustainable development and the maintenance of biodiversity and ecosystem services by taking an integrated and landscape approach to mapping out desired land uses over specific territorial area. These should go beyond traditional development plans that typically only consider housing, commerce and transport. Instead, best practice spatial plans consider all potential land uses in relation to a positive and long-term vision covering all economic, social and environmental needs. Spatial planning can play a particularly important role in the identification, protection and enhancement of Green Infrastructure and ecological networks. This can in turn contribute to the identification of areas that would most benefits for habitat restoration through offsetting, thereby potentially supporting offsetting policy options (as discussed in Section 5.10).

The concept of integrated spatial planning is supported and encouraged in the European Spatial Development Perspective (ESDP)[78], which was approved by the Informal Council of Ministers of Spatial Planning of European Commission in Potsdam in 1999. Although it had no binding status, the ESDP influenced spatial planning policy in European regions. The concept of spatial planning has been especially developed with respect to coastal and marine areas, including through various international and EU initiatives on Integrated Coastal Zone Management (ICZM), an EU Council Recommendation on ICZM in 2002[79], and most recently a draft proposal from the Commission adopted on 12th of March 2013 for a Directive establishing a framework for maritime spatial planning and integrated coastal management (see further discussion under Opportunities).

Existing measures identifying and addressing residual impacts

EIA, SEA and spatial planning for biodiversity help to ensure that the implications of consented activities could be recognised when these activities are planned. Spatial planning can further support efforts to achieve NNL outcomes, by ensuring that biodiversity needs

[78] http://ec.europa.eu/regional_policy/sources/docoffic/official/reports/pdf/sum_en.pdf
[79] http://ec.europa.eu/environment/iczm/rec_imp.htm

and objectives are reflected in decisions relating to a wider range of activities which might affect the use or allocation of environmental resources, not just those for which EIA or SEA are required. Not all Member States carry out explicit spatial planning for biodiversity, but where this does occur, there are opportunities to ensure that SEAs and EIAs for consented activities are consistent with national and EU biodiversity action plans and targets or with the maintenance or development of coherent networks. This can include identification and safeguarding of suitable areas for delivering biodiversity offsets or other compensatory measures or for identifying areas which are needed to meet local, national or EU biodiversity targets. Such areas might be prioritised to contribute to strategic planning objectives such as climate resilience or the provision of viable habitat for European Protected Species. When carried out as part of a rigorous and biodiversity-inclusive spatial planning system, SEA can play a very effective role in heading off adverse impacts on biodiversity and avoiding the need for expensive mitigation.

As discussed above, EIA and SEA do not directly address residual impacts, but provide a framework by which residual impacts may be identified, and quantified, and options to offset them elaborated. SEA and spatial planning provides a framework that can potentially support the strategic location of offsets.

5.5.2 Weaknesses

Existing measures for identifying, avoiding and reducing potential impacts

Several weaknesses can be identified in the current available impact assessment and spatial planning measures with respect to achieving NNL of biodiversity. An obvious gap is the omission of any explicit requirement to consider biodiversity in the EIA Directive. Instead, the requirement relates to assessment of impacts on flora and fauna and this has tended to result in a species-based approach with insufficient consideration of the implications of development for the three levels of biodiversity identified in the Convention on Biological Diversity (genes, species and ecosystems). Few EIAs carry out thorough assessments of impacts on biodiversity, including the cumulative impacts of a proposed project which may be considered insignificant when considered in isolation but which may be very significant in combination with the effects of other consented developments and other environmental changes which are not subject to EIA.

Another key weakness is that screening criteria and thresholds for the requirement to carry out impact assessments tend to be defined simplistically by the type or size of development, rather a more direct consideration of the likelihood that the specific development may have significant impacts. This means that several developments or sources of impacts are not subject to controls or requirements.

However, the most fundamental weakness is that EIA and SEA are process focussed instruments that aim to ensure that environmental issues are considered and described: there is NOT a mandatory legal requirement to actually avoid or reduce impacts let alone compensate for residual impacts. Thus they do not normally by themselves lead to NNL being achieved with respect to developments.

EIAs do lead to mandatory mitigation and compensation measures being taken where they link to another instrument that has such requirements, such as where a Natura 2000 site or nationally protected area may be affected. However, according to the Commission's 2009 *Report on the application and effectiveness of the EIA Directive* (European Commission, 2009a) the requirements of the Appropriate Assessment are often not taken properly into account in practice, in the context of EIA procedures. Furthermore, the EIA procedures focus on the impact on Natura 2000 sites, while the species protection provisions tend to be neglected.

A significant weakness of EIA is its limited ability to take into account cumulative impacts arising from other developments. SEA has a potentially important role to play in addressing such impacts. However, although integration between Appropriate Assessments and SEA is not considered to be problematical according to Member States (European Commission, 2009b) there is scope for improving the contribution that SEA makes to reducing cumulative impacts on the Natura 2000 network (Arcadis & IEEP, 2010).

Some of the problems concerning the treatment of biodiversity in EIA and SEA have been addressed through the publication of recent guidance (European Commission, 2013b; European Commission, 2013c). However, a more fundamental problem is that many Member States have not developed (or in the case of the UK, have scrapped) large-scale spatial plans that identify desired land uses with respect to environmental, social and economic needs. Therefore many SEA and EIA processes are conducted in the absence of high level spatial policy and related guidance. Furthermore, practical initiatives to promote and support spatial planning in the terrestrial environment appear to be no longer explicitly on the policy agenda. For example, although the EU's Green Infrastructure Strategy calls for Green Infrastructure concepts to be integrated into spatial planning it does not explicitly propose improving large-scale strategic spatial planning despite the obvious potential benefits.

Although some of the weaknesses with respect to EIA relate to the legislation and process, there are also significant problems with implementation (COWI, 2009), as for example illustrated in a recent study of EIA practices in Spain (Villaroya and Puig, 2010). There are particular problems regarding EIAs of agricultural developments. The EU's EIA legislation requires Member States to act to minimise environmental damage from agricultural developments and other 'projects' in rural areas including the restructuring of agricultural land and conversion of uncultivated or semi-natural habitats to intensive agricultural management. If implemented well, this should provide a strong legal underpinning to complement land management options within Pillar 1 and Pillar 2 of the CAP (see section 5.6 below). However, a recent analysis by IEEP (Baldock et al, 2013) found that despite the fact that it is a legal requirement under the Directive to ensure that a register of all screening applications and subsequent decisions is available in the public domain, such information could not be found for most Member States. The only information that could be found outside the UK was for the Republic of Ireland and for Germany.

Analysis of these countries' EIA information indicated that the frameworks and criteria for screening (shown in Table 5-8) of projects for restructuring or intensifying agricultural land is generally weak. Effectively this exempts most such projects and so the impact is not assessed (COWI, 2009; IEEP, 2010; Beaufoy et al, 2011).

Table 5-8: Thresholds applied for screening applications for the application of the EIA (Agriculture) Directive in the UK regions and Ireland

<table>
<tr><th rowspan="2">Country</th><th colspan="2">Thresholds</th></tr>
<tr><th>Restructuring of rural land holdings on agricultural land</th><th>Conversion of land: 'use of uncultivated land or semi-natural areas for intensive agricultural purposes'</th></tr>
<tr><td>Scotland</td><td>Sensitive areas:
• All restructuring projects within defined sensitive areas will be considered on a case by case basis

Non-sensitive areas:
Where a restructuring project involves :
• more than 200 hectares of land; or
• the movement of more than 5,000 cubic metres of earth or rock; or
• the construction or addition of more than 1km of vehicle track; or
• the removal of 0.5 km of hedges or dry-stane dyke or the removal or addition of 6km of other boundary features (eg fencing, walls, ditches or channels).</td><td>No threshold
For unimproved grassland, heath and moorland, land would be considered uncultivated if
(1) it had less than 30% of ryegrass (Lolium species) and/or white clover (Trifolium repens), or other sown species indicative of cultivation; or
(2) it has not been improved by management practices including liming or fertiliser.
To assist in determining whether the land is uncultivated using the above definition, the following guidance might be useful:
• Land has not been cultivated for around 12 - 15 years.
• The land has not been reseeded, drained or ploughed within this time period.</td></tr>
<tr><td>England</td><td>Sensitive areas:
• changes to two km or more of field boundaries;
• movements of 5,000 cubic metres or more of earth of other material in relation to land; or
• restructuring of an area of 50 hectares or more

Non-sensitive areas:
• changes to four kilometres or more of field boundaries;
• movements of 10,000 cubic metres or more of earth or other material in relation to land; or
• restructuring of an area of 100 hectares or more.</td><td>No threshold
Land is considered to be uncultivated if it has not been subject to physical or chemical cultivation in the last 15 years.

Cultivated land is that which has been cultivated by physical or chemical means.

There is a presumption that land is uncultivated land unless the responsible person can provide evidence that the land has been cultivated in the last 15 years. This might be done through witness evidence, statements from previous owners, tenants or other land managers, farm records, subsidy records, photographic evidence etc.</td></tr>
<tr><td>Wales</td><td>Sensitive areas:
• changes to two kilometres of field boundaries;
• movements of 5,000 cubic metres of earth or rock;
• restructuring of an area of 50 hectares.

Non-sensitive areas:</td><td>No threshold

Land is considered uncultivated or semi-natural if it contains less than 25 - 30% of improved agricultural grass species (for example rye grass and/or white clover), that are indicative of cultivation</td></tr>
</table>

Country	Thresholds	
	Restructuring of rural land holdings on agricultural land	**Conversion of land: 'use of uncultivated land or semi-natural areas for intensive agricultural purposes'**
	• changes to four kilometres of field boundaries; • movements of 10,000 cubic metres of earth or rock; • restructuring of an area of 100 hectares.	
Northern Ireland	**Environmentally valuable land:** • changes to two kilometres or more of field boundaries; or • restructuring of an area of 50 hectares or more. **Other land:** • changes to four kilometres or more of field boundaries; or • restructureing of an area of 100 hectares or more.	**No threshold** Land is considered to be uncultivated land if it has not been subject to physical or chemical cultivation in the last 15 years. Cultivation would include agricultural soil-disrupting activities such as ploughing, sub-surface harrowing, discing, or tining, as well as chemical enhancement of soil through the addition of organic or inorganic fertilisers and soil improvers. Cultivation would not include practices which do not directly affect the soil. Mowing grass, chain harrowing or clearing scrub or other vegetation would not in themselves be considered as cultivation of land.
Ireland	• Length of field boundary to be removed: Above 500 metres • Re-contouring (within farm-holding): Above 2 hectares • Area of land to be restructured by removal of field boundaries: Above 5 hectares	**Above 5 hectares** Land is considered to be uncultivated land if it has not been subject to mechanical or chemical cultivation (for example by ploughing or rotavating or by the addition of organic or chemical fertilisers) for at least 15 years.

Existing measures identifying and addressing residual impacts

As described above, a fundamental weakness with respect to the achievement of NNL is that EIA and SEA do not require that residual impacts from developments on biodiversity and ecosystem services are addressed (eg through offsetting). In other words they do not explicitly require NNL with respect to biodiversity or ecosystem services. In practice residual impacts are normally described in EIAs and potential offsetting measures may sometimes be identified, but actual resulting levels of offsetting are typically very low, as for example found in a study of road and rail projects in Spain (Villaroya and Puig, 2013).

5.5.3 Opportunities

EIA

The EIA Directive is currently being revised and proposals for amendments to the EIA Directive have already been prepared and published by the Commission[80]. The Commission's proposals recognise shortcomings that relate to the screening procedures, quality and analysis of the EIA and the risks of inconsistencies with the EIA process itself and in relation to other EU legislation. In particular the following specific deficiencies were identified (European Commission, 2009a):

- insufficient screening processes;
- a lack of harmonised practices public participation;
- poor quality of EIA processes and the information used in EIAs;
- difficulties with EIA transboundary procedures; and
- inconsistencies between the EIA and other environmental directives and policies, such as climate change and biodiversity.

In addressing these and other problems, the Commission has produced recommended amendments that would address some of the weaknesses of the current EIA Directive with respect to biodiversity and ecosystem services. Particularly importantly, to ensure coherence with EU biodiversity policies the proposed revisions explicitly give biodiversity and ecosystem services a more prominent role. The preamble to the proposal refers to the CBD targets and that the assessment of impacts should contribute to attaining the EU headline biodiversity target. The preamble also refers to measures that should contribute to avoiding any net loss of biodiversity.

Other important proposed amendments include the strengthening of screening procedures through the specification of screening criteria, the content of the screening decision and the timetable for screening. Measures to improve the quality of EIAs include mandatory 'scoping' by project promoters of the significant effects to be assessed and the methods to be used, and more precise specification of the contents of the EIA report. The reports must provide an assessment of reasonable alternatives and an improved justification for the final decision. Compulsory monitoring requirements are also introduced by the proposal to ensure a common approach in all Member States and to ensure that, after the implementation of mitigation and compensation measures, no impacts exceed those initially predicted.

The proposal also requires Member States to provide for coordinated or joint procedures. Under the coordinated procedure, the competent authority is required to coordinate the various individual assessments required by the EU legislation (including SEA, Birds and Habitats Directives, among others) and issued by several authorities. As part of this joint procedure, the competent authority has to issue one EIA, integrating the assessments of one or more authorities.

[80] http://ec.europa.eu/environment/eia/pdf/COM-2012-628.pdf

According to the Commission's impact assessment (European Commission, 2009a) the proposed amendments that are likely to have at least moderate environmental impacts are as follows (with the Commission's impact predictions in parentheses):

- adaptation of Annex I listing projects that must be subject to an EIA and Annex II listing projects must be subject to an EIA where Member States consider that their characteristics require them (Limited to High, depending on the nature of changes performed and the Member States concerned);
- modification to Annex III criteria for screening project types listed in Annex II (High);
- mandatory assessment of reasonable alternatives (High);
- treatment of additional environmental issues, in particular biodiversity with regard to the NNL objective (High);
- mandatory post-EIA monitoring (High);
- mandatory scoping (Moderate); and
- quality control of the EIA information (Moderate)

These proposals are therefore likely to improve the effectiveness of the Directive in terms of reducing impacts on biodiversity and ecosystem services. But as concluded at the NNL Stakeholder workshop (see Annex 10), further amendments would be needed, especially regarding the treatment of residual impacts, for EIAs to make a significantly greater contribution to the NNL objective. However, there is little possibility for introducing further measures now that would achieve this. In fact, at the time of writing this report a draft report on the Commission's proposals had been prepared by the European Parliament[81]. This largely supports the Commission's amendments (including welcoming the explicit consideration of biodiversity in EIAs) and makes some proposals to further strengthen some. For example, the Parliament agrees that the monitoring of significant adverse effects is important, but goes further to suggest that: 'Where the outcome of the monitoring indicates the presence of unforeseen adverse effects, provision should be made for appropriate corrective action to remedy the problem, in the form of additional mitigation and/or compensation measures.'

Given this situation there is a clear current opportunity to support the Commission's and Parliament's proposed reforms of the Directive that would support the NNL objective, and to support their implementation (eg through improved guidance and training etc). In the longer-term, more far reaching reforms might be possible and would be necessary for the instrument to make a significant contribution towards NNL. Therefore two separate EIA policy options are proposed below.

SEA

The SEA Directive is relatively new, being introduced in 2001, and delays with its transposition have constrained the assessment of its performance to date. Consequently, the last review by the Commission (in 2009) concluded that 'the application of the SEA in Member States is in its infancy, and that further experience is needed before deciding on

[81] http://www.europarl.europa.eu/meetdocs/2009_2014/documents/envi/pr/932/932755/932755en.pdf

whether the Directive should be amended and, if so, how this should be done.' (European Commission, 2009b). An updated review is expected in 2013 and should be able to draw on a growing body of experience. For instance Arcadis and IEEP completed a guidance document for DG Environment on how best to incorporate consideration of implications for the coherence of the Natura 2000 network into the SEA procedures, rather than focusing only on the site specific impacts of plans and programmes. Although the study has not been published by the Commission, its recommendations could form a starting point for further consideration of the role that SEA could play in supporting broader NNL goals.

As noted above, the Commission has put forward a proposal for a Directive on 'establishing a framework for maritime spatial planning and integrated coastal management' that would help to ensure biodiversity conservation and ecosystem service maintenance requirements are better taken into account in decision making on the location of marine activities. It is beyond the scope of this study to undertake a detailed analysis for the specific measures within the proposal but it is clear that an important policy option is to ensure that the Directive with its current aims and major components are adopted and implemented in an effective and timely manner.

Spatial planning

The draft proposal from the Commission for a Directive establishing a framework for maritime spatial planning and integrated coastal management will require Member States to establish coastal management strategies that build further on the principles and elements set out in the 2002 ICZM Recommendation and the Protocol to the Barcelona Convention on Integrated Coastal Zone Management[82], which was ratified by the EU in 2010.

Under the proposed directive:

- Member States will be required to establish and implement maritime spatial plans and integrated coastal management strategies.
- Maritime spatial plans should at least map the actual and potential spatial and temporal distribution of maritime activities in marine waters.
- Integrated coastal management strategies should at least contain an inventory of existing measures applied in coastal zones and an analysis of the need for additional action for the appropriate management of activities in coastal zones.
- The plans and strategies will need to be mutually coordinated, provided they are not integrated, and be reviewed at least every 6 years.
- All relevant stakeholders and authorities should be appropriately consulted on the draft plans and strategies and have access to the results once available.

[82] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:034:0019:0028:EN:PDF

- Plans and strategies should be based on best available data that should be collected, as far as possible, by making use of existing instruments established under other EU initiatives.

- Member States have to cooperate together and with third countries to ensure that plans and strategies are coherent across coastal zones and marine regions.

- Plans and strategies will need to be subject to applicable procedures in relation to SEA.

- Member States will need to designate the authority or authorities for the implementation of the Directive and will need to report to the Commission on the implementation of the Directive on a regular basis.

The term 'spatial planning' has been largely omitted from the political agenda with respect to terrestrial activities, but the concept is reflected in debates over territorial cohesion and is included in the Treaty of Lisbon. For example, as part of its sixth priority, the EU's Territorial Agenda for 2020[83] 'supports the integration of ecological systems and areas protected for their natural values into Green Infrastructure networks at all levels'. It also encourages integrated development in cities, rural and specific regions and supports the safeguarding and sustainable use of 'territorial capital' as well as the ecological functions that it provides.

5.5.4 Policy options

EIA Policy Option 1: Ensure key EIA reform proposals made by the Commission are adopted

As described above, the current proposal to amend the EIA Directive addresses some of the weaknesses regarding the treatment of biodiversity and ecosystem services. However, it is by no means certain that all of the Commission's proposals will be retained.

This first EIA policy option is simply to adopt and implement the Commission's 2010 proposals for amending the EIA Directive and in particular the elements that would probably make the greatest contribution to the NNL objective as listed above.

Policy Option Evaluation

Table 5-9 below summarises the likely potential impacts of the policy proposal, drawing largely from the Commission's proposal impact assessment (European Commission, 2013d) of the selected policy option (ie Option 2b).

[83] agreed at the Informal Ministerial Meeting of Ministers responsible for Spatial Planning and Territorial Development in Gödöllő, Hungary in 2011 http://www.mmr.cz/getmedia/fb9825b3-9d22-490d-bcd0-43528e505ea3/Uzemni-agenda-2020-(EN-verze)

Table 5-9 Evaluation of the effectiveness, efficiency and policy coherence of option EIA 1: Ensure key EIA reform proposals made by the Commission are adopted

Evaluation criteria	Assessment of policy option's potential contribution to NNL
1. Effectiveness	
Mitigation hierarchy stages	Primarily measures that avoid and reduce impacts.
Land use impacts	Wide-ranging, but primarily related to built infrastructure and urban and industrial development, which require EIAs (GHK, 2010).
Potential coverage and impacts on biodiversity	Moderate impacts on all habitats and species, but especially those not covered by the Birds and Habitats Directives.
Potential coverage and impacts on ecosystem services	Moderate direct benefits through the increased consideration of ecosystem services, and indirect benefits through improved protection of semi-natural ecosystems and biodiversity that underpin ecosystem services.
Clarity	High level of clarity. The weaknesses to EIA have been elaborated through long experience with the Directive, and the proposed revisions have been developed through a well-developed process engaging the public and stakeholders.
Measurability	Moderate. There is a long history of the EIA Directive, so a reasonable baseline against which to compare any changes. However, because it is a process oriented Directive, the measure will likely be in terms of a change in the defined processes (eg costs, number of EIAs, number of mitigation measures), and would be difficult to equate to a measure of biodiversity or ES benefits.
Feasibility	High (see Clarity, above).
Enforceability	High. Non-compliance is likely to be low and degree of acceptance high as project proponents already integrate EIA costs into project planning. Further, the competent authorities for EIA are already in place.
2. Efficiency	
Unit costs	
Public: 1-off (€)	Low costs of implementing and adjusting to revised Directive.
Public: Recurring (€/yr) (cumulative)	Savings of EUR 0.5 million to costs of EUR 2.5 million. Plus moderate to high (ie 5-25% over baseline) increase in costs due to coverage of additional environmental issues, but also moderate (ie 5-10% compared to baseline) savings from the "EIA one-stop shop".
Private: 1-off (€)	Low costs of adjusting to revised Directive.
Private: Recurring (€/yr) (cumulative)	Costs of EUR 44.3-81.6 million. Plus moderate to high (ie 5-25% over baseline) increase in costs due to coverage of additional environmental issues, but also moderate (ie 5-10% compared to baseline) savings from the "EIA one-stop shop".
Distribution of costs	Costs will fall mainly on the project proponent, particularly for infrastructure and development sectors that currently account for the majority of EIAs. Additional costs, however, only represent a marginal increase over total current costs.
Benefits (other than NNL)	
Economic activity	Significant positive impacts
Jobs	An industry is already developed around implementing and assessing EIAs, but some limited additional jobs may be created.
Health/quality of life	Moderate to significant benefits.
Other	Streamlining the EIA process will benefit the internal market and competiveness.
3. Coherence	The proposed revisions to the EIA Directive were assessed as highly coherent with other EU policy objectives, and by strengthening the process for identifying impacts on biodiversity would also be coherent with NNL.

EIA Policy Option 2: Wider future reforms of the EIA Directive

Assuming the currently proposed reforms are adopted, additional future reforms could provide further significant biodiversity and ecosystem service benefits. Such reforms could most obviously attempt to address the primary weakness of EIA, which is the lack of a mandatory requirement for the EIA process to result in NNL of biodiversity through measures to avoid and reduce impacts and compensate for unavoidable residual impacts. Indeed, the simple inclusion of an article in the Directive requiring this would appear to be a straightforward action that could result in a major step towards the achievement of the EU's NNL objective. However, legal advice from the Commission indicates that such a revision would result in a fundamental change in the aims of the Directive from a decision supporting process to one with a mandatory outcome. It is considered at this time such a change would not be possible for legal reasons, and therefore such a change is not put forward as part of this option.

Instead, it is suggested that this option would include the introduction of an explicit requirement to indicate how the mitigation hierarchy has been used to ensure a NNL outcome. This would include a requirement to document, in the EIA report, the measures proposed to avoid and mitigate for adverse impacts in cases where biodiversity would not be able to recover spontaneously post-development as well as measures proposed to offset or compensate for any residual adverse effects in order to achieve NNL. It would also include a more detailed requirement than currently included in the proposed EIA Directive amendments to indicate how the proposed measures will be implemented and their effectiveness monitored (individually and in terms of the achievement of NNL overall) and to suggest contingency measures needed in the event of a failure in achieving NNL. Member States would then be encouraged to link planning permission to the implementation of the identified mitigation and offsetting measures, and, if found to be necessary from the results of monitoring, further contingency measures needed to achieve NNL.

In addition, the following specific amendments based on relevant recommendations made in the 2013 Habitat Banking Demand, Supply and Design Study could be made:

- Widen the coverage of activities, including deforestation of large areas and offshore hydrocarbon production according to amendments to the Espoo convention, as well as golf courses and installations working with GMOs.
- Enlarge the scope to cover additional types of development by adapting the screening criteria (Annex III of EIA and Annex I of SEA).
- Ensure that the 'significant' impacts that should be offset 'if possible' are interpreted similarly throughout the EU (eg obligatory scoping procedure for EIA) and in a manner that contributes towards no net loss, either through modifying the wording, providing a clarification in the Annex (the SEA Directive Annex already partly explains 'significant'), or through a guidance document.

Policy Option Evaluation

Table 5-10 Evaluation of the effectiveness, efficiency and policy coherence of option EIA 2: Wider future reforms of the EIA Directive

Evaluation criteria	Assessment of policy option's potential contribution to NNL
1. Effectiveness	
Mitigation hierarchy stages	Primarily measures that avoid and reduce impacts, but the treatment of residual impacts would be improved.
Land use impacts	Wide-ranging, but primarily related to built infrastructure and urban and industrial development (the industries currently using the most EIAs; GHK, 2010).
Potential coverage and impacts on biodiversity	Moderate impacts on all habitats and species, but especially those not covered by the Birds and Habitats Directives.
Potential coverage and impacts on ecosystem services	Moderate direct benefits through the increased consideration of ecosystem services, and indirect benefits through improved protection of semi-natural ecosystems and biodiversity that underpin ecosystem services.
Clarity	Moderate, but dependent on clarity of new policy language. In addition to the amendments to the EIA in Policy Option 1, which are intended to increase clarity, this option includes language of "significant impacts" and an offsetting mechanism. Historically, clarifying significant impacts has not been clear (eg for ELD); and an offsetting mechanism outside BHD would be new. Care needs to be taken to ensure that future reforms do not reduce the clarity introduced by the immediate proposed amendments.
Measurability	Moderate-high. As described above, the amendments to improve the process of EIA will be measurable but potentially difficult to link to measures of NNL. The additional reforms in Policy Option 2 would be more directly related to achieving NNL and introduce new measures within EIA. Building on the long history of EIA, a reasonable baseline could be constructed against which actions under the new measures could be compared.
Feasibility	Moderate. Some new training may be necessary for both public and private sectors in relation to some elements of this policy option, particularly offsetting. Additionally, some industries and activities not previously covered under the EIA would be included so need to gain capacity. Similar to Policy Option 1, however, it builds on a strong history and industry around EIA that already exists, so the shift is feasible.
Enforceability	Going beyond the procedural basis of EIAs and introducing specific requirements related to impacts on biodiversity could face some resistance. Specifically, defining a level of "significant impacts" and a registry of commitments and offsetting could incentivise the impacted industries to report lower than actual impacts. Additionally, the adaptation of Annexes 1 and 2 may not be accepted. Similar proposals, including specifically an expansion of Annex 1, were widely rejected by stakeholders during the IA of proposed revisions to the EIA Directive (EC, 2012).
2. Efficiency	
Unit costs	
Public: 1-off (€)	Low costs of implementing and adjusting to revised Directive.
Public: Recurring (€/yr) (cumulative)	EC (2012) estimated that the proposed reforms in Policy Option 1, plus adaptation of Annexes 1* and 2 would cost the public sector EUR 34.9-44 million/year. Plus moderate to high (ie 5-25% over baseline) increase in costs due to coverage of additional environmental issues, but also moderate (ie 5-10% compared to baseline) savings from the "EIA one-stop shop".

Private: 1-off (€)	Low costs of adjusting to revised Directive.
Private: Recurring (€/yr) (cumulative)	EC (2012) estimated that the proposed reforms in Policy Option 1, plus adaptation of Annexes 1* and 2 would cost the private sector EUR 178-241.5 million/year. Plus moderate to high (ie 5-25% over baseline) increase in costs due to coverage of additional environmental issues, but also moderate (ie 5-10% compared to baseline) savings from the "EIA one-stop shop".
Distribution of costs	The costs would still be more evenly spread across all sectors, compared to current EIA situation or Policy Option 1.
Benefits (other than NNL)	
Economic activity	Significant positive impacts.
Jobs	An industry is already developed around implementing and assessing EIAs, but some limited additional jobs may be created.
Health/quality of life	High benefits.
Other	Streamlining the EIA process will benefit the internal market and competiveness
3. Coherence	The proposed revisions to the EIA Directive were assessed as highly coherent with other EU policy objectives, and by strengthening the process for identifying impacts on biodiversity would also be coherent with NNL.

* "These estimates are based on the assumption that 10 % of the projects undergoing a screening are moved to Annex I and are subject to an EIA; the costs can be very high, if 15-20 % of the projects screened are subject to an EIA." (EC, 2012; Table 11; pg. 44).

EIA Policy Option 3: Improve implementation of the EIAs through awareness raising and enforcement, especially for agriculture

As described above, some developments, especially relating to agriculture and forestry are not subject to EIAs when they should be. This may be the result of a lack of awareness amongst project proponents (especially landowners) of the need for EIAs, but also inappropriate screening criteria and thresholds, and screening decisions by authorities. This option would therefore increase awareness of the EIA Directive and the developments and activities that require EIAs. It would also include measures to encourage project proponents to seek screening decisions and ensure environmental authorities in Member States strengthen screening criteria and improve decision making.

Policy Option Evaluation

Table 5-11 Evaluation of the effectiveness, efficiency and policy coherence of option EIA 3: Improve implementation of the EIAs through awareness raising and enforcement, especially for agriculture

Evaluation criteria	Assessment of policy option's potential contribution to NNL
1. Effectiveness	
Mitigation hierarchy stages	Primarily measures that avoid and reduce impacts.
Land use impacts	Primarily a constraint on land intensification projects (eg irrigation, drainage, ploughing of semi-natural grasslands) and also some afforestation.
Potential coverage and impacts on biodiversity	Moderate-high impacts on habitats and species associated with semi-natural agricultural habitats, especially outside N2K sites.
Potential coverage and impacts on ecosystem services	Moderate benefits through improved protection of semi-natural ecosystems and biodiversity that underpin ecosystem services.
Clarity	High. The option is aimed specifically at better communication and awareness raising.
Measurability	Moderate. The incidence of EIAs in the targeted sectors could be compared to historical baseline to determine effect of policy.
Feasibility	High. Does not require any new capacity to implement.
Enforceability	High. There would be minimal resistance and increased awareness raising could support better reporting.
2. Efficiency	
Unit costs	
Public: 1-off (€)	Minimal, to implement an awareness raising initiative.
Public: Recurring (€/yr)	Minimal, to maintain resources, and there may be some costs to public sector to manage increased number of EIA applications, if cost recovery is not used.
Private: 1-off (€)	Minimal, to adapt to increase use of EIAs.
Private: Recurring (€/yr)	Minimal. GHK (2010) found that EIAs cost on average 1% of project costs. So sectors that are targeted by awareness raising and may carry out more EIAs could experience some additional costs of that magnitude per project.
Distribution of costs	Additional costs would apply primarily to certain sectors, like agriculture and forestry, but these costs should already be experienced.
Benefits (other than NNL)	
Economic activity	Low increase if more EIA work is carried out.
Jobs	GHK (2010) found that the average annual number of EIAs per public sector staff is 4, so there may be some increase in civil sector job creation. Additionally, there may be low additional demand for sector EIA specialists in the private sector.
Health/quality of life	Low, but positive. The sectors in need of increased awareness and enforcement are, compared to other sectors, more relevant for land use and subsequent values, eg recreation.
Other	n/a
3. Coherence	Coherent, and includes a small degree of strengthening coherence between policies, to achieve EU objectives.

SEA Policy Option 1: Improved implementation of SEA through capacity building and guidance

Despite the limited experience of SEA implementation that could be referred to, the last review of the implementation of the Directive noted there are opportunities to improve the Directive which could 'take into account the entry into force of the SEA Protocol, extend the scope of the SEA Directive (so as to better address certain issues such as climate change, biodiversity and risks), and reinforce synergies with other pieces of environmental legislation. In this regard, the following recommendations could be considered:

- The entry into force of the SEA Protocol may result in changes to the SEA Directive. Potential additional amendments to the SEA Directive could be considered. Some of these amendments could be incorporated as part of the review of the EIA Directive, for instance through amendments to its Annexes.

- The SEA Protocol goes further than the SEA Directive, in that it also encourages potential application to certain policies and legislative proposals. The fact that the SEA Directive does not apply to policies which set the framework of P&P makes it necessary to consider the possible inclusion of policies and legislation in the application of the Directive as an option for the future.

- There is a need to develop capacity in the Member States so as to ensure effective implementation of the SEA Directive. In order to do this, capacity building must be strongly encouraged, in particular through targeted campaigns for the recruitment and training of SEA experts and guidance documents.

- Finally, some Member States have highlighted the need for further guidance, in particular on the interpretation of certain key concepts of the Directive (screening criteria, identification of alternatives, coordination mechanisms and/or joint procedures for fulfilling the requirements for assessment under other Directives, specific guidance on the link between SEA and EIA). EU guidance on consideration of better integration of climate change and biodiversity issues in SEA could be developed by the Commission in cooperation with the Member State. Another area of uncertainty is the requirement to consider alternatives and the level of information needed to assess alternatives to an adequate extent.

There is limited guidance available on best practice approaches to SEA for biodiversity and ecosystem services as well as little documented information on how objectives and outcomes for these have been formulated in the SEA process. For example, one of the potential benefits of SEA is the streamlined provision of baseline data that can then be used in EIAs without the need for duplication. However, this benefit is often not realised in practice due to a lack of mechanisms for effective information exchange and sharing. Guidance for Member States on how to identify land suitable for compensation and ensure that this is recognised in SEA, as well as land already protected for biodiversity, would also help to strengthen the role of SEA in enabling achievement of NNL.

Policy Option Evaluation

Table 5-12 Evaluation of the effectiveness, efficiency and policy coherence of option SEA 1: Improved implementation of SEA through capacity building and guidance

Evaluation criteria	Assessment of policy option's potential contribution to NNL
1. Effectiveness	
Mitigation hierarchy stages	All stages.
Land use impacts	Wide-ranging, but primarily related to built developments and extractive industries.
Potential coverage and impacts on biodiversity	Moderate benefits for all levels of biodiversity.
Potential coverage and impacts on ecosystem services	Moderate benefits through the better use and protection of ecosystems and their associated services.
Clarity	High. The option is designed to improve clarity of SEA.
Measurability	Low. It is difficult to identify, and thus measures, positive improvements caused by improved guidance and capacity building.
Feasibility	High. Can build off central EU capacities already in place, and relatively easy and quick to implement.
Enforceability	Should be broadly accepted and does not introduce any new requirements, so enforceability is not a concern.
2. Efficiency	
Unit costs	
Public: 1-off (€)	Limited impacts of developing improved guidance.
Public: Recurring (€/yr)	Depending on measures could be EUR 0-500,000 / year (Arcadis, ECNC, eftec, in prep).
Private: 1-off (€)	Low impacts of improving internal management procedures.
Private: Recurring (€/yr)	Limited impacts of implementing improved guidance, and of slightly increased opportunity costs of lost activity.
Distribution of costs	No change from present.
Benefits (other than NNL)	
Economic activity	Negligible increase in need for services.
Jobs	Negligible increase in jobs.
Health/quality of life	Potential small increases due to preservation of strategically located ecosystems and their associated services Green Infrastructure.
Other	
3. Coherence	Moderate. Improves application of SEA, and is not incoherent with EU policies, but does not improve the situation much from current level of policy coherence.

SEA Policy Option 2: Improvements to the SEA Directive, through improved screening criteria

Member States have some flexibility concerning the application of SEA and can, to some extent, define plans and programmes so that the need for SEA is avoided. This potential loophole could be avoided by improving screening criteria, with a greater emphasis on the characteristics of affected areas (including their role in safeguarding biodiversity) rather than on the type of plan concerned.

While it is clear that for all plans, having a potential impact on the coherence of the Natura 2000 network which might lead to significant impacts on Natura 2000 sites, an Appropriate Assessment and an SEA should be prepared, the identification of situations where such significant impacts might occur is not necessarily straightforward. A recent report for the European Commission concludes that, when screening a plan to establish the need for SEA, it is important to consider the implications of planned activities for affected areas in between Natura 2000 sites as well as the sites themselves (Arcadis & IEEP, 2010). These may be located some distance from designated sites, but have ecological functions that are nevertheless essential to achieve conservation goals. Due to the complexity of the issue it is difficult to develop a methodology that allows screening in a reasonable time-frame in a way that can reliably ascertain whether or not there are likely to be significant impacts on the coherence of the Natura network. Guidance could therefore be usefully developed on methods for assessing potential Natura 2000 coherence impacts and the application of the precautionary principle to such issues. This should be supported by efforts to improve awareness about possible functional roles of land outside Natura 2000 sites in terms of maintaining the coherence of the network.

The extension of SEA to policies could improve the extent to which NNL outcomes for biodiversity and ecosystem services is recognised and integrated with planning policy. SEA could also be improved by requiring explicit consideration of those alternatives most likely to result in a NNL outcome, thereby improving the extent to which 'best possible outcomes' might be recognised and factored into planning and decision-making, as opposed to an emphasis on the 'best of the worst'.

Policy Option Evaluation

Table 5-13 Evaluation of the effectiveness, efficiency and policy coherence of option SEA 2: Improvements to the SEA Directive, through improved screening criteria

Evaluation criteria	Assessment of policy option’s potential contribution to NNL
1. Effectiveness	
Mitigation hierarchy stages	All stages.
Land use impacts	Wide-ranging, but primarily related to built developments and extractive industries.
Potential coverage and impacts on biodiversity	Moderate benefits for all levels of biodiversity.
Potential coverage and impacts on ecosystem services	Moderate benefits through the better use and protection of ecosystems and their associated services.
Clarity	Moderate. Improving the screening procedure would require improved language and guidance. Inclusion of a specific NNL consideration, however, will require care to ensure clarity.
Measurability	Low. Difficult to measure direct impact on NNL, however, a measure of the change in number of SEAs and other procedural measures could be developed.
Feasibility	High. Could be carried out with current expertise.
Enforceability	Low-Moderate. Certain sectors and Member States could reject tightening of screening loopholes to permit preferred outcomes for regional planning. Additionally, if NNL considerations are included, this could also be perceived as tightening of the rules, and rejected by the same stakeholders. It might be difficult for EU to enforce.
2. Efficiency	
Unit costs	
Public: 1-off (€)	Negligible costs of developing improved guidance (EU) or adjusting procedures (MS).
Public: Recurring (€/yr)	Low, due to increase in number and extent of SEAs. Committee of the Regions (2010) reports that SEAs lead to a 0.1-1% increase in relevant costs, while COWI (2009) reports that SEAs cost EUR 3,000-100,000 each.
Private: 1-off (€)	n/a
Private: Recurring (€/yr)	Negligible-low, increased opportunity costs of lost activity.
Distribution of costs	
Benefits (other than NNL)	
Economic activity	Possible low, negative impacts: low increase in demand for expertise in carrying out SEAs, but potential cost of lost activities.
Jobs	Possible low, negative impacts: low increase in demand for expertise in carrying out SEAs, but potential cost of lost activities.
Health/quality of life	Potential increases due to preservation of strategically located ecosystems and their associated services Green Infrastructure.
Other	
3. Coherence	As SEA 1

Spatial Planning Policy Option 1 (SP 1): Adoption and implementation of the proposed Directive establishing a framework for maritime spatial planning and integrated coastal management, the Marine Spatial Planning Directive

This policy option would primarily aim to ensure that the Directive is adopted with its current objectives and major components, and then implemented in an effective and timely manner.

In addition the Commission could encourage Member States (eg through published guidance) to include in their national strategies the comprehensive identification of habitats, species and ecosystem services that require protection (as a minimum including nationally threatened biodiversity) and therefore explicit consideration in SEAs and EIAs. The plans could also identify areas that would most benefit from restoration (thereby contributing to restoration and the enhancement of Green Infrastructure in accordance with Target 2 of the biodiversity Strategy and) and could therefore be targeted areas for offsets. EMFF funds could also be targeted (with favourable co-financing rates) to such areas particularly where they could provide wide-ranging ecosystem service benefits.

Policy Option Evaluation

Table 5-14 Evaluation of the effectiveness, efficiency and policy coherence of option SP 1: Adoption and implementation of the proposed Marine Spatial Planning Directive

Evaluation criteria	Assessment of policy option's potential contribution to NNL
1. Effectiveness	
Mitigation hierarchy stages	All stages.
Land use impacts	All marine and coastal habitats and activities potentially environmentally impacted.
Potential coverage and impacts on biodiversity	Moderate-high, wide-ranging benefits on marine and coastal habitats and species, but the main added benefits would be for those that are not covered by the Habitats and Birds Directives.
Potential coverage and impacts on ecosystem services	Wide-ranging moderate-high benefits for all significant ecosystem services.
Clarity	Moderate. Clarity will depend largely on the how easy it is to understand the framework directive. Following the preferred policy option on the IA of marine spatial planning policy options, however, this option also includes providing guidance and elaboration of best practice. Presumably when implemented in conjunction with a framework directive, guidance would include information on interpretation and implementation of the directive.
Measurability	Low. High-level spatial planning is seen as essential to long-term NNL, but mainly as a procedural tool that broadly supports planning decisions, so direct impact on achieving NNL is difficult to measure.
Feasibility	Moderate-high. Marine spatial planning is already being implemented in some Member States, aided by more powerful GIS tools. Diffusion may require capacity building and training in other MS, but is feasible.
Enforceability	Should be accepted, particularly as the elements of the policy option should

	reduce some costs through EU-wide coherent coastal management.
2. Efficiency	
Unit costs	
Public: 1-off (€)	Establishment of ICZM full implementation is estimated to cost EUR 15-150 million, costs of MSP unclear, but annualised estimate for UK only is available (see recurring costs)(European Commission, 2013e).
Public: Recurring (€/yr)	Net savings. Operational costs of full ICZM implementation is EUR 5-10 million annually, annualised costs of MSP in UK only is ~EUR 5 million (European Commission, 2013e). It is noted that the estimated benefits of MSP in the UK are 4-5 times greater than the costs. If that benefit-cost ratio is applied across the EU, it implies that just the benefits of MSP alone would be greater than the costs of both MSP and ICZM.
Private: 1-off (€)	Low, adjust management procedures to fit with new MSP processes.
Private: Recurring (€/yr)	Moderate, adjustment of activities to new spatial planning constraints. Impacts on existing activities may be moderate, but may limit potential rapid expansion of marine industries.
Distribution of costs	Administrative costs will fall on Member State governments. Private sector costs will only be incurred for coastal activities, and generally focused in the fisheries, transport and energy sectors.
Benefits (other than NNL)	
Economic activity	Net increase. Some opportunity costs may occur due to reductions in constrained activities. Sizeable gains are predicted, however, due to lowering of transaction costs on the order of EUR 0.17-1.3 billion (annually) by 2020 (European Commission, 2013e). Additionally, regulatory certainty is estimated to increase investment in maritime industries by EUR 0.155-1.6 billion (annually) by 2030.
Jobs	Net increase due to increased investment in maritime industries.
Health/quality of life	Maintain sustainable fish stocks and health of marine environment as recreational and cultural resource.
Other	Decreasing transaction costs and increasing regulatory certainty could have knock-on positive effects for other industries.
3. Coherence	High coherence with implementation of the EU Integrated Maritime Policy, and regional commitments (eg Barcelona Protocol on ICZM for the Mediterranean in 2010), support for the MFSD, renewable Climate Change policy and key components of the Biodiversity Strategy, include Target actions relating to Green Infrastructure. May be some conflicts with existing maritime sector regulations (eg for hydrocarbon exploitation) so need to integrate regulations.

Spatial Planning Policy Option 2 (SP 2): Promotion of best practice by Member States

As described above, landscape-scale integrated spatial planning in the terrestrial environment has the potential to provide many environmental benefits, including more effective strategic protection of biodiversity and ecosystem services and the identification of priority areas for restoration and Green Infrastructure enhancement. Such priority areas could be target areas for offsetting (as for example carried out in Berlin - see Box 5.4) or agri-environment schemes. Furthermore, as recognised for the marine environment, spatial planning can provide social and economic benefits by encouraging investment (by instilling predictability, transparency and clearer rules), improved coordination and increased crossborder cooperation. Such benefits may also apply to the terrestrial environment. For example, although many marine areas are a shared resource, land typically also provides a range of ecosystem services beyond the most obvious primary land use (eg water resources, carbon sequestration, landscape aesthetics values etc).

However, the European Commission has little competency over planning issues and there does not appear to be a clear political mandate for an initiative on spatial planning in the terrestrial environment. Therefore the first option put forward here is to encourage and facilitate the adoption of good practice spatial planning across the Members States. This could be achieved by:

- Preparation of Commission guidance on spatial planning, indicating its potential benefits and most effective approaches and practices.

- Development of spatial planning mapping tools (eg relating to the identification of Green Infrastructure).

- Development of a knowledge exchange platform on spatial planning, for Member States and experts to share experiences and lessons and showcase the most successful example of Spatial Planning.

- Greater enforcement of environmental legislation that would benefit from Spatial Planning, such as the protection of landscape features under Article 10 of the Habitats Directive (see above).

Box 5.4 Berlin Compensation Concept

In order to concentrate and manage compensation measures in the context of sustainable urban planning, the Berlin Senate Department for Urban Development has developed a so-called General Urban Mitigation Plan, which complements the Berlin Landscape Program 2004. The development objectives and measures were grouped by types of impact and types of compensatory measures. From the perspective of the city as a whole, areas and measures have priority when they qualify and complement components of the Berlin open space system. Special priority is given to measures which improve the quality of the inner city as is shown below.

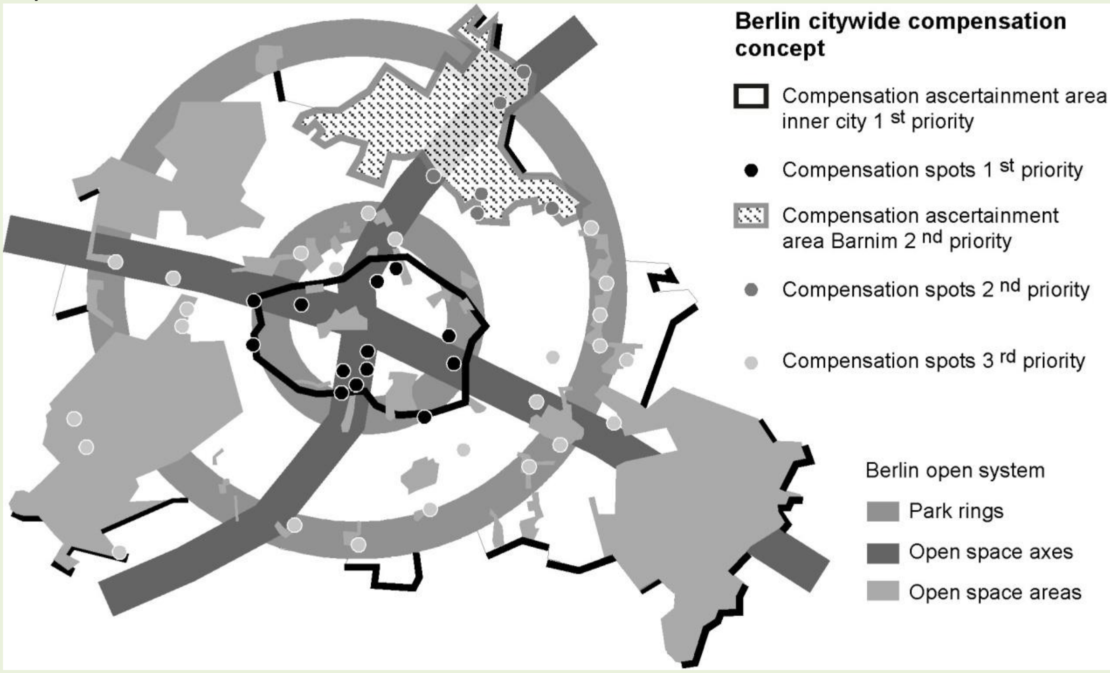


Figure. General Urban Mitigation Plan Berlin (Senatsverwaltung für Stadtentwicklung und Umwelt 2004, adopted)

Compensation areas of secondary priority are areas of the green and open-space system within the Berlin-Barnim Recreation Area in the northeast of Berlin. In addition to these two compensation ascertainment areas are the Green Axis Cross and the Inner and Outer Park Rings, which are to be developed and completed; this is where the third priority compensation areas are located.

Generally, these areas should be selected for their demonstrable environmental and conservation-related enhancement potential. In cases of structural interventions in the urban open space, and impacts on the environment, compensation measures are now to be developed according to this strategy. The respective “perpetrator” of the impacts, generally a private investor, must bear the costs for these measures in such cases. The measures are checked and documented in the Berlin register of compensation areas of the Senate Department for Urban Development. That ultimately ensures the permanent safeguarding of these environmental and nature-improving measures (Senatsverwaltung für Stadtentwicklung und Umwelt 2004).

Source: Senatsverwaltung für Stadtentwicklung und Umwelt, 2004 Berlin

Policy Option Evaluation

Table 5-15 Evaluation of the effectiveness, efficiency and policy coherence of option SP2: Promotion of best practice by Member States

Evaluation criteria	Assessment of policy option's potential contribution to NNL
1. Effectiveness	
Mitigation hierarchy stages	All stages.
Land use impacts	All terrestrial habitats and activities potentially environmentally impacted.
Potential coverage and impacts on biodiversity	Wide-ranging, low-level benefits, particularly for habitats and species that are not covered by the Habitats and Birds Directives.
Potential coverage and impacts on ecosystem services	Wide-ranging, low-level benefits for all related ecosystem services.
Clarity	High, the option is explicitly to provide guidance.
Measurability	As with marine spatial planning, this policy action occurs at a high level. So although implementation is important, it is difficult to directly link spatial planning to NNL.
Feasibility	High, providing guidance should be generally within the capacity of current authorities.
Enforceability	High. The plan is voluntary, so no issue of meeting or missing obligations, and little resistance from target sectors.
2. Efficiency	
Unit costs	
Public: 1-off (€)	Low. Impact assessment of marine spatial planning framework directive indicated that up-front costs (of ICZM implementation) are expected to be EUR 2-22 total for MS (European Commission, 2013e).
Public: Recurring (€/yr)	Low. Impact assessment of marine spatial planning framework directive indicated that annual costs to Member States (for MSP and ICZM implementation) are expected to be EUR 3-6 annually (European Commission, 2013e); and negligible for EU support (no more than EUR 0.5 million annually, and likely of the order of EUR 10,000s) (Lammerant et al, 2013).
Private: 1-off (€)	Negligible (based on similar policy option for marine spatial planning in EC, 2013).
Private: Recurring (€/yr)	Negligible (based on similar policy option for marine spatial planning in EC, 2013).
Distribution of costs	The minor costs that may occur would be spread across all relevant sectors, including housing, energy, infrastructure, etc.
Benefits (other than NNL)	
Economic activity	Limited impacts
Jobs	Limited impacts
Health/quality of life	Limited, but actions that are taken could have amenity and cultural value.
Other	n/a
3. Coherence	This is consistent with the objectives of Europe 2020 and the Resource Efficiency Roadmap, would implement components of the ESDP and Territorial Agenda for 2020, support SEA and EIA processes and enhance many actions included in the Biodiversity Strategy, most notably relating to Green Infrastructure.

Spatial Planning Policy Option 3 (SP 3): Development of a Directive establishing a framework for terrestrial spatial planning

Although, as noted above, there does not appear to be a clear political mandate for an initiative on spatial planning in the terrestrial environment, there is a case for proposing the development of a 'framework type' Directive on Spatial Planning. Such a Directive would be more effective than guidance proposed under Spatial Planning Option 2 in ensuring better coordinated, consistent and stronger spatial planning, which would support the achievement of several EU polices. Such a "framework-type" Directive would set general obligations and providing guidance for specific implementation by Member States thereby facilitating predictability, stability and transparency. But in accordance with principles of subsidiarity it would maintain flexibility and allow Member States to choose their approaches to achieving the overall aims and specific objectives of the Directive.

Under this policy option a Directive would be established with similar aims to those of the framework for marine spatial planning, that could include requirements for Member States to:

- develop, through an ecosystem-based approach, spatial plans and integrated management strategies, which aim to facilitate the co-existence and prevention of conflicts between competing sectoral activities;
- collate data and exchange information that supports spatial planning;
- consult with the public over the development of spatial pans and strategies;
- cooperate with bordering Member States; and
- subject the plans to SEA.

Policy Option Evaluation

Table 5-16 Evaluation of the effectiveness, efficiency and policy coherence of option SP 3

Evaluation criteria	Assessment of policy option's potential contribution to NNL
1. Effectiveness	
Mitigation hierarchy stages	All stages.
Land use impacts	All terrestrial habitats and activities potentially environmentally impacted.
Potential coverage and impacts on biodiversity	Wide-ranging potentially moderate-high benefits for terrestrial habitats and species, but the main added benefits would be for those that are not covered by the Habitats and Birds Directives.
Potential coverage and impacts on ecosystem services	Wide-ranging moderate-high benefits for all significant ecosystem services.
Clarity	Moderate. Clarity will depend largely on the how easy it is to understand the framework directive. Following the preferred policy option on the IA of marine spatial planning policy options, however, this option also includes providing guidance and elaboration of best practice. Presumably when implemented in conjunction with a framework directive, guidance would include information on interpretation and implementation of the directive.
Measurability	Low. High-level spatial planning is seen as essential to long-term NNL, but

	mainly as a procedural tool that broadly supports planning decisions, so direct impact on achieving NNL is difficult to measure.
Feasibility	Moderate-high. Marine spatial planning is already being implemented in some Member States, aided by more powerful GIS tools. Diffusion may require capacity building and training in other MS, but is feasible.
Enforceability	Should be accepted, particularly as the elements of the policy option should reduce some costs through EU-wide coherent coastal management.
2. Efficiency	
Unit costs	
Public: 1-off (€)	Low, establishing new powers and governance capacity to implement terrestrial spatial planning.
Public: Recurring (€/yr)	Low costs, and net gains in long run – additional governance capacity to implement terrestrial spatial planning will incur short-term costs, but that should lead to cost savings in the middle and long term.
Private: 1-off (€)	Low, adjust management procedures to fit with new terrestrial spatial planning processes.
Private: Recurring (€/yr)	Moderate, due to adjustment of activities to new spatial planning constraints, but net gain in mid to long term due to lower transaction costs and increased regulatory certainty.
Distribution of costs	Administrative costs will fall on Member State governments. Private sector costs will be spread across all sectors affected by terrestrial spatial planning, including housing, energy, infrastructure, etc.
Distribution of costs	
Benefits (other than NNL)	
Economic activity	Net increase. Some opportunity costs may occur due to reductions in constrained activities. Based on research for a similar marine directive (EC, 2013) sizable gains are predicted due to lowering of transaction costs on the Additionally, regulatory certainty is estimated to increase investment in the long term.
Jobs	Net increase due to increased investment.
Health/quality of life	Maintain health of terrestrial environment as recreational and cultural resource, may also include direct benefits through healthier soil and water.
Other	n/a
3. Coherence	High coherence by providing backbone to support SEA and EIA.

5.6 The Common Agricultural Policy (CAP)

The Common Agricultural Policy (CAP) is one of the key EU policies by which to influence land management, and therefore the management of biodiversity and ecosystem services associated with agricultural land as well as forests and other wooded areas in the EU (see section 0 for forestry-specific policies). The CAP budget, although reduced following the recent MFF discussions, is the second largest of any of the EU policies and accounts for just under 38% of the EU budget as a whole. The CAP is implemented in all EU Member States and regions. A major reform of all elements of the CAP is in the process of being concluded, with the new provisions due to run from 2015 – 2020, with transitional rules in place for 2014.

The CAP plays a major role in supporting biodiversity conservation and the maintenance of ecosystem services in the EU. The geographic scope and thematic focus of the policy, alongside the budgetary resources devoted to it, make the CAP one of the key tools available for Member States to achieve a variety of environmental objectives. It provides by far the largest source of funding for biodiversity conservation in the EU, both for delivering management within Natura 2000 sites as required under Article 6.1 of the Habitats Directive, and by maintaining and enhancing the environmental management of farmland (and forests) in the wider countryside. It is a particularly important source of funding for maintaining the semi-natural habitats that form an integral part of High Nature Value (HNV) farmland.

Since the 1980s environmental issues, and more specifically biodiversity, have become an increasingly integrated component of the CAP with the most recent reforms beginning to integrate an element of environmental management within Pillar 1 (Allen and Hart, 2013).

The CAP comprises a range of measures, some of which are mandatory for Member States to apply in their territory (although they may have some discretion over how they are designed) and others which are optional for them to offer to land managers (see below). Equally there are some measures which must be implemented by farmers (cross-compliance and direct payments) and those which are voluntary and for which they may apply should they wish to (primarily rural development measures).

The decisions of individual land managers and land owners are influenced increasingly by the market as the support provided via the CAP has become gradually decoupled from production through successive reforms of the policy. Pillar 1 continues to provide a means of basic income support to farmers, with considerable flexibility now provided to Member States as to how this is structured. Member States are required to provide additional payments for young farmers as well as implement the new 'greening' measures to support 'agricultural practices beneficial for the climate and the environment', for which they must allocate 30% of their national envelope. Member States have the option of also providing top-ups for farms in Areas of Natural Constraint (ANC), implementing a redistributive payment for the first thirty hectares on a holding[84], as well as using a proportion of the budget for coupled support in certain sectors.

[84] Or up to the average size of holdings if this is greater than 30 ha

While the new 'greening' measures under Pillar 1 are intended to ensure a basic level of environmental management on a significant proportion of agricultural land[85], the provision of public goods, including biodiversity conservation and improvements in the delivery of environmental ecosystem services on agricultural land in the EU is achieved largely via rural development measures under Pillar 2 of the CAP, predominantly the agri-environment-climate measure, although a range of other measures also play an important role. The agri-environment-climate measure is the only rural development measure that is compulsory for Member States to implement in their territory.

Underpinning all area payments on agricultural land are the cross-compliance requirements. Receipt of payment is conditional upon adherence to a set of Statutory Management Requirements (SMRs) and standards of Good Agricultural and Environmental Condition (GAEC). SMRs consist of requirements of certain EU legislation that apply at the farm level (such as the Nitrates, Birds and Habitats directives). GAEC standards comprise a set of additional requirements that farmers must adhere to. The issues that must be covered are set out at EU level, but the detailed standards are developed nationally (see below).

Even without the cross-compliance rules, agricultural land use and management is influenced by the existing EU regulatory framework and the rules that this imposes. There is a range of regulations that apply, both those that are EU-wide as well as those that are nationally or regionally specific. At the EU level, some of the key pieces of EU legislation that have a bearing on rural (agricultural) land are: Birds and Habitats directives; ELD, WFD, Nitrates Directive, Groundwater Directive, Sewage Sludge Directive, Sustainable Use of Pesticides Directive, Environmental Impact Assessment Directive (for agricultural projects as stipulated under Annex II), Climate change policy, including the rules on reporting in relation to Land Use, Land Use Change and Forestry (LULUCF).

There are considerable improvements and changes that could be made in relation to the other policy areas mentioned above as a means to avoid and minimise biodiversity loss and reductions in ecosystem service provision from agriculture (and forestry) and these are addressed in other relevant sections of this report.

This section focuses on the CAP as agreed for the 2014 – 2020 programming period, including new measures, and considers ways in which the policy could be improved to help better contribute towards a NNL policy for biodiversity and ecosystem services in the EU. Due to the fact that the CAP reform process has been concluded very recently, the proposals in this section focus on what may be feasible within the bounds of the agreed regulations. However, there are a number of ways in which the CAP could be amended to improve the delivery of environmental objectives on farmland and be used as a tool to deliver NNL on agricultural land. Where these build on the proposals put forward, these are flagged, although more radical proposals for reforming the CAP in the future have not been covered, given the focus of the study on action that is feasible by 2020.

[85] To note: permanent crops are not covered by any of the three greening measures. In addition, the thresholds put in place for the Ecological Focus Areas and crop diversity measures mean that significant areas of land are not covered by these measures in some Member States.

The details of the new CAP provisions are based on drafts of the consolidated texts dated 26 September 2013. These reflect the agreement reached in the informal trilogue with the European Parliament and the Commission on 26 June 2013, as finalised in the informal trilogue with the European Parliament and the Commission on 24 September 2013[86]. These regulations are still subject to legal agreement. It should be noted that the implementing and delegated acts are not yet available in the public domain.

5.6.1 Strengths

Existing measures for identifying, avoiding and reducing potential impacts

Rural development policy (via the European Agricultural Fund for Rural Development (EAFRD), or Pillar 2) is still the main element of the CAP for delivering environmental benefits. The new EAFRD includes a series of six Union priorities[87] towards which EAFRD measures, such as the agri-environment-climate or forest-environment-climate measures, must contribute. These replace the old four-axis structure and allow greater flexibility to combine measures in more creative and innovative ways (Allen *et al*, 2012). Priorities 4 and 5 include specific reference to environmental aims that have relevance to NNL, which are[88]:

4) Restoring, preserving and enhancing ecosystems related to agriculture and forestry, with a focus on the following areas:

> *(a) restoring, and preserving and enhancing biodiversity, including in Natura 2000 areas, areas facing natural or other specific constraints and high nature value farming, and the state of European landscapes;*
> *(b) improving water management, including fertiliser and pesticide management;*
> *(c) preventing soil erosion and improving soil management.*

5) Promoting resource efficiency and supporting the shift towards a low carbon and climate resilient economy in agriculture, food and forestry sectors, with a focus on the following areas:

> *a) increasing efficiency in water use by agriculture;*
> *b) increasing efficiency in energy use in agriculture and food processing;*
> *c) facilitating the supply and use of renewable sources of energy, of by-products, wastes, residues and other non food raw material for purposes of the bio-economy;*
> *d) reducing green house gas and ammonia emissions from agriculture;*
> *e) fostering carbon conservation and sequestration in agriculture and forestry.*

In addition to these two, all of the Union priorities shall contribute to the cross-cutting objectives of innovation, environment and climate change mitigation and adaptation. 30% of the total EAFRD budget in each Rural Development Programme (RDP) must be reserved for measures delivering environmental and climate benefits[89]. Although now only voluntary, Member States may transfer 15% of funds from Pillar 1 to Pillar 2 in order to increase

[86] These have been accessed via the Council of the European Union website http://register.consilium.europa.eu
[87] Translating the thematic objectives of the Common Strategic Framework (CSF)
[88] Taken from the draft consolidated text of 26 September 2013 of the EAFRD regulation following the political agreement on the CAP: http://register.consilium.europa.eu/pdf/en/13/st13/st13349-re01.en13.pdf
[89] This may include funding under the following measures: environment or climate expenditure under Article 18 (Investment)[89], 22 to 27 (Forestry) , 29 (Agri-Environment), 30 (Organic farming) and 31 (Natura, excluding WFD-related payments), 32 and 33 (ANCs) and 35 (Forest Environment Measure).

support to Rural Development measures. Reductions made to Pillar 1 payments over €150,000 will also be transferred to the Pillar 2 budget in the country concerned.

There are many Pillar 2 measures that could be utilised to help address NNL. This is astrength of the policy in that the variety of tools available can be used to address specific issues in ways that are most appropriate to different Member States or regions. For example, a review of the different Pillar 2 measures used to deliver environmental services across the EU-27 showed that although the agri-environment measure was by far the most widely used, other measures such as upgrading of rural heritage were used to deliver similar outcomes in a way more suitable to the region in question (ENRD, 2013). The scope of the EAFRD measures can also allow tailored and targeted approaches to specific management objectives, such as restoration or management of particular habitats, through to more widespread measures that seek to maintain certain types of farming systems. These measures, and indeed all funding through the EAFRD, are subject to monitoring and reporting requirements in order to measure success and help to improve policy.

Pillar 1 direct payments continue to constitute by far the largest share of the CAP budget, but in the past have had limited scope to address environmental aims. However, the recent reform has led to the inclusion of a requirement for Member States to make 30% of Pillar 1 direct payment national ceilings contingent on measures beneficial for climate and the environment. The proposed new ‘green’ payment for agricultural practices beneficial to climate change and the environment comprises the following three measures with which eligible farmers must comply[90]:

Crop diversification: Farmers with 10 - 30 ha of arable land are required to cultivate at least two crops with no crop covering more than 75% of the area; and, farmers with 30 hectares and above must cultivate at least 3 crops with the main crop not covering more than 75% and two together not covering more than 95%. There are a series of exemptions to the measure and different rules apply for farms in areas north of the 62nd parallel. Exemptions include: farms where over 75% of arable land is used for the production of grass, herbaceous forage or fallow; where over 75% of eligible agricultural area is permanent grass or under water; farms where more than half the arable area declared was not declared the previous year and where it can be proved that all arable land is planted with a different crop to the previous year.

Permanent grassland: The ratio of land under permanent grassland must not decrease by more than 5% compared to a reference ratio, which will be established according to the situation in 2015. This results in a near-NNL policy for permanent grassland, which can operate at national, regional or farm level, although no reconversion of land would be required if the requirements were breached as a result of afforestation. Member States must designate permanent grassland, including peat and wetlands in Natura 2000 areas and

[90] Some flexibility has been introduced into the final text to implement the greening requirements. In order to accommodate the diversity of agricultural systems and the different environmental situations across the EU, it has been recognised that, besides the three greening measures, certain types of practices that are similar to greening, may considered as 'equivalent' practices' (as defined in an Annex to the basic act)

may identify 'further sensitive areas' situated outside these areas where no conversion or ploughing is allowed at all.

Ecological Focus Areas: 5% of eligible arable areas[91] over 15 ha must be managed as ecological focus areas (EFAs). This figure may rise to 7% if 'justified' following an evaluation in 2017. The final list of features agreed as forming part of an EFA includes: land laying fallow, terraces; landscape features (including those adjacent to eligible agricultural areas covered by arable land); buffer strips (including those covered by permanent grassland); agro-forestry supported under EAFRD; strips of land along forest edges without cultivation; short rotation coppice; areas afforested under EAFRD; areas with catch crops or green cover established by the planting and germination of seeds; and nitrogen fixing crops. A weighting matrix is to be added as an Annex to the regulation, stipulating which of these elements would be subject to weighting coefficients, but the coefficients themselves are to be decided by the Commission via a delegated act. In addition, Member States may choose to implement up to 50% of the EFA requirement at a regional level. Significant exemptions are also in place which include: where over 75% of the eligible agricultural area is permanent grassland, used for the cultivation of grasses or other herbaceous forage or with crops under water; and where over 75% of the arable area is used for the production of grass, herbaceous forage, land laying fallow or cultivated with leguminous crops[92].

Together the two CAP pillars provide both financial and advisory support for environmental management within a range of farming (and forest) systems, covering all different farm types. The support provided is critical for maintaining much of the semi-natural land present in the EU, particularly High Nature Value (HNV) systems, which comprise a high proportion of the Natura 2000 network and include numerous semi-natural habitats and species of Community interest (Olmeda et al forthcoming; Keenleyside et al, forthcoming). Pillar 1 direct payments are often a significant component of land managers' incomes in these areas, although this is not always the case, with Pillar 2 providing much needed support both for the positive actions undertaken as well as addressing the natural constraints placed on land managers in many of these areas. Pillar 2 measures used in such areas include Less Favoured Area payments[93], agri-environment and forest-environment management (now agri-environment-climate or forest environment-climate) or Natura payments (Oñate et al, 2007; Poláková et al, 2011).

Biodiversity is only one of the environmental objectives and challenges that are met through the CAP. The EAFRD plays a key role in supporting ecosystem services through maintaining cultural landscapes, traditional rural practices and economies, improving the quality of natural resources such as soils and water, preventing flooding, and helping improve climate

[91] Permanent crops are now no longer covered by this measure.

[92] Source: Hart & Menadue, 2013 based on Council agreed texts

[93] To be replaced under the proposed reforms with payments for Areas with Natural *or other specific* Constraints. It is worth nothing that the proposed reforms include additional ANC support granted through Pillar 1.

mitigation[94] and adaptation[95] . The CAP is therefore a key tool in delivering against a range of objectives and policies beyond just biodiversity.

In addition to the support for beneficial farming systems and practices, adherence to environmental regulations as well as minimum standards of good agricultural and environmental condition are a condition of the receipt of support. For CAP area-based payments to farmland these conditions are defined under cross-compliance as follows:

- relevant Statutory Management Requirements (SMR), for example elements of the Habitats or Birds Directives relating to farm level protection of Natura 2000 habitats and species; and
- standards for Good Agricultural and Environmental Condition (GAEC) as defined by Member States within a common EU framework.

The new SMR and GAEC requirements on Member States and regions are set out in Table 5-17 based on the draft consolidated text of the Horizontal Regulation[96]. In addition to cross-compliance requirements, all recipients of agri-environment-climate payments must also adhere to certain requirements on the use of fertilisers and plant protection products which Member States and regions must define in their Rural Development Programmes.

Unlike the SMRs which reflect national and EU law, Member States are able to define their own verifiable GAEC standards within the framework provided by the legislation and in so doing they must take into account '*… the specific characteristics of the areas concerned, including soil and climatic condition, existing farming systems, land use, crop rotation, farming practices, and farm structures*'[97]. This provides scope for Member States to define specific GAEC standards that are nationally appropriate taking into account their regional situation.

Finally, the monitoring and evaluation systems embedded in the new CAP are important to measure the outcomes and impacts of different measures as well as contributing towards the future development of the policy. The Common Monitoring and Evaluation Framework (CMEF) has been extended beyond Pillar 2 EAFRD expenditure to cover Pillar 1 (in particular greening) and cross-compliance, allowing for greater monitoring of the impact of both Pillars. In parallel to better monitoring, there has been an increase in the scope of advice provision across both Pillars with the Farm Advisory Services extended to rural development measures, cross-compliance and the implementation of the Water Framework Directive and Sustainable Use of Pesticides Directive.

[94] Through improved sequestration of carbon and better land management to reduce Greenhouse Gas (GHG) emissions
[95] Of natural systems and in some cases land managers
[96] http://register.consilium.europa.eu/pdf/en/13/st13/st13387-re01.en13.pdf
[97] Article 94 of the horizontal regulation

Table 5-17: Revised cross-compliance requirements under the reformed CAP

Area	Main Issue	Requirements and standards		
Environment, climate change, good agricultural condition of land	Water	SMR 1	Council Directive 91/676/EEC of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources (OJ L 375,31.12.1991, p. 1)	Articles 4 and 5
		GAEC 1	Establishment of buffer strips along water courses	
		GAEC 2	Where use of water for irrigation is subject to authorisation, compliance with authorisation procedures	
		GAEC 3	Protection of ground water against pollution: prohibition of direct discharge into groundwater and measures to prevent indirect pollution of groundwater through discharge on the ground and percolation through the soil of dangerous substances, as listed in the Annex to the Directive 80/68/EEC in its version in force on the last day of its validity, as far as it relates to agricultural activity	
	Soil and carbon stock	GAEC 4	Minimum soil cover	
		GAEC 5	Minimum land management reflecting site specific conditions to limit erosion	
		GAEC 6	Maintenance of soil organic matter level through appropriate practices including ban on burning arable stubble, except for plant health reasons[1]	
	Biodiversity	SMR 2	Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds (OJ L 20, 26.1.2010, p. 7)	Article 3(1), Article 3(2)(b), Article 4 (1), (2) and (4)
		SMR 3	Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild flora and fauna (OJ L 206, 22.7.1992, p. 7)	Article 6 (1) and (2)
	Landscape, minimum level of maintenance	GAEC 7	Retention of landscape features, including where appropriate, hedges, ponds, ditches, trees in line, in group or isolated, field margins and terraces, and including a ban on cutting hedges and trees during the bird breeding and rearing season and, possible as an option, measures for avoiding invasive plant species and pests	

[1] The requirement can be limited to a general ban on burning arable stubble, but a Member State may decide to prescribe further requirements.

Source: Own compilation based on the draft consolidated version of the regulation for the financing, management and monitoring of the common agricultural policy (the horizontal regulation (CAP Reform) of 26 September 2013; Annex II rules on cross-compliance pursuant to Article 93. http://register.consilium.europa.eu/pdf/en/13/st13/st13387-re01.en13.pdf

Existing measures identifying and addressing residual impacts

At present there are no specific measures that are used to address residual impacts in order to achieve NNL. However, the CAP does provide the framework within which such measures could be implemented, if they were thought to be a necessary element of the policy. For example, the cross-compliance framework could be expanded in the future to include a requirement for land managers to address residual impacts. Similarly, RDPs could include specific reference to residual impacts with some flexibility for land managers to choose the measures and land management actions used to address such impacts. Of course, there are many things to consider if such measures were proposed, including the most appropriate scale at which residual impacts should be addressed, the part of the policy in which they should be included, and thus how they are financed and monitored.

5.6.2 Weaknesses

Existing measures for identifying, avoiding and reducing potential impacts

Although the CAP is by far the largest source of funding for environmental management on farm and forest land in the EU, it is widely recognised that this funding is insufficient to address fully the environmental challenges faced in the region (Hart et al, 2011; Hart et al, 2013; IEEP et al, 2012b). Despite this and the wide recognition of the importance of agri-environment schemes, negotiations for the new EU Multi-annual Financial Framework (MFF) have resulted in significant real cuts in funding for the 2014-2020 programing period. The Pillar 1 budget has declined by 13% to €277.8 billion but the Pillar 2 budget has seen a greater decrease of 18% to €84.9 billion[98]. A new provision has been introduced which allows all Member States to transfer up to 15% of their Pillar 2 budget to Pillar 1, and for ten Member States the amount transferred can be increased to 25%. Depending on the degree to which this provision is used, this could reduce limited rural development budgets yet further, with implications for the funding available for environmental measures and achieving NNL goals. Furthermore, such funding already has to compete with many other rural development priorities at Member State or regional level, and it will be more important than ever to build coherent packages of environmental support using funds from *both* Pillars of the CAP.

Member States have considerable flexibility to ensure that the environmental provisions of the CAP through Pillar 1, cross-compliance are implemented effectively and that at least some of the funding provided through Pillar 2 is targeted to those areas most in need of support to achieve NNL. The approval process for RDPs will be a critical means of ensuring that Member States address the environmental priorities in their regions appropriately through Pillar 2. Although the inclusion of the 'greening' measures into Pillar 1 is a welcome change and presents opportunities to raise the environmental delivery, the final outcome of the reforms are less ambitious than the original proposals, applicable to fewer land managers and cover consequently a smaller proportion of agricultural land, particularly arable land in the EU.

[98] Based on comparing 2020 and 2013 figures.

There are other weaknesses of the CAP when considering its potential to aid in a NNL policy. For example, despite the significant budgetary resources devoted to it and widespread uptake the CAP remains, as for any funding instrument, a voluntary tool. Land managers are not required to receive CAP support through Pillar 1 (and some choose not to) and thus do not have to be bound by cross-compliance[99] and greening requirements just because they manage agricultural land. In reality however, the market economics of most farms and some forests means that the majority of land managers will inevitably choose to receive direct support if they are eligible to do so. The same however cannot be said for Pillar 2. Although it is compulsory for Member States to implement the agri-environment-climate measure, it is the decision of individual land managers to apply for and enter into schemes. It is therefore important to ensure that Pillar 2 schemes remain attractive to land managers. Institutional and financial issues are also linked to sub-optimal use of CAP tools for achieving NNL objectives. In most Member States, the agriculture and environment ministries are separate, with the agricultural ministry designing and administering the implementation of both Pillars of the CAP. In many countries evidence suggests that dialogue between the two ministries continues to be limited, with environmental ministries finding it difficult to influence the use of CAP funds for environmental purposes. In addition, the prioritisation of limited financial resources is another limiting factor for achieving NNL through use of the CAP budget, with many competing economic demands of the funding available.

Existing measures identifying and addressing residual impacts

As described in the previous section, although there are opportunities to include specific measures to address residual impacts, none exist at present. Nor is the concept of NNL or offsetting well known within the agricultural sector, save for those agricultural representative groups that have been engaged in the EU NNL Working Group.

5.6.3 Opportunities

There are many existing elements of the CAP whose use could be improved in order to increase the efforts on agricultural land to achieve the goal of NNL of biodiversity and ecosystem services, some of which are described in existing reports (see Allen *et al,* 2012; Polakova *et* al, 2012), and some of which are set out below. These can include opportunities to change the policy itself as part of a formal review process, such as including explicit policy objectives (not possible now until the next reform review process), but also to use the tools and measures available within the current policy in order to better deliver NNL of biodiversity and ecosystem services, such as ensuring that extension services are used to raise awareness amongst land managers of the importance of stemming declines in biodiversity.

Specific proposals for changes to the CAP are set out below. However, there are two considerations, which though not policy options themselves, should be taken into account in any proposals for a NNL as part of the CAP. These are:

[99] Of course all land managers are bound by national and EU laws as implemented in the different Member States, such as those set out under the SMRs, irrespective of their participation in the CAP.

- Ensuring a balance between Ecosystem Services - When considering policy instruments/tools to achieve NNL of ecosystem services in relation to land management, it is important to retain a balance between the provisioning and non-provisioning services. Although the focus here is on the ecosystem services that are public goods, agricultural land will need to continue to be used for productive purposes and ways must be found for environmental services and food, fibre, feed, energy production from land to work alongside one another.

- Improve the implementation and effectiveness of existing policy tools - There remain significant environmental issues in relation to agriculture which need to be addressed, but it is important to remember that there are many policy tools already available under the CAP or associated with CAP support (such as existing regulations and directives) to address some of the earlier stages of the mitigation hierarchy. It is important not to lose sight of these and continue efforts to improve their implementation in order to increase their effectiveness in contributing to NNL.

There are of course issues that the CAP and agriculture more generally will struggle to address. For example, residual impacts are likely to continue and although ways need to be found to address these through the CAP and the agriculture sector, finding solutions that are feasible to administer and enforce without significant costs is likely to remain a barrier in many cases. This is due to the characteristics of the farming sector in the EU, with millions of individual holdings and individual decision makers to which any new system would need to apply.

The opportunities for making significant changes to the policy are also worth considering. June 2013 saw agreement reached on a particularly challenging and drawn out reform of the CAP. Some environmental gains were seen but these were hard won. The next CAP reform will be in 2020 following the end of the next programming period, too late to help contribute towards the 2020 biodiversity targets. An earlier opportunity to influence the policy may arise if a mid-term review is instigated, however even with this opportunity the lag time for implementation of any changes at sufficient scale would likely draw close to the 2020 time horizon. Despite these challenges there are still opportunities to inform the implementation of the existing policy as well as providing associated support and measures that can help the CAP to deliver NNL.

5.6.4 Policy options

Because the options are focussed on what is feasible to 2020, more radical options which would require significant changes to the structure and/or focus of agricultural support have not been included as these would require a further reform of the CAP or more significant changes to the broader policy framework which may not be possible within the timeframe for this study. The majority of the changes proposed, therefore, are intended to be feasible to realise through adjustments to the way in which the CAP is implemented. Nonetheless, where associated additional changes would enhance the policy proposal, but require a change to the policy, this is highlighted in case opportunities for revisions arise during the 2014-2020 programming cycle, for example should a midterm review of the policy be instigated (although this is not currently planned). The emphasis is also placed on those areas where the EU can intervene. There are many areas where action would require Member States to take action, and in these situations the issue is how to encourage them to do so. In order to achieve NNL though the CAP all of the following options would need to be implemented, therefore no order is given in the following list.

CAP Policy Option 1: Raise awareness amongst land managers about the importance of maintaining semi-natural habitats, with a particular focus on HNV farmland

Given that one of the key pressures on biodiversity in relation to farmland is the continued loss of semi-natural habitats outside protected areas, greater emphasis should be given to promoting the importance of maintaining such habitats, most of which can be defined as HNV farmland. Member States need to be encouraged to provide a suitable mix of policy measures and funding to ensure HNV farming remains viable and that any loss of such habitats is prevented or offset elsewhere. Member States need to be held to account, through the RDP approval process, to ensure that appropriate measures have been put in place in their RDPs to ensure NNL of such habitats, and required to amend their draft RDPs should this not be the case.

To help encourage greater awareness, in addition to sufficient funding being made available via RDPs, the value of HNV farming to society needs to be demonstrated, in particular highlighting the important role that those managing HNV farmland play in providing society with the public goods it demands. A major publicity campaign could be funded through the Commission to raise the profile of HNV farming, akin to the 2014 focus on family farming. Member States could also be encouraged to ensure that advice for this purpose is available via the Farm Advisory Service, that all Member States are required to implement.

Policy Option Evaluation

Table 5-18 Evaluation of the effectiveness, efficiency and policy coherence of option CAP 1: Raise awareness amongst land managers about the importance of maintaining semi-natural habitats, with a particular focus on HNV farmland

Evaluation criteria	Assessment of policy option's potential contribution to NNL
1. Effectiveness	
Mitigation hierarchy stages	All stages.
Land use impacts	Will primarily affect semi-natural habitats, encouraging their appropriate management.
Potential coverage and impacts on biodiversity	Low-moderate: Low by itself, but moderate impacts if supporting other policy options.
Potential coverage and impacts on ecosystem services	Low-moderate: as above.
Clarity	High, the approach is clear and the actions themselves would help improve understanding of conservation needs in agricultural community.
Measurability	It is possible to measure the provision of advice, but less straightforward to measure the impacts of advice on protection of semi-natural habitats/HNV farmland. All MSs have started to develop inventories of HNV farmland although improved data on the extent and condition of the resource is needed.
Feasibility	High – all MSs are required to put a Farm Advisory Service in place and the importance of semi-natural habitats could be incorporated into this. In addition to providing funding for the FAS, advisory measures under the EAFRD can be used for additional advisory services to be put in place.
Enforceability	There is unlikely to be any resistance from private sector, but additionally, there would be no enforcement of any actions or requirements.
2. Efficiency	
Unit costs	
Public: 1-off (€)	Likely no significant additional public costs. An informational campaign could be coordinated through already existing communications contracts.
Public: Recurring (€/yr)	Likely no significant additional public costs. Advisory costs can be covered via EAFRD. Additionally, checking that HNV farmland is appropriately covered by RDPs can be done as part of the approvals process.
Private: 1-off (€)	None
Private: Recurring (€/yr)	None
Distribution of costs	All public costs.
Benefits (other than NNL)	
Economic activity	Possible ancillary benefits, for example through keeping land in production rather than being abandoned.
Jobs	More likely to keep farmers on the land than create new jobs.
Health/quality of life	By keeping HNV farming going and avoiding abandonment there is likely to be a knock on effect on rural communities, avoiding outmigration.
Other	
3. Coherence	High as this action would support other measures that aim to meet key environmental objectives including those of the CAP.

CAP Policy Option 2: Include suitable indicators within the Monitoring and Evaluation Framework to allow progress to be evaluated against NNL objectives

At present, and in the agreed CAP, NNL is included indirectly with the official objectives of the policy given that the CAP is one of the policies through which the objectives of the biodiversity strategy are to be achieved. It is important, therefore, that the final set of indicators developed at EU level and additional indicators put in place by Member States within the CAP Monitoring and Evaluation Framework, should allow not just for the overall impact of funding on biodiversity and ecosystem services to be assessed, but also the degree to which NNL has been achieved. The impact indicators are of particular relevance here. One of the key issues that deserves particular attention is the overall situation in relation to HNV farmland and efforts to ensure that the indicator relating to HNV farmland continues to be developed in a way that can be implemented effectively in Member States, and guidance provided on how it can be operationalised in ways that suit the circumstances of specific countries. This also requires accurate baseline data to be in place against which progress can be assessed

In the future, a more explicit link to NNL in the objectives of the CAP, applying to both Pillar 1 and Pillar 2, would require a more thorough consideration by all Member States on how to apply the various measures at their disposal in light of this objective. However, this would require a formal change to the CAP, which would not come into force until 2020. An explicit objective for NNL would help to broaden the focus of the policy from maintaining and enhancing ecosystem services, often in particular locations, to a greater focus on addressing the continued environmental degradation taking place on agricultural land (and forest areas) across the EU[100]. This could include better enforcement of regulations or the putting in place of processes whereby some losses are deemed acceptable under very strict guidelines, but only where the damage is offset elsewhere. If a NNL objective were to be written into the Pillar 2 EAFRD regulation, then the situation and SWOT analysis carried out by Member States during the preparation[101] of their Rural Development Plan (RDP) would need to consider NNL. All RDPs submitted for approval could then be assessed against the degree to which the measures put forward might achieve NNL.

[100] Either in contravention of existing regulations and rules or through accepted agricultural management practices.
[101] Or subsequent revisions

Policy Option Evaluation

Table 5-19 Evaluation of the effectiveness, efficiency and policy coherence of option CAP 2: Include suitable indicators within the Monitoring and Evaluation Framework to allow progress to be evaluated against NNL objectives

Evaluation criteria	Assessment of policy option's potential contribution to NNL
1. Effectiveness	
Mitigation hierarchy stages	All stages.
Land use impacts	Potentially significant - indirect. Should help to reduce detrimental changes to semi-natural habitats by raising awareness of the scale and location of these impacts.
Potential coverage and impacts on biodiversity	Moderate EU wide benefits, increasing data availability and understanding of what is happening to all semi-natural habitat types subject to CAP support.
Potential coverage and impacts on ecosystem services	Moderate EU wide, applied to all semi-natural habitat types subject to CAP support. Regulating and cultural services could benefit.
Clarity	NNL policy definition needs to be clearly articulated to be understood by those implementing the policy and carrying out the land management actions. Boundaries need to be drawn on the extent of NNL in relation to ecosystem services.
Measurability	High. Information is available on the areas enrolled and level of payments made to HNV farm areas.
Feasibility	Monitoring and Evaluation Framework is already in place and HNV indicator already exists, although some MSs have found it difficult to put into practice. Requires further development of methods and guidance for MSs on how to apply in their particular circumstance. Target in Biodiversity strategy provides basis for action.
Enforceability	Challenging. Despite the extended monitoring and evaluation framework in the CAP, checking the implementation and achievement towards NNL would require significant effort and resources.
2. Efficiency	
Unit costs	
Public: 1-off (€)	Negligible cost given key indicators already exist, potentially some minimal costs associated with developing methods to ensure that RDPs can be assessed against NNL objective.
Public: Recurring (€/yr)	The budget for CAP is set, and this policy option is designed to ensure that expenditure helps achieve NNL. As such there are no notable additional recurring costs associated with this policy option.
Private: 1-off (€)	Need to better account for biodiversity and NNL in farm management decisions, but additional costs should be negligible as this is a process farmers have to go through to receive CAP funding irrespective of the specific objectives of the policy.
Private: Recurring (€/yr)	Because the CAP is voluntary in nature, there are no notable, required recurring costs for the private sector.
Distribution of costs	Indicators would focus on HNV farmland, so although additional private costs are expected to be negligible, any additional costs that do occur would likely impact HNV farms.

Benefits (other than NNL)	
Economic activity	Likely minimal, but depends on how the results of indicator measurement ultimately impact upon the targeting and focus of policy measures. One key concern with previous measures is abandonment of land and intensification of the remaining, which has negative impacts on farmland biodiversity. A push for more extensive land management may require greater inputs. In contrast, that may incur opportunity costs for other uses of the land, although they are assumed low if the previous issue was abandonment (rather than conversion) of HNV farmland.
Jobs	As with above, likely low, but increased extensive land management could increase labour demand.
Health/quality of life	Moderate-high. Farmland or mosaic biodiversity occurs where people live, so the benefits related to cleaner environment, recreation, and broader well-being will be directly beneficial to rural populations.
Other	
3. Coherence	High. The CAP is the largest component of the EU budget. It is crucial for its expenditure to be working with the NNL objective in order for any other policies to also work (ie rather than conflicting environmental policy and CAP spending). Additionally, broader integration of NNL in CAP, along with other proposed reforms, should improve coherence between Pillar 1 and 2 regarding biodiversity objectives.

CAP Policy Option 3: Encourage and support all Member States in mapping and recording semi-natural habitats and landscape features on agricultural land

Member States are required to map all elements of a holding that receive direct payments. This means that any features that are eligible to receive payments under the newly introduced Ecological Focus Area (EFA) measure need to be mapped – this will differ from country to country, depending on how Member States choose to implement the EFA measure (at the time of drafting, decisions on how to implement the greening measures had not been taken in Member States). However this does not include requirements to map all semi-natural habitats or features, including those outside the scope of EFA or those that might be subject to support under EAFRD. As such there remains a significant gap in the data and information available on which to target EU-wide policies to address particular habitat types. For example, there remains no consistent mapping in place to assess the location and extent (let alone condition) of semi-natural grassland and work remains ongoing in estimating the current extent of HNV farm and forest land (Alterra et al, forthcoming; Keenleyside et al, forthcoming).

This lack of information has already caused significant implications for policy design. For example, the original proposals for the CAP included a GAEC requirement for the 'protection of wetlands and carbon rich soils including a ban on first ploughing[102]. However, Member States argued that they could not apply this at the scale which would be required due to a lack of sufficiently fine-grained data. In addition, proposals for payments targeted at HNV farmland are held back by the lack of robust and consistently mapped information on the location of such land. Therefore one of the key means of increasing the ability of the CAP to

[102] COM(2011) 628/3 Annex II – GAEC 7

help contribute towards NNL is to improve the data and information on which the policy can be designed and targeted.

The key barriers to implementing this policy change are the time, the administrative burden and financial costs of improving such information. The EU could encourage Member States to improve the availability of such information and the ENRD Contact Point or Evaluation Helpdesk could be used to share Member States' experiences, best practice and provide guidance to Member States. The feasibility of making funding available, such as via the technical assistance part of the EAFRD regulation or even via a dedicated pot could also be considered. However, even with appropriate funding the recording of such information would take a significant amount of time. In addition, a number of EU institutions, such as the Joint Research Centre (JRC), Eurostat and the European Environment Agency (EEA) could play an enhanced role in standardising, collating and monitoring spatially explicit data on rural land use at EU level so that these data are more readily available in the future in a consistent form (Hart et al, 2013). Indeed this could build on existing work by JRC and others as part of the Mapping and Assessment of Ecosystem Services (MAES) initiative (Maes et al, 2012b), which is implementing Action 5 of the EU Biodiversity Strategy in support of Target 2.

Policy Option Evaluation

Table 5-20 Evaluation of the effectiveness, efficiency and policy coherence of Option CAP 3: Encourage and support all Member States in mapping and recording semi-natural habitats and landscape features on agricultural land

Evaluation criteria	Assessment of policy option's potential contribution to NNL
1. Effectiveness	
Mitigation hierarchy stages	All stages.
Land use impacts	EU wide, all semi-natural habitats and landscape features. Provides means to assess current extent and influence targeting of policies as well as assessing progress towards target.
Potential coverage and impacts on biodiversity	Low-High: uncertain as dependent on Member State uptake; if taken up, low benefits for semi-natural habitats and landscape features by itself, but high if in support of other related policy options.
Potential coverage and impacts on ecosystem services	Low-High: uncertain as dependent on Member State uptake; if taken up, low benefits for ecosystem services associated with semi-natural habitats and landscape features by itself, but high if in support of other related policy options.
Clarity	Clear. Can work within existing data framework and systems.
Measurability	Low. It is a capacity building option, with high-level benefits for all policies related to farmland biodiversity, so direct impacts difficult to measure.
Feasibility	Limited in relation to scale of exercise. Limited resources at Member State level and reluctance to conduct major mapping exercises are also a barrier. However, current contract let by Commission for updating of semi-natural grassland inventory. Further work taking place to improve existing land use and land cover datasets and inventories across the EU.
Enforceability	Simple. Auditing of completion of task largely desk based. Validation of data may prove more problematic. Additionally, this proposal is likely to receive

	much resistance from Member State authorities given scale of funding required.
2. Efficiency	
Unit costs	
Public: 1-off (€)	Costs to EU would be minimal. Encouragement for mapping, and any technical or financial support, could come through already existing institutions and channels. Considering the potential costs to MS, should they undertake mapping, evidence indicates that mapping costs can be on the order of EUR 4/hectare at the Member State level, but coordination across the EU should be able to leverage economies of scale and lower this cost. Applying the EUR 4/hectare provides a rough, but high-end, estimate of the total cost if all utilised agricultural area (UAA) in the EU-27 was mapped of EUR 686 million. However, it might only be necessary to target mapping to areas with semi-natural habitats and important landscape features, in which case the costs would probably be no more than half the estimate above.
Public: Recurring (€/yr)	Recurrent costs lower than initial one-off cost, and updating can be incremental
Private: 1-off (€)	n/a
Private: Recurring (€/yr)	n/a
Distribution of costs	Public costs
Benefits (other than NNL)	
Economic activity	Low. Mapping and survey work where necessary.
Jobs	Low. Mapping and survey work where necessary.
Health/quality of life	n/a
Other	Applicable to wider policies, research etc. Improves understanding of EU land use and land cover.
3. Coherence	Moderate. Similar to spatial planning, this will provide information that will improve design of policies for NNL, so should improve policy coherence. However, its application is at the discretion of Member States, so this may reduce coherence.

CAP Policy Option 4: Encourage Member States to require all land holdings entering land management options under EAFRD to have an environment plan in place against which changes can be assessed, approved etc.

One of the challenges in measuring the achievement of pursuing NNL through the CAP, and in any policy framework, is having a clear baseline at the holding level, which could subsequently be combined to provide information and inform management planning at a broader landscape scale, identifying the priorities for particular areas and enabling an assessment to be made about which losses may be justified and acceptable in a given location and if so, what this means for any options to address the resulting losses in other locations. This sort of information is essential for effective prioritisation and targeting of resources at the landscape scale and would allow a more strategic approach to NNL to be taken in relation to EAFRD spend in Member States. This can build on the requirements for mapping of habitats and species (as proposed under CAP Option 2) and include greater detail whereby individual environmental features (including species and habitats) are mapped for the individual holding alone.

A holding map of all the habitats, environmental designations and features would provide a useful tool that could be used as a baseline and updated as and when changes are made. Such maps should be digitised to allow landscape scale management planning to take place. This sort of a map should enable land managers to make better-informed decisions regarding land use/management in relation to the environment and in particular with regard to NNL, but will need to be supported with additional advice and training.

In practice, a significant barrier to implementing this change will be the lack of (digital) maps available for environmental features at the farm scale, the additional administrative burden and financial costs of such an exercise. CAP Options 2 and 3 can work synergistically, with Option 2 (proposal for EU wide mapping) providing updated information for Option 3, or the holding scale mapping of features helping to contribute to and verify EU wide data.

This option would not require a formal change to the CAP, but would require buy-in from Member States as this would need to be stipulated in the requirements set out in RDPs.

Policy Option Evaluation

Table 5-21 Evaluation of the effectiveness, efficiency and policy coherence of Option CAP 4: Encourage all land holdings entering land management options under EAFRD to have an environment plan in place

Evaluation criteria	Assessment of policy option's potential contribution to NNL
1. Effectiveness	
Mitigation hierarchy stages	All stages.
Land use impacts	This would primarily affect semi-natural habitats and environmental features on farm and forest land in receipt of environmental management support under EAFRD.
Potential coverage and impacts on biodiversity	Low-Moderate: uncertain as dependent on Member State uptake; if taken up low benefits for semi-natural habitats and landscape features by itself, but moderate if in support of other related policy options.
Potential coverage and impacts on ecosystem services	Low-Moderate: uncertain as dependent on Member State uptake; if taken up low benefits for ecosystem services associated with semi-natural habitats and landscape features by itself, but moderate if in support of other related policy options.
Clarity	Requirement clear, effective guidelines needed for implementation at holding level.
Measurability	Low regarding the direct impact of this policy on achieving NNL, but will improve measurability of other policy options.
Feasibility	Requires investment by land managers but could be supported through EAFRD. Guidance and training needed for land managers and those (consultants/others) who may formulate the holding environment plan.
Enforceability	Relatively simple if the plan is made as a condition of receiving support for environmental management, however, due to the costs and time required todraw up plans, this policy option could receive some resistance.
2. Efficiency	
Unit costs	

Public: 1-off (€)	Design of plan requirements. Digital maps and base data provision (see Option 2 above). Cost to implement and draw up plans by the private sector would likely be reimbursed through EAFRD, so this would ultimately be a public cost.
Public: Recurring (€/yr)	Cost of guidance and training.
Private: 1-off (€)	None, assuming reimbursement occurs.
Private: Recurring (€/yr)	n/a
Distribution of costs	Public entities are ultimately responsible for all costs.
Benefits (other than NNL)	
Economic activity	Low. Mapping and survey work where necessary.
Jobs	Low. Mapping and survey work where necessary. Advice contracts and work.
Health/quality of life	n/a
Other	Applicable to wider policies, research etc. Improves understanding of EU land use and land cover.
3. Coherence	Moderate. Similar to spatial planning, this will provide information that will improve design of policies for NNL, so should improve policy coherence. This option will be better than CAP Option 2 for coherence because it can support decision making at farm level, where decisions and policy impact occur. However, its application is at the discretion of Member States, so this may reduce coherence.

CAP Policy Option 5: Encourage Member States to apply the Pillar 1 greening requirement for permanent grassland in a way that protects valuable semi-natural grasslands

One of the key issues to be addressed by an EU NNL policy is the continued loss of semi-natural grasslands. The Pillar 1 greening requirement for permanent grassland, which includes the requirement for farmers not to plough semi-natural grasslands in Natura 2000 areas, does not extend beyond the requirements as set out under the Habitats Directive. However the measure also gives Member States the option to designate other areas as 'environmentally sensitive' and not permit ploughing. Given the pressures facing semi-natural grasslands, this optional element of the permanent grassland measure could be an important means of protecting the significant areas of environmentally valuable semi-natural grassland (HNV farmland) outside protected areas. It would need to operate at farm level.

Member States should be encouraged, therefore, as part of the greening requirements to identify areas outside of Natura 2000 sites that are environmentally sensitive and where no ploughing should be permitted. This should include all semi-natural grassland, wetland areas and areas of carbon rich soils. Once such areas have been defined, farmers would not be permitted to plough semi-natural grassland within these areas unless express permission is received from a competent national authority or nominated environmental body.

In the future, it might be envisaged that in cases where permission is granted, a proportion of the direct payment that the farmer would have received under this measure could be allocated to a habitat bank or trust administered conservation credit scheme to allow for the creation of an equivalent habitat elsewhere (see section 5.10.5)[103]. This sort of arrangement, however, would require a formal change to the CAP and therefore would be unlikely to be feasible before 2020.

This option could address the avoidance of damage stage of the mitigation hierarchy, but only where Member States decide to implement the optional element of the permanent grassland requirement.

Policy Option Evaluation

Table 5-22 Evaluation of the effectiveness, efficiency and policy coherence of Option 5: Encourage Member States to apply the Pillar 1 greening requirement for permanent grassland in a way that protects valuable semi-natural grasslands

Evaluation criteria	Assessment of policy option's potential contribution to NNL
1. Effectiveness	
Mitigation hierarchy stages	Avoidance of damage stage.
Land use impacts	Limited conversion of semi-natural grasslands. Possible ploughing of existing grassland not designated under Member State rules.
Potential coverage and impacts on biodiversity	High if implemented but uncertain as dependent on Member State uptake.
Potential coverage and impacts on ecosystem services	High if implemented but uncertain as dependent on Member State uptake. Impacts expected to be positive for regulating and cultural services. Provisioning services for traded commodities may be negatively impacted depending on the production response that results on existing farmland.
Clarity	High. Clear policy change building on existing requirements.
Measurability	Moderate. The changes are specifically designed to achieve NNL objectives, and at minimum, land use change will be measurable.
Feasibility	Moderate. Feasible for public sector to implement, farmers may require some additional capacity building to adjust to new practice requirements.
Enforceability	Acceptance low. Unlikely to gain political acceptance and would require a change to the CAP.
2. Efficiency	
Unit costs	
Public: 1-off (€)	Low, because the main costs would be the identification and mapping of semi-natural grassland and this would be covered under Option CAP 3 above.
Public: Recurring (€/yr)	Minimal.
Private: 1-off (€)	Minimal costs to alter management plans.
Private: Recurring (€/yr)	Uncertain, but possibly low-moderate if a change in production practices or plans is required for certain areas and leads to foregone profits.
Distribution of costs	Costs fall to farmers based on geographic distribution.
Benefits (other than NNL)	
Economic activity	Unclear, possibly low negative - neutral. There may be a small negative impact in areas for which a change in productive practices is required and that leads to less production/revenue, but that could be offset by intensifying areas that

[103] This does not necessarily need to be on the same holding but a decision would be needed in relation to the location and scale of any offsetting requirement.

	remain under production.
Jobs	Unclear, possibly low negative - neutral. There may be a small negative impact in areas for which a change in productive practices is required and that leads to less production/revenue, but that could be offset by intensifying areas that remain under production.
Health/quality of life	Low positive. Areas considered for exclusion have high levels of provisioning and regulating ecosystem services, and occur in semi-natural landscapes where populations occur.
Other	
3. Coherence	Moderate. This option helps plug a gap in current policy to help achieve NNL objectives, and also supports broader greening objectives of CAP. However, its application is at the discretion of Member States, so this may reduce coherence.

CAP Policy Option 6: Encourage Member States to implement the EAFRD agri-environment-climate and forest-environment-climate measures (and other measures) in ways that deliver greater contributions towards NNL.

All EAFRD measures must address environment, climate and innovation as cross cutting objectives of the policy, however it is at the discretion of Member States how these objectives are interpreted (to some degree) and the way in which they are addressed. Some of the key areas of improvement include: better targeting at priority areas or issues (more focused); improving delivery against objectives at the wider landscape scale; cooperation between land managers; ensuring payment rates are competitive; ensuring support is accompanied by the necessary advice and support with funding for infrastructure should it be necessary.

Many of the tools necessary to implement these improvements exist already within the current EAFRD and have been expanded in the new EAFRD regulation for 2014. However, it remains up to Member States how they choose to design their schemes and the way in which they might combine different EAFRD measures to best effect[104]. If NNL is to be included as a specific objective of the CAP (Objective 1) or if Member States are to be required to better address environment benefits contributing towards NNL good practice guidance will be needed in the design of different schemes in addition to that provided already.

The extent to which measures such as agri-environment-climate and forest-environment-climate can be used to deliver against aspects of NNL, such as the loss of semi-natural grasslands, identified within a particular country or region is something that could be considered during the RDP approval process. However, due to the fact that NNL is not a specific objective of the EAFRD, no formal assessment of RDPs against a NNL objective is possible for the current programming period.

[104] For example combining advice and training measures with capital investments and on-going multi-annual support payments.

These changes will likely require a greater proportion of EAFRD funding to the AEC and FEC measures than is currently the case. This may require additional funds (CAP Option 7) or may require Member States to change the current allocation and prioritisation of funding within their RDPs.

This option could address both restoration and residual impacts in the mitigation hierarchy and would not require a formal change to the CAP.

Policy Option Evaluation

Table 5-23 Evaluation of the effectiveness, efficiency and policy coherence of Option CAP 6: Encourage Member States to implement the EAFRD agri-environment-climate and forest-environment-climate measures (and other measures) in ways that deliver greater contributions towards NNL

Evaluation criteria	Assessment of policy option's potential contribution to NNL
1. Effectiveness	
Mitigation hierarchy stages	Restoration and residual impacts stages of the hierarchy.
Land use impacts	Widespread impacts on all agricultural land in receipt of support under the two (AEC and FEC) measures, therefore especially semi-natural ecosystems.
Potential coverage and impacts on biodiversity	Moderate-High: but uncertain, as depends on Member State uptake.
Potential coverage and impacts on ecosystem services	Moderate-High: but uncertain, as depends on Member State uptake. Main benefits relate to regulating and cultural services.
Clarity	High. This option is designed to improve clarity.
Measurability	Low. Improved guidance and encouragement is a necessary policy action, but difficult to quantify: it is challenging to monitor some outcomes and attribute to these two measures. Nonetheless, some level of measure can be gained by assessing the extent of AEC and FEC measures.
Feasibility	High. Builds on existing framework of advice and training and does not require change to CAP policy.
Enforceability	Moderate. Integration of advice into schemes can be assessed at the RDP and scheme approval stage. Integrating it into this process should make it 1) more acceptable to MS, and 2) easier to implement.
2. Efficiency	
Unit costs	
Public: 1-off (€)	Minimal. Costs to design advice and training packages at EU level, and any extra labour by Member States to include measures in RDPs.
Public: Recurring (€/yr)	Variable as it will depend on the resulting changes in use of specific measures.
Private: 1-off (€)	Negligible, integrating measures into management plans.
Private: Recurring (€/yr)	Negligible. Ongoing changes to management plans.
Distribution of costs	
Benefits (other than NNL)	
Economic activity	Low. Possible some supply needs related to implementation of measures.
Jobs	Low. Improved through creation of additional jobs in training and advice – or expansion of existing training and advice.
Health/quality of life	n/a

Other	Greater understanding of environmental issues, in particular NNL, for land managers.
3. Coherence	Moderate. Policy option is coherent with NNL and CAP, but allows some risks to coherence to remain (eg Member States' determination of application of measures).

CAP Policy Option 7: Include 'preservation of semi-natural habitats, including semi-natural grassland, peatlands, wetlands [others]' in the cross-compliance framework as a GAEC standard as an alternative to CAP Option 4.

Although not feasible in the short term, any review of the cross-compliance framework needs to reconsider the protection afforded to semi-natural habitats, including HNV farmland. Post 2020, the cross-compliance framework could be expanded to include a GAEC standard that makes specific mention of the protection of semi-natural habitats as a compulsory standard, with a particular focus on semi-natural grasslands. Despite being compulsory, Member States would have discretion over how to achieve this standard and would need to stipulate how and where the measure should apply. The standard could be articulated in a similar way to the current GAEC standard covering landscape features (see Table 5-17 above).

Issues may arise with the availability of data with which to assess whether the GAEC standard has been followed and in the suitable adoption of any nationally described measures.

This option could address the avoidance of damage stage of the mitigation hierarchy but would require a formal change to the CAP.

Policy Option Evaluation

Table 5-24 Evaluation of the effectiveness, efficiency and policy coherence of Option CAP 7: Include preservation of semi-natural habitats, in the cross-compliance framework as an alternative to CAP Option 4.

Evaluation criteria	Assessment of policy option's potential contribution to NNL
1. Effectiveness	
Mitigation hierarchy stages	Avoidance of damage stage of the hierarchy.
Land use impacts	Increased protection of semi-natural habitats but could have displacement impacts elsewhere.
Potential coverage and impacts on biodiversity	Moderate-High: High if effectively implemented and linked to CAP 3 maps, but uncertain as dependent on Member State interpretation.
Potential coverage and impacts on ecosystem services	Moderate-High: High if effectively implemented and linked to CAP 3 maps, but uncertain as dependent on Member State interpretation. Main benefits for regulating and cultural services associated with semi-natural habitats. Provisioning services for traded commodities may be negatively impacted depending on the agricultural production response.
Clarity	Moderate-high. Clear description of standard and appropriate guidance and implementation rules necessary for Member States and land managers.
Measurability	Low.

Feasibility	Moderate-high. Feasible, but requires baseline assessment and mapping of habitats (CAP 3).
Enforceability	Low. Achieving the standard will be dependent on Member State transposition and how and where they apply it, but this option requires change to CAP that may not garner support from all Member States.
2. Efficiency	
Unit costs	
Public: 1-off (€)	Minimal. Establishing regulation on how and where to apply the standard.
Public: Recurring (€/yr)	Unclear.
Private: 1-off (€)	Unclear, due to lack of knowledge on how Member States might apply the standard. Where it is applied, there may be some costs to delimiting those semi-natural habitats requiring protection.
Private: Recurring (€/yr)	Unclear, due to lack of knowledge on Member States' application of the standard. Where it is applied, there may be some costs of 1) maintaining protected semi-natural habitats in good condition, and 2) changing productive activities on areas now protected
Distribution of costs	Costs will fall to farmer based on proximity to designated semi-natural habitats.
Benefits (other than NNL)	
Economic activity	Unclear, possibly low negative - neutral. There may be a small negative impact in areas for which a change in productive practices is required and that leads to less production/revenue, but that could be offset by intensifying areas that remain under production.
Jobs	Unclear, possibly low negative - neutral. There may be a small negative impact in areas for which a change in productive practices is required and that leads to less production/revenue, but that could be offset by intensifying areas that remain under production.
Health/quality of life	Low positive. Areas considered for exclusion have high levels of provisioning and regulating ecosystem services, and occur in semi-natural landscapes where populations occur.
Other	
3. Coherence	Moderate-High. This option helps plug a gap in current policy to help achieve NNL objectives, and also supports broader greening objectives of CAP. However, its interpretation and application is up to Member States, so that leaves room for application that reduces coherence.

5.7 Soil policy and the proposed Soil Directive

Soil biodiversity is an essential component of most ecological functions in soils (de Vries et al, 2013; Turbé et al, 2010), and soil degradation adversely affects soil biodiversity, notably due to the decrease in soil organic matter (Pulleman et al, 2012). The European State of the Environment report considers that soil degradation is accelerating in many parts of Europe, due to *inter alia* the loss of soil organic matter, soil erosion, soil sealing, compaction and contamination (EEA & JRC, 2010). The pressures of soil degradation, land use change and invasive alien species in soils are also assessed as constituting a widespread threat to soil biodiversity in Europe (Gardi et al, 2013). Soil degradation is also a pressure on biodiversity more widely through its impacts on water pollution, and its links with groundwater contamination, landslides and other forms of soil erosion, and flooding.

In 2006 the Commission proposed a Soil Framework Directive aimed at the protection of soils. Article 1 of the proposal lists a number of soil functions to be protected, including the 'biodiversity pool, such as habitats, species and genes', and specifies that one of the proposal's objectives is to mitigate human impacts on soil functions, as well as to restore and remediate degraded soils. The Directive takes a risk-based approach to protecting soils through the following main objectives and themes (GenSec, 2009; Jones et al, 2012):

- *Preventative measures*: an obligation on Member States to ensure sustainable use of soil, and to undertake mitigation actions if soil is used in a way that hampers its functions.
- *Awareness raising, reporting and exchange of information*: an obligation on Member States to assess their soils and identify areas where there are threats, and draw up an inventory of contaminated sites.
- *Operational measures*: an obligation on Member States to adopt programmes of measures for identified soil risk areas, national remediation strategies for contaminated sites, and measures to limit or mitigate soil sealing.

Member States have failed to reach a political agreement on the Soil Framework Directive and it has been stalled ever since. A basic division can be seen between Member States who see the Directive as an opportunity to better protect their environment and a blocking minority who are opposed to an EU approach to this issue, preferring it to remain at national level (GenSec, 2009). A key challenge is that dealing with soil threats encroaches on the issues of land owners' rights and land use planning, which are both politically sensitive areas[105]. The priority area approach also causes concerns for some Member States.

The EU Roadmap to a Resource Efficient Europe (European Commission, 2011c) contains an objective on land and soils that states that by 2020, EU policies take into account their direct and indirect impact on land use in the EU and globally, and the rate of land take is on track with an aim to achieve no net land take by 2050; soil erosion is reduced and the soil organic matter increased, with remedial work on contaminated sites well underway. Member States should better integrate direct and indirect land-use and its environmental impacts in their decision making and limit land take and soil sealing to the greatest possible extent; implement the actions needed for reducing erosion and increasing soil organic matter; and set up an inventory of contaminated sites, and a schedule for remedial work (by 2015).

One of the key instruments for soil protection in the EU is the cross-compliance regulation of the Common Agricultural Policy. The 2007-2014 programming period included three GAEC standards related to soil, namely the maintenance of minimum levels of soil cover, land management to limit erosion, and the maintenance of minimum levels of soil organic matter including a ban on burning arable stubble.

5.7.1 Strengths

Existing measures for identifying, avoiding and reducing potential impacts

In the absence of dedicated EU legislation on soils, the Commission has been taking action on the other aims of the Soil Thematic Strategy, namely the integration of soil protection

[105] IEEP analysis briefing 17 July 2009 "Member State deadlock over the proposed Soil Directive continues"

into existing policies, research and monitoring, and awareness raising (European Commission, 2012b). Integration aims have included the CAP, particularly the cross-compliance requirements, the introduction of a provision that sets a sort of "zero tolerance" policy for new pollution from installations in the Industrial Emissions Directive[106] and reporting of soil pollution in the European Pollutant Release and Transfer Register[107]. The Commission is preparing guidance on reducing rates of soil sealing (Prokop et al, 2011). Soil biodiversity monitoring efforts are being developed and standardised by FP7-funded research programmes[108] and others (Bell et al, 2008; Martin et al, 2011; Turbé et al, 2010), and by the activities of the Joint Research Centre[109] (Gardi et al, 2009; Tóth et al, 2013).

The CAP cross-compliance GAEC standards relevant to soil play a critical role in maintaining a minimum standard of good farming practices, thereby slowing the rate of soil degradation (Angileri et al, 2012; Poláková et al unpublished). Cross-compliance has had a role in improving compliance with the Nitrates Directive, which directly targets water quality but also has an effect on soil quality. In addition, many Member State agri-environment schemes have soil protection as one of their key objectives (Keenleyside et al, 2012).

Existing measures identifying and addressing residual impacts

The restoration of contaminated land is one of the priorities of EU soil policies and strategies. The aim is to restore land to active uses, as well as reducing environmental pollution and stimulating jobs. However, contaminated land is not necessarily damaging to soil biodiversity (eg where heavy metal contamination is associated with the presence of rare species). Therefore, contaminated land restoration needs to take this into account and should be regarded as contributing to NNL of biodiversity and ecosystem services more broadly by reducing contamination of water, and by enabling the productive use of land that spares damaging land use elsewhere (for example by enabling the resumption of agricultural production or denser urban planning).

5.7.2 Weaknesses

The lack of progress on the proposed Soil Directive (or alternative policies that would protect soils) appears to be a major weakness in soil policy as existing measures are failing to halt the increase in soil degradation rates, which continues to be a pressure on terrestrial and aquatic biodiversity across Europe. The trend is likely to continue unless actions are more effective at strategically planning land use and reducing soil sealing, avoiding soil erosion, preserving soil organic matter and decreasing soil compaction and salinization of agricultural soils (see section 3.2.3), and reducing soil contamination (European Commission, 2012b).

[106] Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) (Recast).
[107] E-PRTR at http://prtr.ec.europa.eu/
[108] Eg the RAMSOIL project identified a number of risk assessment methodologies for soil degradation processes, demonstrating comparability among different methodologies; the ENVASSO project has proposed minimum requirements for a gradual harmonisation of soil monitoring activities and policy-relevant soil indicators.
[109] Eg the LUCAS land cover and land use survey now includes a specific soil module and the first soil monitoring data is expected soon.

5.7.3 Opportunities

The proposal for the Soil Framework Directive continues to be supported by a majority of the European stakeholders and Member States[110]. However, the Commission has recently proposed to "*examine carefully whether the objective of the proposal…is best served by maintaining the proposal or by withdrawing it, thus opening the way for an alternative initiative in the next mandate*"[111].

In addition, the EU Decision on accounting rules for Land Use, Land Use Change and Forestry (LULUCF) requires that Member States develop and implement soil monitoring systems and prepare mandatory accounting of greenhouse gas emissions from agricultural activities and wetlands by 2020. The availability of such monitoring systems is critical for effective implementation of measures to reduce GHG emissions from soils and increase the capacity of soils to sequester carbon[112].

5.7.4 Policy options

Soil Policy Option (SD 1): Adopt and implement the proposed Soil Directive

This policy option assumes the adoption of the Soil Framework Directive in its current form. The current wording gives Member States a large scope to set targets and to decide how and by when to achieve them, and emphasises voluntary codes, good practices, best available techniques and information sharing. The process of identification and inventory of contaminated sites now contains significant Member State flexibility in response to concerns about cost-effectiveness of the soil contamination inventory and remediation obligations.

The costs of implementation are taken from the impact assessment of the Soil Framework Directive proposal[113]. These should be regarded as indicative only. The Directive does not establish who bears the costs of its implementation, as this will be decided by each Member State. Depending on the funding schemes they will adopt, costs will be borne in varying degrees by land users, economic sectors, national budgets or the EU budget. Because the proposed Directive gives Member States flexibility to decide on risk acceptability, to define targets and take measures to meet those targets, it is not possible to fully assess the environmental, economic and social impacts.

The Commission website states, however, that it expects that by encouraging a sustainable use of soil and taking a preventive approach, the Member States will save costs which so far

[110] The opposing Member States are Germany, France, UK, Austria, Netherlands and Malta (see AgraFacts newsletter No 73-13 at http://www.agrafacts.com/Home.html

[111] Annex of European Commission (2 October 2013) Regulatory Fitness and Performance (REFIT): results and next steps. COM(2013) 685 final. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions.

[112] Decision No 529/2013/EU of the European Parliament and of the Council of 21 May 2013 on accounting rules on greenhouse gas emissions and removals resulting from activities relating to land use, land-use change and forestry and on information concerning actions relating to those activities.

[113] See impact assessment at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52006SC0620:EN:HTML and questions and answers http://europa.eu/rapid/press-release_MEMO-06-341_en.htm

were borne by society, and that these benefits will by far outweigh the additional costs of the Directive[114]. Not all costs will be incurred simultaneously and the distribution of costs and benefits will not be even among Member States. Some threats are more important in certain Member States than others and some Member States are more advanced than others in combating soil degradation.

Policy Option Evaluation

Table 5-25 Evaluation of the effectiveness, efficiency and policy coherence of SD 1: Adopt and implement the proposed Soil Directive

Evaluation criteria	Assessment of policy option's potential contribution to NNL
1. Effectiveness	
Mitigation hierarchy stages	All stages.
Land use impacts	Spatial planning impact of measures to reduce soil sealing. Restoration of contaminated land. Agricultural land, especially arable land, and associated water courses. Urban and industrial brownfield sites. Areas at high risk of soil erosion and desertification, eg sloping land, mountainous areas, steppe, coastal land.
Potential coverage and impacts on biodiversity	Moderate: mainly benefiting agricultural soil biodiversity and other species dependent on it; but uncertain as will be depend on final outcome and implementation.
Potential coverage and impacts on ecosystem services	Potentially high, especially regarding soil condition, water quality and carbon sequestration; but uncertain as will be dependent on final outcome and implementation.
Clarity	Dependent on Member State interpretation
Measurability	Due to the high degree of flexibility accorded to Member States, there are few clear targets to measure. There is a reporting requirement for the inventory of contaminated sites.
Feasibility	Soil biodiversity monitoring techniques and EU-wide programmes are still in the research and development stage, and are unlikely to be implemented across the EU for a number of years. More general EU-wide soil degradation monitoring systems are developing more rapidly.
Enforceability	Due to the high degree of flexibility accorded to Member States, there are few clear targets to enforce. There is a high reliance on "soft" policy options.
2. Efficiency	
Unit costs	
Public: 1-off (€)	The overall costs for the identification of risk areas are likely to be less than €2 million per year for the whole of the EU. The costs for the first five-year stage to establish an inventory of contaminated sites, based on a preliminary inventory are estimated at about €51 million per year.
Public: Recurring (€/yr)	On site investigations of sites identified in the inventory of contaminated sites to check if there is indeed a serious risk to human health or the environment might cost up to an upper bound annual amount of €240 million during the full 25 year period provided for completing the inventory (based on a scenario approach as the number of potentially contaminated sites is unknown).
Private: 1-off (€)	Uncertain
Private: Recurring (€/yr)	Uncertain

[114] Estimated costs of soil degradation include: erosion: €0.7 – 14.0 billion (in 13 Member States at most risk); organic matter decline: €3.4 – 5.6 billion; salinisation: €158 – 321 million (only 3 MS); landslides: up to €1.2 billion per event; contamination: €2.4 – 17.3 billion

Distribution of costs	Dependent on Member State interpretation
Benefits (other than NNL)	
Economic activity	The restoration of contaminated sites is expected to stimulate economic activity associated both with the restoration activities and with the subsequent land uses facilitated by the restoration.
Jobs	The restoration of contaminated sites is expected to create employment.
Health/quality of life	Reduced soil erosion will improve soil and air quality in human habitations in affected areas.
Other	The sustainability and resilience of agricultural production is expected to improve long-term as a result of improved soil protection measures. Increased knowledge and expertise associated with soil quality monitoring and assessment.
3. Coherence	High, as it would support Soil Thematic Strategy and wider policy goals including the EU Roadmap to a Resource Efficient Europe, climate policy and key ecosystem elements of the 2020 biodiversity target.

5.8 Forest policy

Although the EU has limited competency over forests and forestry activities,[115] there is a long history of Community initiatives to protect and encourage the sustainable use of forests and associated biodiversity and ecosystem services, including the past and new EU Forest Strategy. The EU also participates alongside Member States in a number of international processes that influence EU policies with regard to forests, notably the pan-European FOREST EUROPE process, and the United Nations Forum on Forests. The EU represents the Union in the CBD Work Programme on Forest Biodiversity, and climate change negotiations under UNFCCC.

A wide range of EU policies affect forests, the most influential being the EU Forest Strategy, the CAP (in relation to funding for forest management and afforestation – see section 5.6), the Habitats and Birds Directives (in relation to protection and management of high biodiversity forest), the Renewable Energy Directive (in relation to bioenergy targets), climate policy (in relation to LULUCF accounting), the regulatory framework for wood and wood-based products, and phytosanitary and plant reproductive materials regulations. National-level and regional-level policies affecting forests include forest law, forest fire regulations and preventative measures, policies directing the public or state-owned forest sector and funding sources, phytosanitary measures to control forest pests and diseases including invasive alien species, and policies governing public participation in forest policy.

A limited amount of funding that may support forest biodiversity and ecosystem services conservation and restoration at the EU level is provided under the European Fund for Agriculture and Rural Development (EAFRD). However, Member States can use their discretion regarding their relative allocation of EFARD funding to agriculture and to forestry. Forest genetic diversity conservation is funded by European research programmes and national programmes.

[115] The forest sector is not included in the provisions of the Founding Treaty or the Lisbon Treaty

There is currently no EU-wide system of regular monitoring and reporting on forest biodiversity, so it is difficult to draw conclusions on the effectiveness of national and EU measures at preventing biodiversity loss in forests. However, there is evidence that current forest management practices (eg that lead to mono-cultures, even-aged stands and low amounts of dead wood) are not maintaining biodiversity or associated ecosystem services. According to Member State reporting under the Habitats Directive, nearly two-thirds of forest habitats of Community interest are currently in unfavourable or unknown conservation status, including almost all of the Atlantic, Boreal and Pannonian forest habitats (EEA, 2010a). There are also known cases of illegal logging of Natura 2000 sites[116]. The condition of forests in the wider environment is also of concern. For example, current deadwood quantities in commercial forests are far too low to maintain the biodiversity dependent on this habitat (Mueller and Bütler, 2010), and "business as usual" scenarios of forest use project continuing losses to 2020 (UNECE & FAO, 2011b).

Growing demand for wood as a source of bioenergy is increasing the pressures on forest biodiversity, as described in section 3.2 (and see discussion under Weaknesses below). For example, a report on forests in the Czech Republic concludes that strict standards for forest residue extraction are urgently needed, as well as targets for the establishment of new areas of forest and agroforestry for bioenergy, as well as reinstatement of coppice management (Postulka, 2012).

5.8.1 Strengths

Existing measures for identifying, avoiding and reducing potential impacts

European Member States are bound by the Forest Europe principles and the upcoming Legally Binding Agreement (LBA) on Forests in Europe[117]. This includes a commitment to **Sustainable Forest Management** (SFM) principles, defined as forest use that "*maintains biodiversity…and that does not cause damage to other ecosystems*"[118]. The new **EU Forest Strategy**, published on 20 September 2013 (European Commission, 2013f), sets the overall objective of ensuring and demonstrating that all forests in the EU are managed according to SFM principles by 2020 (referring to the definition and criteria for SFM agreed in FOREST EUROPE) (but see discussion of criteria and indicators under weaknesses below).

The Strategy provides a framework for forest-related actions by the EU and Member States. It recognises that forest policy is a competence of the Member States, but states that the EU can contribute to the implementation of SFM through common policies, and stresses the

[116] Eg see reporting illegal logging in Hungary, available at http://europa.eu/rapid/press-release_IP-10-526_en.htm and http://www.illegal-logging.info/content/forester-calls-stricter-controls-illegal-logging; illegal logging in Bialowieza forest, Poland, see http://www.illegal-logging.info/content/poland-limit-deforestation-primeval-bialowieza

[117] The negotiations are to be concluded by the end of this year so that the Agreement can be adopted by all parties, including the European Union

[118] MCPFE (now FOREST EUROPE) Helsinki Resolution H1 1993 Preamble clause A: " *"sustainable management" means the stewardship and use of forests and forest lands in a way, and at a rate, that maintains their biodiversity, productivity, regeneration capacity, vitality and their potential to fulfil, now and in the future, relevant ecological, economic and social functions, at local, national, and global levels, and that does not cause damage to other ecosystems*."

need to improve coordination, communication and cooperation in all policy areas that are of relevance to the forest sector. This follows the same line as the previous EU Forestry Strategy, adopted in 1998, and the supporting EU Forest Action Plan, adopted in 2006. The **implementation** of the new EU Forest Strategy should be able to build on the extensive consultation process with both Member States and stakeholders, as well as the EU coordination structure for forest policy established under the previous EU Forest Action Plan, including the Standing Forestry Committee, the Advisory Group on Forestry and Cork, and the Commission Interservices Group on Forests (Pelli et al, 2012).

Certified forests (eg under FSC or PEFC) are rapidly becoming more widespread and **certification** could play a role in achieving the NNL target in synergy with improving SFM standards, though they do not address forest biodiversity conservation directly (Clark and Kozar, 2011; Elbakidzel et al, 2011; Johansson et al, 2013; van Kuijk et al, 2009).

The EU Forest Strategy highlights the multi-functional importance of forests for rural development, for forest-based industries, bioenergy, and climate change mitigation and adaptation, and emphasises that the impacts of other policies on forests and developments taking place beyond forest boundaries should be taken into account. It addresses aspects of the "value chain" (ie the way forest resources are used to generate goods and services) which strongly influence forest management.

In addition to the EU level measures, most EU Member States have **national and/or regional laws** that make forest clearance and conversion to other land uses very difficult, and in many cases the forest owner is obliged to reforest the land area within a certain time period (through planting and/or natural regeneration) (Bauer et al, 2004). This means that large-scale conversion of forest cover into other land uses is rare (but see the limitations under weaknesses below). Some Member States have legal forest protection measures. For example in Germany, under Article 14 (Interventions in nature and landscape) of the Federal Nature Conservation Law, regarding the use of woodlands for forestry purposes, the aim must be to establish semi-natural forests and to manage these sustainably without clear-felling. An adequate proportion of native woodland plants must also be retained.

Existing measures identifying and addressing residual impacts

The EU Forest Strategy does not directly address residual impacts and is therefore not a comprehensive NNL strategy. However, it does provide a framework that could in future incorporate measures that could be used to tackle residual impacts.

As discussed in section 3.2, forest area has increased over recent decades in most EU countries, and this trend is expected to continue. This is partly intentional as many Member States have targets to increase forest cover (eg the UK) and legislation that protects forests also often requires reforestation after clear cutting. Thus in many countries, although major changes in forest type and condition may occur, there is NNL of forest cover. However, there is emerging evidence that the trend of increasing forest cover has significantly slowed down between 2006 and 2010 and gross deforestation compared to 1990 has taken place in a number of Member States (Nabuurs et al, 2013).

5.8.2 Weaknesses

Existing measures for identifying, avoiding and reducing potential impacts

As described in section 3.2.3, demands for woody biomass from forests are expected to increase substantially across the EU over the next decade, whilst pressures on forest biodiversity from climate change combined with large-scale wildfires, air pollution and invasive pests and diseases are also expected to increase (European Commission, 2010b). Whilst it has been calculated that European forests could supply considerably more biomass by 2030 (Mantau et al, 2010; Verkerk et al, 2011b), it is also clear that these projected rates of removal would have serious negative impacts on forest biodiversity (Mueller & Bütler, 2010; Verkerk et al, 2011a). At the same time, demands to harvest mature forest for biomass for energy could conflict with both the goal of maintaining levels of carbon sequestration in forests and maintaining and increasing the proportion of old-growth stands for biodiversity (Nabuurs et al, 2013). If NNL of forest biodiversity and ecosystem services is to be achieved, then rigorous production standards will need to be developed. Currently, although there is some debate over this, these may be introduced through measures under the Renewable Energy Directive. Alternatively, the demand for forest biomass for bioenergy will have to be met from other sources, which may mean transferring biodiversity losses to other parts of the world due to the impact of increased wood imports (Cuypers et al, 2013), or may mean displacing significant areas of other land uses such as agriculture with short-rotation coppice (UNECE & FAO, 2011b).

The fundamental weakness of the current EU Forest Strategy, as well as the previous EU Forestry Strategy and Forest Action Plan, is that it does not impose binding targets or other compelling structures to implement forest policies across the EU27, and is based on voluntary compliance by Member States. Consequently, the ex-post evaluation of the Forest Action Plan in 2012 (Pelli et al, 2012) found that although many of the Plan's actions were implemented, there appeared to be little evidence that it stimulated additional actions. As a voluntary instrument, with no specific resources earmarked for implementation, actions were funded through existing resources, such as Member State RDPs and other EU and national funding instruments. The ex-post evaluation showed that this non-binding approach has had only limited impact on policy processes or implementation at EU and Member State level, and that it was not possible to discern what impact, if any, the Forest Action Plan had on biodiversity conservation objectives[119]. Furthermore, the current Legally Binding Agreement (LBA) on Forests negotiations is also failing to set any concrete, measurable and enforceable targets, or to make reference to other existing targets for forest biodiversity[120].

[119] A number of Member States simply listed their LIFE projects on forest biodiversity as evidence for the FAP objective on forest biodiversity conservation.

[120] BirdLife Europe 10 June 2013, Warsaw. NGO Opening Statement to the 4th session of the Intergovernmental Negotiating Committee (INC) for a Legally Binding Agreement (LBA) on Forests in Europe (INC 4). Available at http://www.birdlife.org/action/change/europe/forest_task_force/Publications.html

It is hoped that the new strategy will be empowered by a strong ownership from the European Commission, Member States, and other forest-related stakeholders[121], but there is concern that a continuation of the voluntary bottom-up approach will not be strong enough to deal with the expected conflicts of interest and trade-offs between different forest functions in the future (Winkel et al, 2009). Environmental NGOs criticise the Forest Europe approach to SFM, to which the EU Strategy refers, noting that it provides nothing new to improve the state of Europe's forests and continues the bias to economic productivity of forests, overlooking social, environmental and cultural aspects[122]. Unless a more rigorous and effective EU-wide evaluation process succeeds in applying peer-pressure on Member States in the future, it is possible that the new policies will not result in any improvement in biodiversity conservation under SFM.

At the national level, though legislation generally hinders large-scale conversion of forest cover into other land uses, these obligations do not generally specify reforestation with native species, and therefore do not regulate the conversion of areas of forest into plantations of non-native species, which have low biodiversity values and often a reduced range of ecosystem services.

National Forest Programmes take a wide range of approaches to SFM, and there is currently no EU-wide system of regular **monitoring and reporting**, so it is difficult to draw conclusions on their effectiveness at preventing biodiversity loss. Effective monitoring and assessment is a prerequisite for effective policy action. Although Forest Europe has adopted a set of SFM indicators and produces regular reports, the data are seldom used either in national biodiversity datasets or in other sector reporting, due to the lack of harmonisation and standardisation and the gaps in coverage (Inhaizer et al, 2013). There are few EU-wide methodological standards defining forest monitoring and implementation instruments (Winkel et al, 2009).

A further weakness in the protection of forest relates to the application of EIA and SEA procedures. As discussed in section 0, many forest developments such as afforestation or clear-felling are supposed to be subject to EIAs. However, these activities often appear to be screened out of the need for an EIA or are inadequately assessed. Furthermore, SEA and EIA procedures, and national forest legislation, are not limiting the on-going fragmentation of forest habitat through transport and energy infrastructure and through piecemeal urbanisation and infrastructure development (EEA & FOEN, 2011). The long trend in expansion of EU forest area, by both natural regeneration and afforestation, has not necessarily improved forest habitat connectivity (Forest Europe et al, 2011).

Current funding of forest conservation management and restoration measures through RDPs is relatively low in relation to agricultural spending (as opposed to afforestation)

[121] Report to the Standing Forestry Committee by the Standing Forestry Committee ad hoc Working Group VIII contributing to the development of a new EU Forest Strategy. SUMMARY AND RECOMMENDATIONS. 2012. At http://ec.europa.eu/agriculture/fore/publi/sfc_wg7_2012_summ-and-recommend_en.pdf

[122] Press Release 18 June 2013. NGOs reject proposed text of the legally binding agreement on forests. FERN, Friends of the Earth Europe, BirdLife Europe, ClientEarth and a coalition of other NGOs. http://www.fern.org/sites/fern.org/files/Broad%20NGO%20rejection%20of%20European%20Forest%20Convention.pdf

(European Commission, 2009c), and may be subject to further pressures from cuts as discussed in section 5.6. Because forest agri-environment schemes are more difficult to audit in accordance with CAP rules, due to the lack of a cross-compliance baseline for forests, forest agri-environment funding tends to take second place to agri-environment schemes for agricultural land.

Existing measures identifying and addressing residual impacts

Current EU and national forest policies and legislation focus on the avoidance and reduction of impacts, and this is appropriate given the very high complexity, sensitivity and biodiversity value of many forest habitats, and consequently the difficulty of replacing them through offsets. However, it is not possible to avoid all residual impacts and therefore an important weakness of the current policy framework is that residual impacts in terms of biodiversity and ecosystem services (rather than simple forest cover) are largely overlooked. Without measures to address this policy gap it is unlikely that the EU NNL objective will be achieved in forest ecosystems.

5.8.3 Opportunities

The new EU Forest Strategy states that all forests across the EU must be managed according to SFM principles by 2020. This target is reinforced by the EU Biodiversity Strategy 2020 Target 3B on forests, which requires that by 2020 all public forest and all forests above a certain size that receive Rural Development funding should have a **forest management plan** or equivalent instrument, in line with SFM, in order to bring about a measureable improvement in the conservation status of species and habitats and in the provisions of related ecosystem services. The improvement should be both quantitative and qualitative, thus considering as large a coverage as possible (ie mandatory requirements to have Sustainable Forest Management Plans on the largest number of holdings) and quality (ie the Plans need to bring a measureable benefit for biodiversity by including measures such as: deadwood levels, ecosystem-based measures, Natura 2000 measures and afforestation according to Pan-European guidelines).

The Commission is currently implementing a **Forest Information System for Europe (FISE)** with modules on biodiversity and forest health and vitality, carbon balance, climate impacts and adaptation, as well as on biomass and bio-economy related variables[123]. The prototype will be published by the European Forest Data Centre by 2016[124]. The new Forest Strategy emphasises coordinated, harmonised monitoring and assessment[125].

[123] Summary Report of the 129th Meeting of the Standing Forestry Committee 28 June 2013 at http://ec.europa.eu/agriculture/committees/forestry/129.pdf
[124] http://forest.jrc.ec.europa.eu/efdac/
[125] European Commission (2012) Towards a New EU Forest Strategy. Presentation to the Advisory Committee on Forest-based Industries, 20 November 2012. Available at: http://ec.europa.eu/enterprise/sectors/wood-paper-printing/files/advisory-committee/20-11-2012/agri-mh-new-forest-strategy-markus-f-bi-ac_en.pdf

The revised carbon accounting requirements on LULUCF[126] provide an additional incentive for Member States to maintain and enhance sustainable forest management in terms of forest carbon sequestration and carbon storage.

5.8.4 Policy options

Member States are divided over the degree to which they see a need for stronger forest policy at the EU level. The need for greater policy coherence and funding is widely recognised in European fora and reports, but there is also resistance from some Member States against EU forest policy initiatives (Winkel et al, 2009). This partly reflects differences in Member States' weighting of the economic role of the forestry sector versus environmental and social benefits of forests. With this in mind as well as the opportunities to address the policy weaknesses that are described above, two policy options are described below that would significantly reduce impacts on forests whilst being practical and realistic.

In accordance with the mitigation hierarchy, and given the long time that is required to offset residual impacts on forests (typically over 100 years), the policies focus primarily on avoiding impacts on the most valuable forests and reducing impacts from forest management. Nevertheless, where unavoidable residual impacts remain it is necessary, in order to achieve NNL, to attempt offsetting as much as is feasible through offsetting policy options as described in section 5.10.5.

Another much more ambitious policy option would be to develop a framework directive for forests, in a similar manner to the WFD and MSFD. The aim of such a directive would be to firstly define minimum standards for the biological condition of forests, according to their types and uses, and then for Member States to take the necessary actions to maintain and where necessary restore forests according to these standards; eg a 'good status' of all forests in the EU by 2030. This option would provide more appropriate, clearer and ambitious measures of forest condition than included in the SFM definition and have greater legal force, and would therefore be enforceable. The framework would need to include sufficient flexibility for Member States to define 'good status' according to local conditions, but also sufficient guidance for it to be transparent, equitable, and enforceable.

The instrument would have to be related to a legally based EU competence as fixed by the primary legislation of the Community, which could be achieved by referring to the EU competence in the environment and the legal competence established by the application of the CAP to forests (Kokko et al, 2006). However, wide political support for the preparatory Green Paper was not found (Edwards and Kleinschmit, 2013), and the political legitimacy of such a policy initiative would be difficult to justify without it. Given the current renewal of the EU's Forest Strategy and resistance from some Member States against EU forest policy initiatives such political backing would not be achievable at the moment. However, the development of a framework directive with binding forest standards could be a future option if the new Forest Strategy is not effective.

[126] Decision No 529/2013/EU of the European Parliament and of the Council of 21 May 2013 on accounting rules on greenhouse gas emissions and removals resulting from activities relating to land use, land-use change and forestry and on information concerning actions relating to those activities.

Forest Policy Option 1 (FP 1): Develop a rigorous standardised accountable forest monitoring and evaluation system

To be effective the new Forest Strategy will need to be underpinned by a more rigorous, standardised, and accountable forest monitoring and evaluation system based on a long-term institutional commitment (Winkel et al, 2009). This will be the case no matter how the Strategy is developed and SFM defined, but it will be especially important if the Strategy adopts a NNL objective as suggested in Forest Policy Option 2 (see below). To achieve this aim, comprehensive, comparable and reliable data need to be gathered in a transparent manner, and made available to a wide public on a regular basis. This will require Member States to agree on a consistent methodology, and a consistent network of long-term observations, complemented by a flexible early-warning system that will allow timely preventative action to new potentially harmful threats to forest biodiversity.

An effective EU-wide forest monitoring scheme will require long-term financial support and an appropriate legal foundation at the EU level, in accordance with the EU Forest Strategy and coherent with other EU policy affecting forests, notably in relation to carbon monitoring and reporting, invasive pests and diseases, forest fire, and other factors affecting forests. National Forest Programmes will need to be integrated into the system, with agreed criteria and indicators and regular reporting requirements. Further research and coordination will also be required to provide a basis for developing common standards and guidelines.

In order for this monitoring information to have an impact on Member States policy, it needs to be directed by a strengthened governance structure at the EU level that includes the Standing Forestry Committee and effective stakeholder participation.

Policy Option Evaluation

Table 5-26 Evaluation of the effectiveness, efficiency and policy coherence of forest policy option FP 1: Develop a rigorous standardised accountable forest monitoring and evaluation system

Evaluation criteria	Assessment of policy option’s potential contribution to NNL
1. Effectiveness	
Mitigation hierarchy stages	Avoidance and reduction of negative impacts.
Land use impacts	Depending on use, some positive impacts on forest management and condition, not on extent or location.
Potential coverage and impacts on biodiversity	Moderate, widespread benefits for forest species, mainly outside N2k sites and for species not covered by the Habitats and Birds Directives.
Potential coverage and impacts on ecosystem services	Moderate, widespread securing the provision of ecosystem services from forests, but mainly outside N2K sites.
Clarity	Moderate. This option is aimed at providing a coordinated and harmonised approach to measuring forests, but care will need to be taken to ensure clarity of policy options for such a technical topic.
Measurability	Low. Although it will be difficult to measure the direct impact of this policy option on attaining NNL, it will be crucial to achieving better design and measurability of all other forest policies in EU and MS.
Feasibility	High. As long as sufficient funding is made available at EU level, the technical

	capacity is present in Europe to implement such a system.
Enforceability	Moderate-High. This option should be relatively well received, and as long as it is supported by strengthened governance structures at EU level, should be achievable.
2. Efficiency	
Unit costs	
Public: 1-off (€)	Low-moderate. Establishment of system and strengthening of relevant governance structures.
Public: Recurring (€/yr)	Moderate. Costs to EU or Member States of implementing forest monitoring.
Private: 1-off (€)	n/a
Private: Recurring (€/yr)	n/a
Distribution of costs	All public costs.
Benefits (other than NNL)	
Economic activity	Low, but some increased demand for expertise related to forest monitoring.
Jobs	Low, but some increased demand for expertise related to forest monitoring.
Health/quality of life	Possible indirect, positive benefits of improved forest management.
Other	n/a
3. Coherence	Depends on design of system, but should be high as this will work towards achieving a number of EU goals and international commitments related to forests, biodiversity and climate.

Forest Policy Option 2 (FP 2): Include targets that contribute to NNL of biodiversity and ecosystems within Sustainable Forest Management in the new EU Forest Strategy and Action Plan

Under this option the new EU Forest Strategy target on SFM would specify that SFM contributes to the achievement of the NNL of forest biodiversity and ecosystem services by 2020, primarily by avoiding and minimising impacts. This would require the development of baseline requirements for dead wood, ages of stands, methods of logging, stump removal, soil protection, fertiliser use, drainage and other management factors affecting biodiversity. Standards would need to be regional- and forest-type specific, and would require significant research and stakeholder consultation in order to achieve consensus on baseline thresholds (Kappes et al, 2009; Lassauce et al, 2011; Mueller & Bütler, 2010). A likely option would be a complete ban on residue and stump removal (UNECE & FAO, 2011b).

The SFM principles would also make reference to the requirement for Habitats Directive Annex I forest habitats to achieve Favourable Conservation Status. This would include a requirement for all Natura 2000 forests to have a management plan or equivalent measure in place by 2020, and should make reference to the Biodiversity Strategy targets with regard to restoration of degraded forest and quantitative improvements in habitats and species assessments.

As the Forest Strategy is a voluntary instrument, building on subsidiarity, the achievement of these targets will be dependent on strengthened Member State cooperation and coordination with coordinated stakeholder involvement, and supported by strengthened monitoring and assessment (see forest policy option 1). The European Parliament has recommended that "active SFM should be clearly mainstreamed and prioritised in research and practice" (European Parliament, 2011).

Policy Option Evaluation

Table 5-27 Evaluation of the effectiveness, efficiency and policy coherence of forest policy option FP 2: Include targets that contribute to NNL of biodiversity and ecosystems within Sustainable Forest Management in the new EU Forest Strategy and Action Plan

Evaluation criteria	Assessment of policy option's potential contribution to NNL
1. Effectiveness	
Mitigation hierarchy stages	Avoidance and reduction/mitigation.
Land use impacts	May increase forest cover and improve forest status.
Potential coverage and impacts on biodiversity	Moderate-high, potentially widespread benefits for forest species, mainly outside N2k sites and for species not covered by the Habitats and Birds Directives, but uncertain as dependent on Member State uptake and interpretation of SFM.
Potential coverage and impacts on ecosystem services	Moderate benefits in terms of forest related ecosystem services, but uncertain as dependent on Member State uptake and interpretation of SFM.
Clarity	Moderate. A series of targets and baseline requirements could be confusing, but if developed through strong stakeholder engagement, should be clear.
Feasibility	Moderate. It is feasible with current capacity, but is unlikely to be developed fast as the Forest Strategy is already almost finalised and substantial research and consensus-seeking is still needed.
Enforceability	Low. The targets and baselines would likely be accepted by most stakeholders because they would be developed through a consultation process. Additionally, they would be based on voluntary measures, so acceptable, but also not enforceable.
2. Efficiency	
Unit costs	
Public: 1-off (€)	Minimal costs to consult and develop targets.
Public: Recurring (€/yr)	Minimal costs to monitor and potentially enforce targets.
Private: 1-off (€)	Negligible, potentially some costs associated with participating in consultative target development.
Private: Recurring (€/yr)	Variable opportunity costs for the forestry sector depending timber production impacts, which will depend on the targets established by each Member State.
Distribution of costs	Cost would primarily affect the forestry sector.
Benefits (other than NNL)	
Economic activity	Possible low increase in economic activity (see "Other" below).
Jobs	Possible low increase in labour demand (see "Other" below).
Health/quality of life	Could have substantial benefits for recreational value of forests, and also increase availability of non-timber forest goods.
Other	Clear targets could reduce business uncertainty and competitive barriers in the timber and other forest related industries, improving competitiveness and economic efficiency.
3. Coherence	Moderate. Would fill a major biodiversity policy gap in terms of achieving NNL, but also the broader 2020 target for biodiversity and ecosystem services, as well as contributing to wider policy goals, eg climate and WFD. However, lack of regulatory force means that coherence is uncertain.

5.9 EU funding instruments for regional policy, transport and energy

Although small in size compared to national budgets the EU's Multi-annual Financial Framework (MFF) has a policy lever function and currently provides important funding for measures that can significantly affect biodiversity and ecosystems in detrimental or beneficial ways. Much of the EU's regional funding is used for infrastructure projects such as those relating to the improvement of transport and energy networks, water resources and waste disposal, and other activities that aim to support development and economic growth. Many such activities may be damaging for biodiversity, but where this is the case potential impacts are normally examined through SEA and EIA procedures, although (as discussed in Section 0), these do not normally result in NNL of biodiversity. However, more stringent obligations included in the Habitats Directive to avoid impacts and compensate for unavoidable residual impacts come into play where Natura 2000 sites are affected.

5.9.1 Strengths

Existing measures for identifying, avoiding and reducing potential impacts

In contrast to the concerns over the possible detrimental impacts of regional funds on biodiversity, there is also an increasing recognition of their potential to play a larger role in biodiversity conservation in future, in particular through the greater use of funds that support EU Cohesion Policy, namely the Structural Funds (ie **European Regional Development Fund** – ERDF and the **European Social Fund** – ESF) and the **Cohesion Fund**. Whilst each of these funds has its own spending priorities the intention is that they should pursue common goals as well. Given the scaling-back of dedicated biodiversity funding in Pillar Two of the CAP (as discussed in section 5.6), and a reduction in funding under the LIFE+ programme, the increased mainstreaming of biodiversity within other policy funding streams is increasingly important[127].

Biodiversity and Green Infrastructure are included within the Common Strategic Framework (CSF) proposed by the Commission in March 2012 as priority actions for the ERDF and the CF under the thematic objective of 'protecting the environment and promoting resource efficiency'. Therefore, Cohesion Policy funds provide a significant opportunity to support biodiversity conservation objectives, including ecosystem restoration that may contribute to Target 2. The importance of nature and Green Infrastructure has been formally recognised in the recent guidance on investment in nature and Green Infrastructure for cohesion policy (IEEP & Milieu, 2013).

However, it is important to note that the eligibility for funding under Structural Funds and the Cohesion Fund is linked with supporting broader sustainable socio-economic development and territorial cohesion within the EU. ERDF is generally aimed at strengthening competitiveness and innovation, creating jobs and promoting environmentally sound growth whereas ESF focuses on promoting social inclusion, education and training, and building institutional capacity (eg creating novel employment opportunities). Therefore, even though ERDF and ESF can be accessed by a wide range of stakeholders, actions supported by these instruments need to be linked with the broader

[127] http://ec.europa.eu/environment/nature/natura2000/financing/docs/financing_natura2000.pdf

sustainable development of the region. Nevertheless, there are opportunities to achieve biodiversity and ecosystem service benefits through the major funding objectives (eg Objective 1, Strengthening Research, Technological Development and Innovation, Objective 3, Enhancing the Competitiveness of Small and Medium-sized Enterprises, and Objective 4, Supporting the Shift towards a Low Carbon Economy) which together are allocated 80% of ERDF funds, by pursing projects that provide jobs and stimulate economic growth. These, for example, may include projects that use nature based solutions to environmental problems, such as flood prevention, and ecosystem restoration, which can provide ecosystem service benefits.

Existing measures identifying and addressing residual impacts

The funds provide a potential framework that could be used to provide compensation for policy level residual impacts, particularly where project level offsetting is difficult or inappropriate.

5.9.2 Weaknesses

Existing measures for identifying, avoiding and reducing potential impacts

Although the funds should be subject to SEA, EIA and Appropriate Assessments where Natura 2000 sites are impacted, there are weaknesses in these procedures and as discussed in Section 0, these do not normally result in NNL of biodiversity.

Although there is in theory significant funding available for biodiversity conservation and measures to support ecosystem service delivery (eg through the establishment of Green Infrastructure) actual funding for biodiversity tends to be a small percentage of the potential funding stream. This is in part due to the absence of biodiversity in some funding objectives and a low prioritisation when they are included. It will be essential for the partnership agreements currently being negotiated and the related Operational Programmes to include explicit reference to the potential for the investment in nature and Green Infrastructure to meet Cohesion Policy objectives.

Furthermore, as with most of the EU funds, ERDF and ESF are divided between Member States through national allocations. Member States then allot funding differently between the various budget categories available, including those related to biodiversity. No compulsory earmarking of funds to support biodiversity under the Structural Funds exists. Also, the budget categories available for – or directly relevant to - biodiversity are very broad and leave significant room for Member States to decide what kind of measures funding will be targeted at. Other barriers to the use of regional funds for biodiversity funding include the limited capacity in some Member States to apply for and use funding (eg due to human resources and other constraints) and high administrative burdens in some cases. Consequently, the amount of total funding available for beneficial biodiversity targeted projects is largely dependent on national priorities, capabilities and political considerations.

Existing measures identifying and addressing residual impacts

There is no mandatory requirement for projects using EU funds to address detrimental residual impacts and nor are regional funds used for such purposes.

5.9.3 Opportunities

To encourage Member States to adopt a more strategic approach and to better seize financing opportunities provided by the EU funds, the Commission promotes the developments of Prioritised Action Frameworks (PAFs) under Article 8 of the Habitats Directive. In these PAFs, Member States define the national funding needs, actions and priorities. These are currently being developed by Member States and will feed in to the national or regional Operational Programmes under the relevant EU financial instruments. DG ENV is supporting the process by producing a set of guidance documents for national and EU level programming officials, which have been recently made public (IEEP et al, 2012c). Similarly, DG Regio (with support by DG ENV) has been providing guidance on the investments in nature and Green Infrastructure for cohesion policy (IEEP & Milieu, 2013).

Recognising that many major development projects in the EU are in part dependent on EU funding from, for example, Cohesion Funds or the Connecting Europe Facility relating to transport (TEN-T) or energy (TEN-E), the EU Biodiversity Strategy calls for **Biodiversity-Proofing** of such funds. As a result of this and a recent study for the Commission (IEEP et al, 2012c) there is increasing awareness that appropriate biodiversity and ecosystem service considerations should be incorporated into the high level objectives of each funding instrument. These should ensure biodiversity impacts are at the very least avoided, and where appropriate provide biodiversity benefits, such as, for example, through wider adoption of ecosystem based approaches to climate change mitigation and adaptation and water retention (AHEWG, 2009).

Biodiversity proofing is considered to be a structured process of ensuring the effective application of tools to minimise biodiversity-harmful spending or to act as a catalyst for biodiversity-friendly spending (ie a process-oriented outcome). It applies to all spending streams under the EU budget, across the whole budgetary cycle and at all levels of governance, and should contribute to a significant improvement in the state of biodiversity according to the 2010 Baseline and agreed biodiversity targets[128].

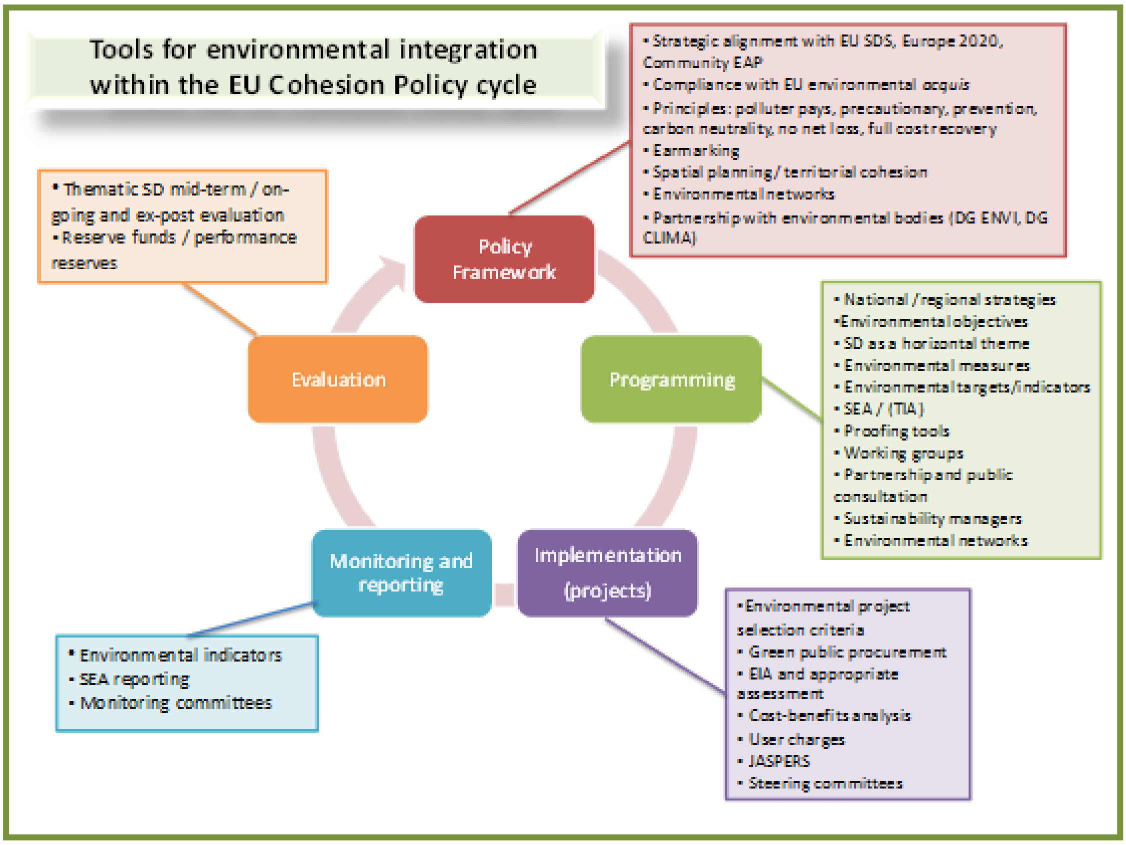
Biodiversity proofing aims to address the use of EU funds both in terms of their appropriate scale (eg to promote funding that meets multiple EU objectives – as discussed above) and quality (eg in relation to improving the performance, coherence and transparency of strategic programming; and enhancing appropriate governance conditions and procedures for better implementation on the ground).

Importantly biodiversity proofing is a process that should be carried out at all stages of the policy cycle, ie during the development/reform of policy frameworks, programming (eg through national strategies and plans), project implementation, project monitoring and reporting, and policy evaluation – as shown in the example relating to Cohesion Policy in

[128] Such as those set in the EU 2020 Biodiversity Strategy (COM(2011) 244 final

Figure 5-2. Therefore it also needs to involve all levels of governance. It is also a step-wise process that should follow the mitigation hierarchy.

Figure 5-2 Example of tools for environmental integration within EU Cohesion Policy



Source: IEEP et al (2012c)

Numerous tools exist to enable biodiversity-proofing, which fall into three key categories:

- Substantive instruments – objective- and target-setting followed by adequate earmarking/allocation of funds, milestones and result indicators, eco-conditionality and performance incentives and corrections ('carrots and sticks'), concrete requirements for biodiversity proofing and policy coherence, etc.

- Procedural instruments – SEA/EIA, tracking expenditure accompanied with biodiversity screening and risk assessment tools, project selection criteria, independent ex-ante, on-going and ex-post evaluations and verification of results, etc.

- Institutional instruments – dedicated administrative units/institutional arrangements tasked with climate change mainstreaming, cross-sectoral coordination and communication mechanisms, environmental networks, working groups and monitoring committees, institutional capacity building and training, improving the knowledge/technical base for expenditure planning etc.

The policy cycle illustrated in Figure 5-2 shows the interplay of these instruments across the different phases of the programming and implementation cycles of the funds. For example, substantive instruments are very important in the first parts of the cycle, ie setting up the general frameworks of the policy and programming guidelines. Objective setting for shares of funds (earmarking) and allocation of funds and setting up concrete requirements for biodiversity proofing tools can only be done at these stages. It is also important to adequately perform SEAs at the programming level. EIA and tracking expenditure approaches accompanied with biodiversity screening and risk assessment tools are relevant for the implementation phase. Authorities can also use biodiversity favourable project selection criteria to steer project selection criteria, both to help minimise trade-offs for those negatively affecting biodiversity and for encouraging investment in natural capital and hence achieving net gain (IEEP & Milieu, 2013).

Procedural instruments are also more important for the monitoring/reporting and evaluation phases, but reserving funds (performance reserves) to reward adequate compliance with provisions constitutes an important substantive instrument in this late phase.

Institutional instruments including dedicated administrative units tasked with biodiversity proofing and communication mechanisms, working groups and monitoring committees need to support the programming and implementation and evaluation phases. Reserving or earmarking funds for institutional capacity building, and training and improving the knowledge/technical base for expenditure planning can help to build early on support.

These instruments can be very effective in terms of avoiding and reducing biodiversity impacts and supporting offsetting where needed to ensure NNL of biodiversity. Furthermore, biodiversity proofing can help to highlight the need for deeper policy coherence, and support the achievement of the EU's broader environmental objectives, such as resource efficiency, as well as socio-economic goals including through the stimulation of green growth.

5.9.4 Policy options

Biodiversity Proofing Policy Option (BP 1): Ensure all EU funds, especially those related to regional policy, transport and energy fully integrate requirements relating to biodiversity and ecosystem services and are subject to biodiversity proofing procedures

In this option, as part of **regional policy** the maintenance of biodiversity and promotion of associated ecosystem services (through, for example, the enhancement of Green Infrastructure) is made a priority in the new thematic objectives of the Common Strategic Framework (CSF) funds including Cohesion Policy. This would include the following two parallel steps:

- Increasing investment in biodiversity and Green Infrastructure by increasing the share of expenditure allocated under the European Regional Development Fund (ERDF) and Cohesion Fund. The European Social Fund (ESF) would also be used to support awareness raising and capacity building of both managing authorities and beneficiaries. For example opportunities to support Thematic Objective 6 of 'protecting the environment and promoting resource efficiency' exist via ERDF (proposed activity: protecting biodiversity, soil conservation and promoting ecosystem services including Natura 2000 and Green Infrastructure) and Cohesion Fund (proposed activity: protecting and restoring biodiversity, including through Green Infrastructures). In addition, opportunities for supporting biodiversity also exist outside the thematic objective dedicated to investment in the environment and resource efficiency; the conservation of nature and maintenance of ecosystem services have synergies with a wide range of policy areas (ie research, innovation, business development, employment, climate change mitigation and adaptation) that are eligible for support from Cohesion Policy.

- Ensuring Cohesion Policy expenditure is effectively biodiversity proofed, through the processes outlined above and described in detail in the DG Environment (IEEP et al, 2012b) as well as in the DG Regio Guide to multi-benefit Cohesion Policy investments in nature and Green Infrastructure (IEEP & Milieu, 2013). The latter underlines that the following areas are promising:

    - *Strategic planning and programming:* via partnership agreements (PAs) and Operational Programmes. Biodiversity and ecosystems should be integrated as a horizontal principle in the PAs and Operational Programmes, responding to Article 8 of the Common Provisions Regulation. Developing "biodiversity-SMART" operational programmes can be facilitated via due use of expert engagement in the Operational Programmes, use of SWOT analysis that builds in biodiversity and ecosystem services, as well as other tools such as PAFs, noted earlier. Similarly, SEAs can be helpful in the programming phase.

    - *Information and support to project development:* To help implement biodiversity-smart Operational Programmes will require those managing the programmes to reach out to stakeholders who have the capacity to initiate the most suitable projects. This requires awareness raising and publication of project opportunities, targeting the right applicants, assistance in helping design biodiversity-smart projects and putting in place support mechanisms.

    - *Fine tune project eligibility criteria, appraisal and selection process:* this includes setting minimum eligibility criteria for projects (linking to EIA and NNL requirements) and selecting the right projects via project appraisal criteria (for example enhancing multi-benefit investments).

    - *Implementation, monitoring and evaluation:* for example through applying suitable indicators, milestones and targets, which can be linked to the Common Provision Regulation's aims to improve EU funding performance and the 2017 and 2019 performance reviews. Similarly monitoring, reporting and evaluation will be important aspects of the process as this can help managing authorities ensure alignment between purported objectives and effective results.

For more details see IEEP & Milieu (2013).

Furthermore, in the area of **transport and energy policy,** the need to better take into account the requirement to conserve biodiversity and ecosystem services would be adequately reflected in the future provisions governing the functioning of the Connecting Europe Facility. In particular, all project applications would be biodiversity proofed and the EU share of co-financing would vary depending on whether or not applicants for funding add to their project proposal a concrete plan to ensure as a minimum NNL of biodiversity and ecosystem services, and where possible a net gain, in close proximity to the proposed development.

The potential policy option of general public investment in net positive gain of biodiversity and ecosystem services, for instance through land restoration, is outside the focus of this study. However, it should be noted that some regions may over time commit to NNL or net positive gain of biodiversity and ecosystem services and/or monitor progress against such a benchmark, which could usefully be encouraged. NNL commitments at the regional level can focus narrowly (ie on the CP programme contribution) or more widely (ie on the region's development as a whole). The NNL commitments could be achieved both by minimising the trade-offs (ie biodiversity proofing the use of CP funds and other regional policies and actions more widely - to the extent possible) and investments in biodiversity and ecosystem services. The minimising of trade-offs and investment in natural capital could be separate processes, that are not formally linked yet are part of the wider CP programme with monitoring and assessment of overall NNL/net positive gain of the Operational Programmes. They could also be formally linked, notably through formal offsetting requirements and mechanisms, which are discussed below.

Policy Option Evaluation

Table 5-28 Evaluation of the effectiveness, efficiency and policy coherence of option BP1: Ensure all EU funds integrate requirements relating to biodiversity and ecosystem services and are subject to biodiversity proofing procedures

Evaluation criteria	Assessment of policy option's potential contribution to NNL
1. Effectiveness	
Mitigation hierarchy stages	All, but mainly mitigation measures to avoid and reduce impacts.
Land use impacts	Wide ranging, but mainly related to built developments, including transport infrastructures.
Potential coverage and impacts on biodiversity	Wide-ranging, moderate-high beneficial impacts, for all levels of biodiversity, but added value greatest for species and habitats that are not included include in Habitats and Birds Directives and mainly occur outside Natura 2000 sites.
Potential coverage and impacts on ecosystem services	Potentially wide-ranging, moderate-high benefits for many ecosystem services related to biodiversity, and in particular Green Infrastructure.
Clarity	Moderate. An increase in substantive instruments, such as more funding for Green Infrastructure is very clear. The clarity of procedural and institutional changes, such as biodiversity-proofing, is more dependent on the care taken in developing and writing such guidelines.

Measurability	Moderate. Measurable for funds directed towards Green Infrastructure, or other biodiversity-related investments. Measurability of "biodiversity-proofing" is lower, but could still occur if a change in the level of mitigation and compensation for residual impacts occurs.
Feasibility	High. The efforts proposed are already elaborated in various EU documents, including efforts to increase Green Infrastructure in recent years, as well as the DG ENV report on biodiversity proofing and DG Regio guide on investment in nature and Green Infrastructure. However, integrating the issue of nature and Green Infrastructure into the partnership agreements will be critically important for the issue to them be picked up by Member States for integration in the operational programmes and their implementation.
Enforceability	Assuming these changes do not detract from the primary goals of the ERDF, ESF and CF, there should be little resistance. Further, oversight of these funds occurs at the EU level, so enforcement should be relatively straightforward.
2. Efficiency	
Unit costs	
Public: 1-off (€)	For governance process: Minimal. Development and implementation of new procedures. Where related to investments up-front costs can be significant - eg greening grey infrastructure investments, or direct Green Infrastructure investments (where focusing on net positive gain aspects). Where investments focus on ecosystem services of value to society, then opportunities for net gain may exist.
Public: Recurring (€/yr)	Minimal additional costs that might arise from additional efforts needed in project design to ensure benefits for biodiversity and ecosystem services. Also, variable increases in public funded project costs to ensure projects are biodiversity-proofed.
Private: 1-off (€)	n/a
Private: Recurring (€/yr)	Variable increases in project costs to ensure projects are biodiversity-proofed.
Distribution of costs	Primarily public costs; any private costs will be distributed primarily in infrastructure and energy sectors.
Benefits (other than NNL)	
Economic activity	Could stimulate greater investment in Green Infrastructure, renewable energy, and other environmentally (and biodiversity friendly) projects. Can also lead to reduction of costs (eg via clean water provision and reduced need for pre-treatment).
Jobs	Could stimulate some demand for labour as well as improving the locational quality of a region, potentially attracting investment, new activities and additional jobs, expanding the skills base.
Health/quality of life	Should have moderate positive impact, by reducing the negative environmental impacts of large projects, and also stimulating an increase in Green Infrastructure.
Other	Some of these funds are designed to leverage further private sector investment (eg Connecting Europe Facility), so a signal from public investors of the importance of biodiversity and ecosystem services will start to force more project developers and investors to also consider such issues.
3. Coherence	High. Both increasing funds for Green Infrastructure (and some ecosystem-based mitigation/adaptation) and biodiversity-proofing of other funds are designed specifically to integrate the multiple objectives of EU policy.

5.10 Offsetting

Assuming that residual impacts on biodiversity cannot be fully eliminated, such as through regulations and incentives, some form of offsetting will be required to achieve NNL. With some exceptions, most notably Germany and France (see Annexes 5 and 6), EU Member States currently lack specific policies that require offsetting except for damage to Natura 2000 sites (Conway et al, 2013). Therefore currently in most countries residual impacts are left unaddressed and although they may be insignificant in some cases their cumulative impacts are undoubtedly contributing to observed declines in biodiversity and ecosystem services. It is therefore clear that, in order to achieve NNL across the EU there is no option other than to develop some form of offsetting policy framework to complement the policy measures described above that generally focus on avoiding and reducing impacts, or incentivising actions that are beneficial for biodiversity and ecosystem services.

Previous DG Environment studies and additional publications on habitat banking and biodiversity offsetting (eg Eftec and IEEP, 2010; Conway et al, 2013; Wende et al. 2005) have concluded that offsets can provide an effective means of delivering conservation outcomes in Europe, and especially in helping to achieve NNL if they are well designed. However, international experience shows that the development of offsetting policies introduces risks especially if it undermines the application of the mitigation hierarchy. A well-developed legal, governance and institutional framework are therefore needed to ensure that offsetting makes a positive contribution to achieving NNL. Moreover, experience in many countries, including Germany (see Annex 6), shows that without an effective framework to ensure that offsets are monitored and enforced, they are unlikely to make a significant contribution towards achieving NNL. Therefore this report and the following sections examine offsetting in detail and the measures needed to ensure it is effective, before proposing a number of offsetting policy options.

5.10.1 Strengths

Existing measures for identifying, avoiding and reducing potential impacts

Case studies[129] and previous reviews (eg Conway et al, 2013; Darbi et al, 2009; EFTEC & IEEP, 2010; Gardner et al, 2013; McKenney & Kiesecker, 2010; Morandeau and Vilaysack, 2012; ten Kate et al, 2004; Wende et al, 2005) of international experience of biodiversity offsetting experience indicate that the strengths of offsets as a means of meeting NNL targets can be summarised as follows:

- Offsets are designed to compensate for residual losses, which are inevitable to some degree, because other measures will not always be able to eliminate biodiversity and ecosystem service losses entirely: therefore some form of offsetting has an essential role to play in implementing a NNL initiative.

[129] Eg BBOP case studies: http://bbop.forest-trends.org/pages/pilot_projects

- Offsets are designed to provide measurable conservation gains, and, if correctly designed and implemented, are able to provide some certainty that NNL is being achieved.

- Offsets can address a wide range of impacts on biodiversity, including those outside protected areas.

- Offsets can be applied to individual projects, or implemented collectively at the policy/organisational/sectoral/regional level to address cumulative impacts from small-scale or low impact developments for which there is no individual legal requirement for compensation.

- Offsets can help to address habitat fragmentation, by allowing for a more strategic and selective placement of compensation measures.

- Offsets may help to achieve NNL through more appropriate and reliable means, and sometimes at a lower cost, than policies that focus exclusively on avoidance and mitigation.

- Offsets can implement the polluter pays principle, by having a system in place that ensures that residual impacts must be addressed, and that the costs of doing so are borne by the developer, which in turn encourage developers to more thoroughly consider earlier steps in the mitigation hierarchy (eg to avoid and reduce impacts first so as to minimise the amount of offsetting required).

Habitat banking (or biodiversity/conservation banking) is the creation of a market for offsets, such that the credits from the biodiversity gains from a bank can be purchased to offset the debit from biodiversity losses. Credits can be produced in advance of, and without ex-ante links to, the debits they compensate for, and stored over time. Banks can also result in the pooling of offset credits, which can increase the size of restored or created habitats, which can increase their ecological value as well as reducing their unit cost of restoration and management. International experience indicates they can have the following additional strengths compared to project-specific offsets:

- more effective, and in some cases ex-ante (and therefore more reliable), delivery of existing biodiversity policy objectives and of compensation requirements;
- increased ecological quality and resilience of large-scale measures (also potentially from pooled offsets[130]);
- increasing ecological connectivity (eg linking up and increase the size of small habitats, or buffering Natura 2000 sites) Green Infrastructure and ecosystem service benefits through strategic and selective placement of compensation measures,

[130] The collective organisation of resources to deliver compensation requirements for debits from more than one source, usually ex-post of damage. They have some features of habitat banking (like economies of scale), but not others (they do not produce a market for the supply credits and are not effective *ex-ante*).

especially if linked to spatial planning, ecological network and Green Infrastructure strategies; and
- the opportunity to efficiently address cumulative impacts from individually small-scale or low level impact developments for which there is no legal requirement for compensation.

5.10.2 Weaknesses

Existing measures for identifying, avoiding and reducing potential impacts

A key weakness in applying biodiversity offsets at the EU level is the **lack of a developed legal framework** requiring offsetting of residual impacts on biodiversity outside the Natura 2000 network (where compensation measures are required – see section 5.3). With some exceptions, for example Germany and France, extending the application of offsets would therefore require new legislation for most Member States and/or at the EU level. Moreover, without an effective framework to ensure that offsets are monitored and enforced, they are unlikely to deliver NNL.

The reviews listed above and a number of other studies (Burgin, 2010; Hannis and Sullivan, 2012; Maron et al, 2012; Walker et al, 2009) discussed in chapter 4 have shown that offsets also have a number of weaknesses that can lead to potential biodiversity risks. These risks include:

- Lowering of protection levels if the mitigation hierarchy is not appropriately followed, resulting in a so-called '**licence to trash'**.

- **Failure to achieve NNL**, which may potentially occur for a number of reasons, such as inaccurate measurement of expected biodiversity and ecosystem services losses (debits) and potential offset gains (credits), incorrect design or location of the offset, a failure to implement agreed measures (and enforce them), or technical failures which may mean that offsets do not achieve their anticipated results.

- L**ack of additionality**, if existing or already planned conservation actions (such as those required to meet the requirements of the Habitats Directive and Birds Directive, or national legal biodiversity conservation frameworks) are counted as offsets.

- **Leakage of benefits** if risk aversion offsets protect certain areas at the expense of others (which could potentially be of higher biodiversity value, especially if outside the EU).

- **Interim biodiversity losses** as a result of the long time period required to establish or restore some habitats (Morris et al, 2006).

- **Failure to deliver lasting gains** in biodiversity and ecosystem services, if offsets are not sufficiently managed and protected in the long-term, which requires adequate funding and appropriate legal measures.

- **High administrative and transaction costs** required to achieve NNL, because of the need for comprehensive regulations, planning and offset guidance, proposal scrutiny and monitoring to ensure offsets are appropriate and implemented effectively, which requires significant resources.

- An **inability to offset some losses** of biodiversity and ecosystem services, for example because they require, or they have very particular ecological requirements that are not found in other locations (Pilgrim et al, 2013).

For these reasons it is particularly important to ensure that any offsetting framework does not weaken or replace existing requirements for the protection of Natura 2000 sites or nationally designated protected areas, and does not replace management and restoration obligations within them (such as those required to meet Targets 1 and 2 of the EU Biodiversity Strategy).

However, experience shows that careful design and implementation of offsets can reduce or eliminate these risks (eg see Bull et al, 2013; Carroll et al, 2007; Gardner & von Hase, 2012; Gardner et al, 2013; Wende et al, 2005). Consequently, standards and guidelines developed by BBOP (eg see Box 4.1) and others aim to inform the design and delivery of offsets to minimise these risks and ensure that they meet their objectives of achieving NNL. Required design features of offsetting frameworks are further described in section 5.10.4 below.

5.10.3 Opportunities

In addition to the clear political mandate for the NNL policy included under Action 7 of the Biodiversity Strategy there is also implicit support for the concept of offsetting residual impacts. This is apparent in the June 2011 Council Conclusions which stressed "the importance of further work to operationalise the 'NNL' objective of the Strategy for areas and species not covered by existing EU nature legislation and of ensuring no further loss or degradation of ecosystems and their services". The conclusions go on to include a preliminary definition of NNL, whereby 'conservation losses in one geographically or otherwise defined area are balanced by a gain elsewhere provided that this principle does not entail any impairment of existing biodiversity as protected by EU nature legislation'. Although offsets are not explicitly referred to there is a strong indication that their use is envisaged.

Offsets are most often applied at a project level to built developments (eg housing, industry and transport infrastructure) and extractive industries (mines and quarries etc) that have individually significant, distinct and measurable environmental impacts and therefore require some form of environmental permit. Project level offsets may be desirable for a number of reasons: to ensure that the party causing damage to biodiversity is accountable for that damage, to enforce the polluter pays principle, and to provide certainty that the required offsets are delivered.

However, not all impacts on biodiversity result from clearly identifiable projects. It may not be practicable to negotiate and enforce individual offsets for some impacts such as diffuse pollution or changes in land management practices. This may require alternative solutions, such that offsets are applied at an:

- organisational level: to compensate for all of the impacts caused by a company or organisation;
- sectoral level: eg to compensate for the impacts of a sector such as agriculture;
- regional level: eg through SEA and spatial planning processes that integrate NNL into the planning for all developments within a particular region; and
- policy level: eg to achieve NNL or net gain for a particular policy, such as the CAP.

Overall, if clear and effective means are established for determining equivalency, gains and losses, then offsetting and habitat banking can constitute important mechanisms for addressing all types and scales of residual impacts on biodiversity. As identified in the analysis in Annex 4, this is currently a critical weakness in the measures currently available for addressing biodiversity loss in the EU.

5.10.4 The design of offsets

To be able to achieve NNL, biodiversity offsets need to be designed in such a way that they achieve sufficient gains in biodiversity and ecosystem services to at least compensate for the losses incurred. Elements related to the wider policy framework, the design of offset requirements (eg determining when offsets are to be used, how much compensation and where) and the arrangement for implementation (eg how offsets will be delivered and which stakeholders will do what) need to be considered for an offset scheme to be successful.

Some of these design and delivery issues are discussed below drawing on the previous studies, including the 2010 Habitat Banking Study (EFTEC & IEEP, 2010); The Habitat Banking Demand, Supply and Design Study (Conway et al, 2013); *Marine Biodiversity Offsetting – UK Scoping Study* (Dickie et al, 2013); country cases studies examined as part of this study (Annexes 5-10); and the results of the Offsetting Policy Workshop (see Annex 11).

Policy framework

Offsetting schemes can be delivered within a **mandatory or voluntary** policy framework. Moreover, impacts on different types of biodiversity can be covered by different requirements. For instance, compensation in Sweden is mandatory for impacts on protected areas, whilst voluntary compensation is available for impacts on biodiversity outside of these areas (see Annex 8). However, experience in the EU and internationally has demonstrated that only mandatory requirements can sufficiently address the residual impacts to biodiversity in order to ensure NNL. For instance, as described in Annex 10, voluntary offsets are currently being trialled in England, through their promotion in six pilot areas. The voluntary nature of the scheme has raised concerns that the scale, rigour and certainty of the requirements are insufficient to stimulate supply and demand and hence deliver the benefits envisaged. Respondents to the government consultation stated that the approach would not make a significant contribution to halting biodiversity loss. At the time of writing this report, no definite offset schemes have been proposed so far, despite the trail starting over 1 ½ years ago.

Similarly in Sweden, voluntary compensation is available under spatial planning regulations and the Environmental Code, but is very rarely used due to a lack of legal provisions (see Annex 8). The voluntary nature of the provisions also mean that it largely depends on the willingness of developers to accept compensation, such that there is little security that NNL is actually being delivered. Moreover, the absence of a clear legal framework means that awareness about compensation is generally low. Approaches are also inconsistent and largely ad hoc, creating delays, considerable uncertainties and administrative burdens which further reduces the likelihood that offsets will be used.

In contrast, a mandatory system is in place in Germany, where measures are legally binding and offsetting for residual impacts is therefore the norm (see Annex 6). Offsetting is also becoming commonplace in France as a result of recent legalisation (see Annex 5).

Whilst individual voluntary offsetting projects can be very effective, the observations above and wider international experience provides strong evidence that voluntary offsetting will not be sufficient to make a significant contribution to the achievement of the NNL target in Europe. This conclusion was also drawn by the NNL Working Group (NNLWG, 2013a) and participants in the offsetting policy workshop undertaken for this study (see Annex 10). Consequently, without the political will on the part of governments to mandate developers to integrate NNL into their project planning and permitting processes in an unambiguous manner, it is highly unlikely that the implementation of a NNL policy will be successful.

Most stakeholders at the workshop noted that whilst there needs to be a mandatory requirement for offsetting, there is nonetheless a need for flexibility at national and local levels on how offsets should be implemented. To ensure a level of comparability and consistency across systems, approaches would likely have to meet certain standards or criteria (ie on the elements discussed below). It is therefore advisable to keep the options for implementation open, provided a consistent standard is met.

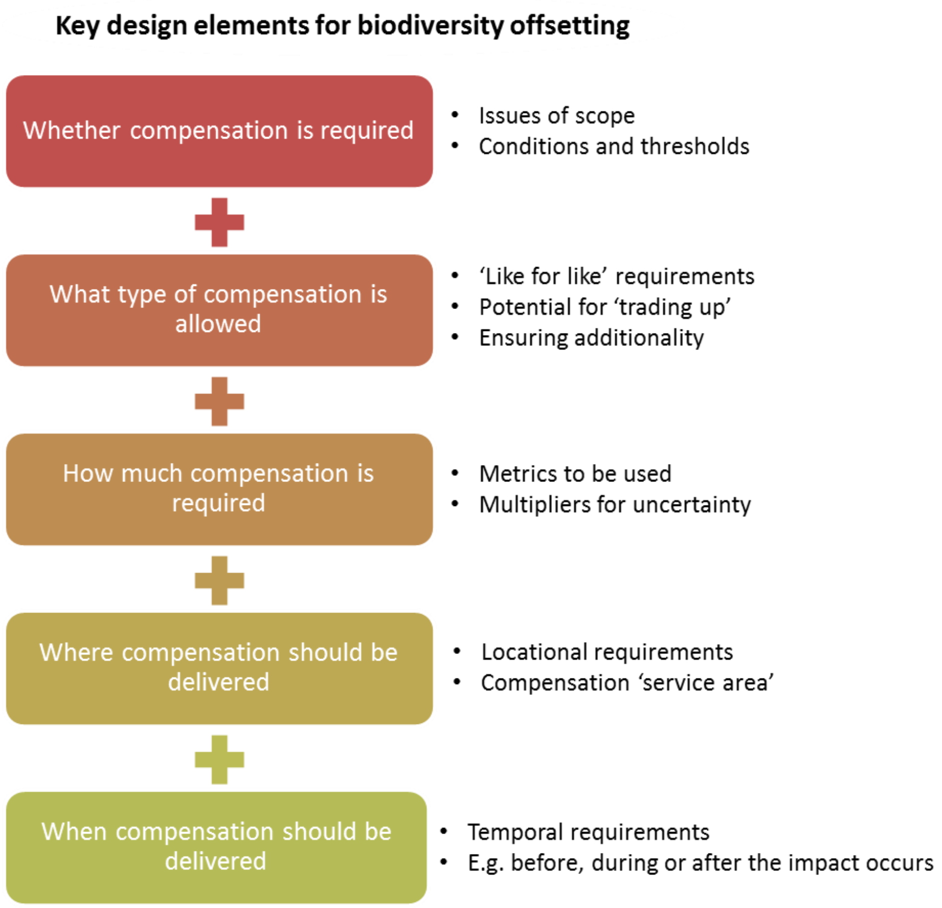
The **purpose and overall objective** for the policy framework will also need to be set. For instance, will the scheme seek to deliver NNL (as in the USA), or will it go further and seek to achieve net gain (as in some states in Australia)? Schemes in the EU, where they exist, tend to aim for NNL rather than net gain. Indeed a recent court case in Germany upheld a developer's claim that they are not obliged to deliver net gain. BBOP notes that there is a spectrum of biodiversity compensation activities, and that only those activities that deliver NNL or a gain in biodiversity, in full compliance with the BBOP Standard, should be termed biodiversity offsets.

As previously discussed in section 4.2, the policy framework that is set also needs to put in place the necessary mechanisms to ensure that the **mitigation hierarchy** is followed. Strict, but thoughtful, application of the mitigation hierarchy is needed to ensure that appropriate avoidance and mitigation measures have been taken first, so that offsets are only used as a last and final resort for adverse residual impacts. Effective adherence to the mitigation hierarchy can and should limit the demand for offsets. However, effective application does require clear guidance to be available on how to implement the hierarchy, proper scrutiny of environmental components of development proposals (ie proposed avoidance, mitigation and offsetting measures) and rejection of proposals where the hierarchy has not been properly applied. Thus regulatory and planning authorities have a key role to play in ensuring the mitigation hierarchy is followed and need adequate resources and knowledge to do this effectively.

Design elements and requirements

To complement a regulatory requirement for NNL, there needs to be guidance that clarifies the rules of the game. These include, for instance, the scope of the policy, the minimum and maximum thresholds, the metrics, as well as temporal and locational issues, as outlined in Figure 5-3.

Figure 5-3 Key design elements for offsetting



An important lesson from international experience is that governments cannot merely provide a basic policy framework and then assume that it will be adequately implemented. Rather, additional guidance and assistance is needed to ensure that the requirements are clear and that offset commitments are subject to high standards and can be relied upon. An example of the need for, and subsequent benefits of, such assistance being provided can be found in Victoria, Australia (see Annex 10).

Key questions need to be considered regarding the **scope** of an offsetting scheme. For instance, will the scheme only cover habitats and/or species, or will it extend to wider ecosystem service benefits? The current system in Germany ensures that losses to both biodiversity and wider ecosystem services are covered, whereas in France the focus is largely on compensating for impacts on species. Stakeholders at the workshops felt that the Natura 2000 network should be outside of the scope of a new offsetting scheme, as there are already measures in place which should theoretically be dealing with these (residual) impacts (although as discussed in section 5.3.4 these can be strengthened). Everything else, however, should be within scope, although there was some discussion about what kind or what size of projects and/or impacts should be covered (ie what kind of threshold to set, whether there should be a '*de minimus*' approach).

The conditions and thresholds that are set will determine **the circumstances in which compensation would be required**. While it is clear that offsets should be applied only in certain circumstances (ie once the rest of the mitigation hierarchy has been followed) and that there are upper limits to what can be offset, rules also need to be specified as to the thresholds of losses over which offsets are applied. For example, offsets could be required for all development activity, or only for projects above a certain size threshold, or affecting certain types of land. Key issues include whether and how offsets are required for activities affecting the biodiversity in agricultural land and previously developed sites, some of which have high biodiversity value. Different Member States apply different kinds of criteria, examples of which are given in Box 5.5 below. BBOP (2012b) supports the idea that offsets might only be appropriate for impacts above a certain threshold, noting that 'the design of a biodiversity offset involves a considerable level of thought and planning, so it may not be an appropriate approach for a project where impacts on biodiversity will be comparatively trivial (eg building a house on a previously developed but vacant lot in a city centre)'. However, equally, if thresholds are set too high and substantial losses are uncompensated for, then NNL will not be delivered. There is therefore a delicate balance to be struck between what is practical and feasible, and ensuring that NNL is nonetheless achieved.

Box 5.5. Criteria used by different Member States for determining when offsets are required

Germany - offsets are applied widely to biodiversity losses overall and not only in protected areas or for protected species. Offsets can be delivered for any type of project where impacts might be significant, however impacts from agriculture, forestry and fishing are still largely excluded.

France – the use of offsets to date has been relatively limited, and have usually been triggered by impacts on protected species. Since June 2012, for projects submitted to an EIA and for facilities classified for environmental protection, the scope of impacts to be taken into account has been widened so that compensatory measures can be applied to a range of impacts, including different ecosystem functions and elements (eg soil, water, air) as well as agricultural, forestry and marine areas.

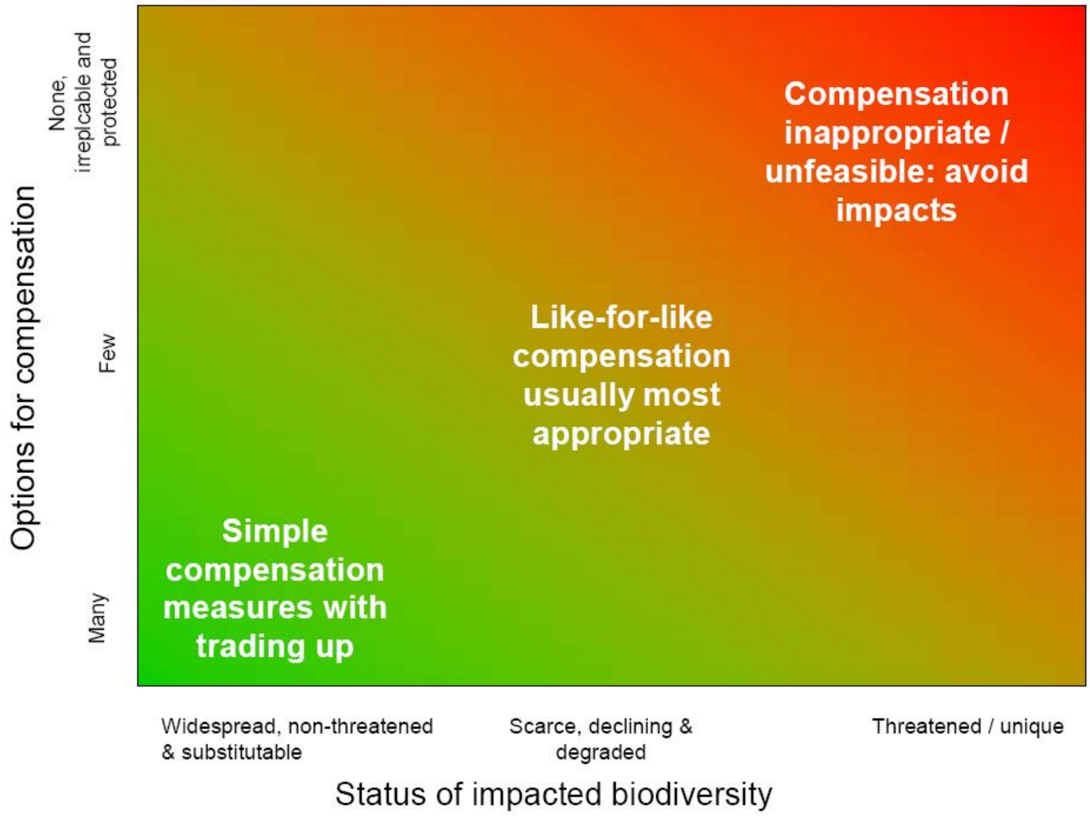
England – compensation is encouraged in the case of significant harm. Although, there is no definition of significance, the term relates to the magnitude of impacts, either alone or in combination, including those which may be temporary during construction, rather than the size of the development under consideration.

Sweden – in principle, compensation can be required in a wide range of cases, however in practice it tends to be demanded relatively rarely and mainly for damage to sites or species of higher nature value.

Aside from considering the circumstances in which compensation is required, it is also necessary to consider **what type of compensation will be allowed.** ‘Like-for-like’ or ‘in-kind’ offsets involve similar habitats, functions, values or other attributes to those affected by the project. ‘Out-of-kind’ compensation allows for compensation of different kinds of biodiversity or attributes. ‘Out-of-kind’ compensation can be appropriate where it issued for ‘trading up’ to biodiversity of higher conservation value. Different types of compensation may be suitable in different contexts, depending for instance on the value of the biodiversity being affected. In some cases, particularly where the biodiversity affected is not especially vulnerable or irreplaceable, it may be beneficial to allow the flexibility to ‘trade up’ to conserve biodiversity of a higher conservation value than that affected. The more vulnerable and irreplaceable the affected biodiversity, the tighter the ‘like for like’ requirement should become (see Figure 5-4). However, in cases where the biodiversity affected is extremely vulnerable or irreplaceable, ‘no go’ areas should be considered as it would be impossible to offset the impacts concerned. This is illustrated by the Figure below.

Figure 5-4 Appropriateness of compensation in relation to the importance of impacted biodiversity and availability of reliable compensation options

Source: adapted from BBOP, 2009



Regardless of what type of compensation is being delivered, a key principle that needs to be applied in every situation is to ensure that the offset results in additional conservation outcomes to what would have happened in their absence; verification of the fact that the offset is additional should be a prerequisite for regulatory approval. Criteria therefore need to be established to assess **what is 'additional' and what is not**. These may relate both to the sources of funding that would be allowed, as well as what kind of conservation actions would be permissible.

There are, for instance, questions around whether **averted risk offsets** (which produce gains by protecting biodiversity or ecosystem components that are at known risk) should qualify as an activity that can be included in offset schemes. As noted by Hansjügens et al (2011) offsets of this kind can only deliver gains where there are significant areas of remaining ecosystems that are:

- worth maintaining;
- unprotected and likely to remain so in the future (to ensure additionality); and
- subject to significant and predictable levels of loss or degradation.

An advantage of such offsets is that the biodiversity components or ecosystem services that make up the offset exist, and are not dependent on restoration or creation. This means that very high quality habitats may be offset that could not be created or restored to the same level of quality. More generally they eliminate the risk of restoration or creation failures. In fact they may be the only option when the supply of other types of offsets is limited, eg due to a lack of suitable alternative sites.

However, they have several major disadvantages. Firstly, the potential for risk aversion offsets to provide reliable long-term, additional benefits is likely to be somewhat limited in the EU given that a large proportion of European habitats whose further degradation is worth arresting are already protected to some degree. Secondly, the likely gains from risk aversion offsets are highly uncertain as they depend on future rates of habitat-specific loss and degradation, which is extremely difficult to predict reliably and will vary greatly from place to place. Thirdly, there is a considerable risk that the benefits of the protection of the offset area from a threat (eg mineral extraction) will merely result in the displacement of the threat to another area. For such reasons risk aversion offsets are not allowed in many countries. For example, in Germany, protection measures are not considered additional, although enhancement of protected areas is allowed. Given these risks, it would not seem appropriate to allow risk aversion offsets where other offsets can be used more reliably. This is the case in the USA under the Mitigation Banking regulation, where risk aversion offsets are only allowed in exceptional circumstances (Morandeau & Vilaysack, 2012) . If they are to be used in the EU then particularly stringent safeguards would be needed to ensure they result in long-term additional benefits, including obligatory contingency measures (eg additional non-risk aversion offsetting) implemented if offset benefits do not turn out to meet expectations in the future.

What offsetting actions are permissible and how these could work in coastal and marine environments will also need to be considered. These options are briefly discussed in Box 5.6 below. In particular, there is likely to be greater scope for averted risk offsets to play an important role. An additional challenge would be dealing with the large-scale and dynamic nature of many coastal and marine ecosystems and processes (ICE, 2013).

Box 5.6 Potential marine biodiversity offset activities

Type of offset	Example Activity
Habitat Restoration	Biogenic reef restoration
	Enhanced connectivity of Marine Protected Areas
	Enhanced protection of Marine Protected Areas
Habitat Recreation	Sediment seeding
Habitat Creation	Artificial reefs
Averted Risk	Eradication of Invasive Alien Species
	Reversing Pressures
Preservation	Species protection measures in fisheries
	Seal colony protection
	Other species protection measures in breeding colonies

Work to consider how these measures could be applied illustrates that:

- In using biodiversity offsets it must be recognised that some damages cannot be offset. It appears that more biodiversity features are non-offsettable in the marine environment due to their dynamism, greater uncertainties, and difficulty of recreating marine environmental conditions for biodiversity.
- Marine offsets may require more lateral thinking on how to boost populations of species in order to offset impacts - making populations more resilient, rather than location specific actions.
- There are some potentially viable marine habitat offset options (eg mussel bed seeding) and others that are worthy of further research (eg Sabellaria reef transplantation).
- In relation to the Habitats Directive, using biodiversity offsets may add further requirements to those of the Directive. Best practice on biodiversity offsets is, if anything, more rigorous than the Habitats Directive in calculating equivalence.

Current understanding of marine biodiversity offsets means they cannot be relied on to deliver compensation (Dickie et al, 2013). However, they could be a useful option to address unavoidable residual impacts on the marine environment. The dynamic nature of marine systems means that offsetting actions may best be undertaken through relieving pressures on marine biodiversity, in particular those caused by the most damaging uses of fishing gears.

Another key consideration is **how much compensation will be required**. This quantification of residual impacts (debits) and offset gains (credits), so as to know whether NNL has been achieved is a key feature that sets offsetting apart from other approaches to conservation. This is a major challenge as biodiversity is complex and multi-dimensional and its value is highly context specific – thus all measures of it are crude proxies. The development of ecosystem service indicators and metrics is in its relatively early stages (ten Brink, 2011). Furthermore, the situation is made even more complex where out-of-kind offsetting is considered and trading occurs with habitat banks. Offsetting **metrics** are therefore required that use common currencies and units of biodiversity to measure changes on the impacted site and the offset site, so that losses and gains can be calculated, which enables equivalency to be assessed and thereby allows trading (Quétier & Lavorel, 2011).

A variety of metrics have been developed for measuring biodiversity impact debits and offset gains; for instance, there are over 40 in Germany (Bruns, 2007; Darbi and Tausch, 2010). Despite this variety, biodiversity metrics typically take into account the following primary biodiversity properties of impact sites and offset sites:

- size of the areas;
- inherent relative biodiversity conservation value of the habitats and associated species (eg in terms of species-richness, rarity, naturalness, biogeographical importance), irrespective of its condition on the sites;
- actual relative condition of the habitat (eg biophysical conditions, species and structural diversity, presence of keystone or functional species and integrity of ecological processes) and viability of species populations on the sites (eg chance extinction risks, genetic bottlenecks); and
- spatial factors, such as the distance between the impacted and offset sites, ecological connectivity to habitat networks, and their overall size and the viability of meta-populations within them.

The consideration of these biodiversity properties therefore gives rise to a few broad types of metric, the advantages and disadvantages of which are summarised in **Table 5-29**. Other types of metric include those that are based on biodiversity or ecosystem service replacement costs. This method, for example, calculates the average costs of replacing the lost habitat, and this amount is used to calculate a minimum amount of habitat that must be created in the offset on the basis of average costs of other acceptable habitats (eg Köppel et al., 1998; Jessel and Tobias, 2002). Replacement cost metrics may also be used to calculate the amount that should be put into a trust etc as part of a fee-in-lieu system or Trust Administered Conservation Credits System (see 5.10.5). In some situations, such as where quantitative data are lacking, expert judgement or stakeholder consultations may be used instead of metrics, or in conjunction with them (Darbi & Tausch, 2010).

Table 5-29 Summary of the main advantages and disadvantages of the main types of offset metric

Metric type	Advantages	Disadvantages
Habitat area ratios	Very simple transparent system with low transaction costs – suitable for impacts on habitats with very low biodiversity values. Enables trading if ratios are set for different habitats.	Will not capture many important values of habitats. Ignores potential species values. Decisions on ratios are largely arbitrary.
Habitat area x condition	Provides a much more reliable and comprehensive measure of biodiversity value and enables potential habitat condition improvements through restoration/enhancement to be taken into account.	Less transparent (especially if complex methods and arbitrary weightings are used for assessing condition), require good quality data and often expensive surveys, which increases transactions costs and can delay projects – so requirements are not considered reasonable for projects that clearly have low level impacts. It is a relative habitat specific metric so does not enable trading.
Habitat area ratio x condition	As above but also enables trading	As above, except for constraint on trading
Species population based approaches	Often a clear, objective and transparent measure, that may link closely to stakeholder concerns (eg species of high cultural value)	Typically does not capture many important biodiversity values – so best used in combination with habitat metrics where important species are known to be present. Sometimes requires expensive surveys, which increases transactions costs and can delay projects – so requirements are not considered reasonable for projects that clearly have low level impacts
Replacement costs	Relatively simple and transparent; suitable for fee-in-lieu or trust administered conservation credit systems	Costs of replacing lost habitat can vary considerably, and be difficult to assess reliably for some habitat types. Because it does not measure biodiversity properties directly, it should not be used as a measure of equivalency, and because replacement costs and biodiversity value are not necessarily directly related, it does not guarantee NNL. Ignores potential species values.

Clearly the achievement of NNL is dependent on the use of appropriate metrics and it is apparent that some widely used metrics have major weaknesses that probably make them unreliable and unfit for setting offset requirements. Most obviously simple habitat area ratio based metrics, as for example widely used in Germany (see Box 5.7), are highly reductionist and are not able to capture biodiversity values reliably, especially if the ratios are set at national or regional scales. The inclusion of habitat-specific measures of ecological condition in metrics greatly increases their suitability for offsetting and forms the core of currently accepted best-practice. The Australian Habitat Hectares offsetting scheme, as initially developed in Victoria (Parkes et al, 2003), is one of the most sophisticated systems that follows this approach. It now measures a number of (generally between 10 and 20) different characteristics of a site including tree canopy, patch size and proximity to ecologically important, or core, areas. These are assessed against benchmarks to arrive at a required offset ratio.

Box 5.7 Example of a simple habitat based offsetting metric used in Germany

Impact	Biotope type before impact		New grassland
	Biotope value before impacts	Vb_1	25
	Biotope type after impact		100% sealed road
	Biotope value after impact	Va_1	0
	Difference between biotope values	$Vd_1 = Vb_1 - Va_1$	25
	Area size	A_1	10 ha
	Resulting value loss	$\mathbf{V_1 = Vd_1 \times A_1}$	**250**
Compensation (ie offset)	Biotope type before compensation	Vb_2	Fallow field
	Biotope type after compensation	Va_2	20
	Biotope type after compensation		Shrub habitat
	Biotope value after compensation		40
	Difference between biotope values	$Vd_2 = Vb_2 - Va_2$	20
	Area size	A_2	12.5 ha
	Resulting value gain	$\mathbf{V_2 = Vd_2 \times A_2}$	**250**
	BALANCE		Value loss impact = value gain offset

Source: Adapted from Darbi & Tausch, 2010

The habitat hectares approach has been adapted for use in the pilot offsetting initiative in England described in Annex 9 (DEFRA and Natural England, 2012), drawing on previous commissioned studies (Temple et al, 2010; Treweek et al, 2006). The metric is based on: the type of habitat (ranging from very important habitats listed in the national Biodiversity Action Plan to intensive agriculture); the condition of the site; and the connectedness of the site.

Habitat focussed metrics seem to be the most widely used now, but some focus on species especially where protected species are involved. In practice, offset requirements for species are usually defined in terms of a required area of suitable habitat for selected evaluation species, which is assessed through procedures such as the Habitat Evaluation Procedures (HEP), which was initially developed by the US Fish and Wildlife Service (USFWS) in 1976[131]. The rationale for the HEP is that impacted and offset areas have various habitats that have

[131] http://www.fws.gov/policy/esm102.pdf

differing suitabilities for species that can be quantified through habitat suitability models, resulting in an Habitat Suitability Index (HSI). Provided that the extent of the different habitats can be measured the overall suitability of an area for a species can be represented as a product of the areal extents of each habitat and the HSI index for each habitat for the species, which is referred to as Habitat Units (HUs). As pointed out by Treweek (1999) the reliability of HEP and HUs are greatly dependent on the ability of the user to assign a well-defined and accurate HSI to the selected evaluation species, and more specifically, to identify clear relationships between carrying capacity and the modification of the specific environmental variables. The selection of evaluation species also has an important influence on the outcome.

It is important to note that whilst the more sophisticated metrics capture biodiversity and ecosystem service values most comprehensively and reliably, they still result in greatly simplified measurements of biodiversity. Thus they do not fully capture what we care about, which according to Salzman & Ruhl (2000) is a key requirement for an offsetting metric and currency. Consequently, Walker et al, (2009) question whether offsetting systems can result in NNL.

Similarly, it is difficult to design metrics that capture ecosystem services and their value. While it is often assumed that more sophisticated metrics that take account of ecosystem quality may provide a proxy for ecosystem service delivery, whether such metrics are capable of guaranteeing NNL of ecosystem services is highly debateable.

Sophisticated metrics also have other drawbacks. Most obviously they lack transparency and this can undermine confidence in the system amongst stakeholders. Project proponents may also favour simpler metrics because they can allow them to easily and reliable assess potential impacts from development options (without costly and lengthy surveys) which allows them to then assess likely offsetting requirements and costs. Such cost estimates then provide an incentive to take actions to reduce residual impacts, and enable businesses to incorporate them into their business plans and costings, thereby reducing commercial impacts. Sophisticated metrics also require good data, which may require detailed and lengthy surveys by experts (especially if species are involved) which delays projects and increases transaction costs. Such problems, especially relating to delays, will therefore reduce the acceptance of offsets amongst businesses, especially for projects that are likely to have minimal biodiversity impacts. This reflects one of the compromises of an offsetting scheme: balancing ecological understanding with the administrative burden on regulators and developers.

The choice and design of appropriate metrics is therefore an important consideration as it is apparent that no single approach is always most appropriate. Instead options should be considered according to the objectives of the scheme and its context, with the selected metrics being most fit for its specific purpose. On the other hand, problems can arise if there are many different metrics being used within a country (as in Germany – see Annex 6). Therefore, the provision of national or regional guidelines or frameworks for metrics may be appropriate, which outline broad approaches and standards, but do not set out detailed methods and values etc. Within such a framework, a proportionate approach could be included, with more streamlined procedures and simpler baseline studies and metrics for impacts that are of a low level or only affect widespread biodiversity and ecosystem services, but full assessments and metrics for more significant impacts.

Good quality metrics endeavour to ensure equity in type, space and time of biodiversity. However, given the complexities of biodiversity and its value, there are some limitations that need to be considered. In addition to the basic metric, it is usually necessary to apply multipliers to take into consideration factors such as uncertainty in offset success, particular national or regional conservation targets and rare/threatened biodiversity components, time preference, and dealing with out-of-kind offsets (BBOP, 2012b).

Finally, consideration needs to be given to **where and when, relative to the impact, compensation will be delivered**. In the case of the former, **defining the 'service area'** within which offsets can be implemented will have significant implications for an offset scheme. Whilst local offsets provide greater confidence in ecological equivalence and that those affected by the project will benefit from the offset, requiring offsets to be near to the impacted site can create supply side constraints where suitable sites are lacking. For instance, a presumption in favour of on- or near-site offsets in some Member States has limited the potential scale of, and benefits being delivered from offsets. In France, for example, a requirement for offsets to be located close to the impacted site means that the lack of suitable land is becoming an issue. Land availability and accessibility is often cited as a factor hindering the implementation of offsets and compensation more generally. A range of options are available for securing land for compensation, including purchase of the site, leasing of the area, or other models based on management arrangements with the landowner.

The need for more flexibility in allowing offsets to be delivered away from an impacted site is being increasingly recognised, such as for example shown through changes in offsetting regulations in Germany (see Annex 6). Moreover, if a more strategic approach is taken, where offsets are delivered where they are needed most, the biodiversity benefits may actually be greater (Kiesecker et al, 2009; Kiesecker et al, 2010). This could, for instance, involve linking the planning of offsets with wider ecological networks or Green Infrastructure plans to maximise the strategic benefits. Biodiversity offsetting could, and should, be linked to landscape level planning (see Spatial Planning Proposals in section 0 above).

However, it will be important to ensure that local benefits and issues of social equity are not overlooked, as for example occurred in the USA, where wetland offsetting resulted in a redistribution of wetlands from urban to rural areas (Ruhl & Salzman, 2006). A solution increasingly used is to define 'composite offsets' with activities taking place in more than one location. This enables biodiversity components with local needs and values to local communities to be conserved through offset activities near the area of impact, while simultaneously conserving other components biodiversity further afield, such as through activities creating connectivity between two protected areas for the benefit of a particular species.

Stakeholders at the workshop noted that for offsets to be more effective, there could be a presumption for a bio-geographic approach on a like-for-like or better basis. Bio-geographic regions could then be used as the 'service area', adopting a similar approach to water basins and river basin management. Such an approach is used in Germany, where natural areas have been identified, and offsets must be within the same natural area as the impacted site (see Annex 6). One exception to this could be for migratory species, which could justify an approach which extends between bio-geographic areas. Whilst trans-boundary offsets may sometimes be beneficial on both ecological and economic grounds, they do, however, raise potential challenges with regard to political acceptability and regulatory enforcement.

Lastly, **when the offset should be delivered** relative to the impact is also important. While project impacts cause immediate and certain losses, the conservation gains of an offset are often uncertain and may require many years to achieve. In order to address this uncertainty, offsets should preferably be in place before the impact occurs. However, this may not always be possible. One way to address this is to build this issue of time preference into the metrics which are used to discount future benefits, and to allow for risk and uncertainty.

Habitat banking schemes, as a means of delivering biodiversity offsets, may help address concerns over interim losses to some extent by achieving some progress in delivering conservation gains prior to the impact taking place. However, habitat banks can also release at least some of their credits at an early stage when significant uncertainties about future outcomes still remain. Given the time taken to establish effective habitat banking arrangements, a requirement for compensation to be fully operational prior to a project taking place may be unduly restrictive, especially in the case of new offset policies for which there may not be an established supply of offsets or habitat banking arrangements. An offset scheme could therefore take a flexible approach, similar to that seen in Australia and the US. For example, in Victoria, Australia temporal issues are factored into scoring, depending on when offsets are initiated. On the other hand, US wetland mitigation banking allows for credit releases in accordance with the achievement of specific milestones.

Determining how these design elements will translate into practice can be particularly challenging in a marine environment. Some of the challenges in implementing marine offsets are discussed in Box 5.8 below.

Box 5.8 Particular challenges associated with marine offsets

Application of biodiversity offsets to the marine environment has been attempted in a limited number of cases worldwide. Experience in the EU however is believed to be zero, or at least very limited. Much international experience relates to tropical reef ecosystems, which have some important characteristics that differ from EU waters and also make application of offsets more feasible. The key characteristic in this respect is the greater proportion of species which are more static (site-faithful) during all, or major parts, of their lifecycles.

Marine biodiversity in much of the EU is characterised by highly dynamic systems (ICE, 2013) and poorly defined property rights in relation to biotic resources, which makes extending current predominantly site-based terrestrial offsetting practices to the marine environment challenging. On the other hand, marine environments represent a more three-dimensional habitat, which offers opportunities for offsets activity to co-exist with economic activities. For example, restrictions can be put on activities affecting sea-floor habitats, but other human activities, such as surface transport or fishing in the water column, may be able to continue.

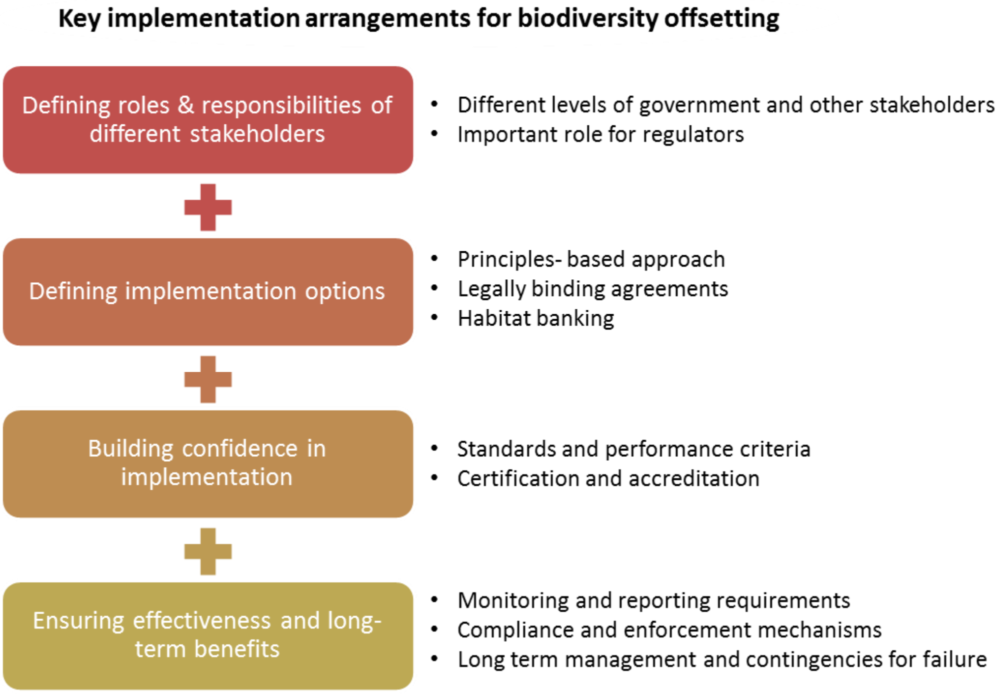
Other pertinent issues relevant to the development of a framework for marine offsets include:

- Reliable marine biodiversity information from accessible sources is essential to inform assessments of the loss from negative impacts on biodiversity and the gains from offsetting activities. There are significant data gaps, but data exist that could act as indicators of biodiversity and enable the use of offsets.
- Marine management and biodiversity laws and regulations are an important part of how offsets could be devised and implemented. The current UK marine management framework does not provide a unique mechanism through which offsets could be implemented, but does not preclude them. Several planning and regulatory routes are available that could facilitate offsetting where it is appropriate to do so. This would require the relevant authorities to work together.
- A number of different sources can be identified that might generate negative impacts on biodiversity in the marine environment. Many of these are regulated in such a way that offsets could be initiated at specific decision points or stages in the consent processes.
- There are a variety of feasible biodiversity offset metrics, for both habitats and species, which could be developed and applied in the marine environment. The metric chosen will depend on how the NNL objective is defined.

Arrangements for Implementation

As well as defining offset requirements, achieving NNL requires that these requirements are implemented effectively, which requires careful consideration of a number of important issues as summarised in Figure 5-5, and discussed below.

Figure 5-5 Key implementation arrangements for biodiversity offsetting



In order for an offset scheme to be effective, it is vital that the **different roles of national, state and local government, and other stakeholders**, are clearly defined. This includes, for instance, responsibility for regulation, monitoring and enforcement; certification of suppliers; provision of offsets and habitat banking services; and oversight of market transactions for offsets or credits. Within this context, **regulators** have a key role to play to ensure that requirements are properly met and adhered to, and defining standards and performance indicators. Stakeholders at the offsetting policy workshop noted the need to consider multi-level governance, and to determine what is best done at what level, and where responsibility for different aspects should be placed (eg EU, regional, national and local level).

Given the largely limited experience with biodiversity offsets in the EU, and the different elements that are required for an offset scheme to be successful, there will need to be a programme of capacity building to overcome these constraints in order for a NNL Initiative to operate smoothly. Capacity building will need to extend not just to regulators and governments, but also to other stakeholders who are likely to be involved, including developers, companies, banks, consultants and NGOs.

It will also be necessary to define which **implementation options** exist for developers (for instance, permittee-led offsets in which developers implement their own offsets, or in lieu fees to trusts or government, or the use of conservation banks and biodiversity credits), which will also include setting standards for implementing and defining whether there will be a preference for any of the implementation options. In doing so, it will be important to be wary of, and mitigate against, any unintended consequences or perverse incentives. In Mexico, for instance, the cost of undertaking proactive mitigation measures within the impact assessment and planning processes is higher than the cost of compensating for damage after the event meaning that the mitigation hierarchy isn't adequately followed (see Annex 11).

Different **models and approaches** are available, which can be broadly divided into:

- **Bespoke, project-specific offsets**, designed to ensure no-net loss arises from a particular project or organisation.

- **Habitat banking** as a market-based means of delivering offsets, whereby landowners who commit to enhance or restore biodiversity values on their land through a habitat banking agreement generate 'biodiversity credits'. These credits can then be sold, generating funds for the management of the site. Credits can be used to offset impacts on biodiversity that occur as a result of development elsewhere.

- **Fee in lieu schemes,** which pool payments (equivalent to the cost of replacing lost biodiversity and ecosystem services), for instance through a governmental institution or appointed body or via an independent environmental trust fund, and use these to provide measured biodiversity and ecosystem service benefits. These do not ensure NNL from a specific project or development, but can be designed and regulated such that they offset losses collectively (eg at the regional or sectoral level).

Project-specific offsets and habitat banking systems are reasonably well known, so are not described here in detail. However, there is less experience of fee in lieu systems in Europe, and therefore, as an example, the fee in lieu framework used in the USA under the Mitigation Regulation is outlined in Box 5.8. But it should be noted that fee in lieu systems can vary greatly.

Box 5.8 The main components of the fee in lieu framework used in the USA under the Mitigation Regulation

The in-lieu fee programme has six parameters (Wilkinson, 2009):

- The programme's framework agreement known as the in-lieu fee program instrument, which is the legal document relating to the creation, management and use of an in-lieu fee programme. This must include in particular: the location of the potential offset sites, the initial status of these sites and the projects, indicating the types of offset which may potentially be implemented. Some programmes specify a hierarchy of offsets to be adopted in the following order of priority: restoration, creation, enhancement and preservation.
- The assessment of the programme by the Interagency Review Team (IRT)48 within which the USACE is the competent authority for programme approval. Each time the promoter of an active in-lieu fee programme wishes to establish a new offset project or modify the existing project, it must have it assessed and approved by the IRT.
- The programme's service area, defined as the geographic area (eg scale of the basin area, ecoregion, physiographic province) in which it is authorised to introduce offsets subsequent to project authorisation.
- The compensation planning framework included in the in-lieu fee program instrument aims to select, guarantee and implement the activities of restoration, creation, enhancement and/or preservation of aquatic resources. Offset sites must be selected strategically using the watershed approach, the aim of which is to maintain or enhance the quality and quantity of aquatic resources in the basin area.
- An in-lieu fee program account created by the programme promoter to control the transfers paid in and out. Funds received from project developers must be kept separate from those from other agencies (associations, etc.). The funds collected must only be used for the purposes of offsetting wetland functions and values (eg habitat restoration or creation activities), and not to finance education or research projects. They should only be used when they are deemed sufficient to enable the programme to attain its objectives. The guide relating to the in-lieu fee programme published in 2000 stipulates that the funds collected "must achieve a minimum surface ratio of 1 for 1 acre".
- Advance credits, which correspond to the limited number of credits available for sale before an offset project is even implemented. These advance credits are recovered as and when the credits are created by the offset project. Once the generated credits have reached the advance credit threshold, the same number of advance credits can be sold again. The in-lieu fee programme promoters can sell wetland credits, stream credits, both together, or both with the addition of another type of credit.

Source: Based on Wilkinson (2009) *In-lieu fee mitigation: model instrument language and resources*, cited in (Morandeau & Vilaysack, 2012).

Based on the reviews of international experience above, the potential advantages and disadvantages of these different types of offset delivery mechanism are summarised in Table 5-30.

Table 5-30 Summary of the advantages and disadvantages of the main offsetting delivery systems

Offset system	Advantages	Disadvantages
Bespoke project-specific offsets	• Clear linkage between impacts and offset gains. • Simplest governance structure. • Enables project proponents to carry out their own offsetting if desired, which may be cost-effective for some. • Avoids breaks in liabilities for NNL outcomes from developers to third parties. • Market provision of offsets may drive down costs thereby increasing acceptability to project proponents and increase efficiency.	• Credits based on expected outcomes and therefore unreliable, and therefore monitoring and contingency measures are required. • Individual offsets may be too small to be effective or viable. • Limited ability to influence location of offsets as market driven (ie often on lowest value land). • Commercial pressures and public spending rules result in purchase of cheapest offsets, which normally only meet minimum legal standards
Habitat banking	• Pooling of offsets creates larger areas of higher ecological value, which can be encouraged to occur (eg through metric multipliers) to occur in strategically beneficial locations. • Market provision and pooling of offsets may drive down costs thereby increasing acceptability to project proponents and increase efficiency. • Moderately simple governance structure • In some cases credits are provided in advance of debits, thus removing the risk of initial failure, which can avoid interim losses, reduce offset need, and facilitate quick permitting.	• Ability to influence location of offsets is based on simple incentives which may no longer reflect priorities by the time credits are sold. • Commercial pressures and public spending rules result in purchase of cheapest offsets, which normally only meet minimum legal standards.
Fee-in-lieu payments to environmental trusts	• Funds are pooled to ensure offsets are of a viable size. • Decision on use of funds is made by experts and stakeholders and not project proponents, so overriding incentive for trust members is to maximise value for money and long-term benefits, ie NOT obtaining the lowest cost acceptable offset. • Choice and location of habitats / species measures can react to changes in priorities (eg in response to previous measures and other environmental changes).	• Loses clear link between impacts and offset gains. • Amount paid may not be tied as closely to metrics designed to achieve NNL as other methods. • Transfers burden of responsibility for measuring and achieving NNL from project to scheme level – which may be a disadvantage in some cases. • Requires a relatively complex

Offset system	Advantages	Disadvantages
	• Low transaction costs enables system to be applied to low biodiversity impacts. • Can utilise habitat banks if appropriate and thereby benefit from their advantages.	governance structure • Possible conflicts of interest amongst trust members (eg regarding use of funds and possible objections to developments that they could gain from). • Cost of habitat replacement can be difficult to calculate and varies from place to place. • Financial risks of miscalculation of replacements costs is transferred from the developer to the scheme, which could cause shifts in objectives and failure to achieve NNL. • Direct nature of charging system may be seen as an unpopular tax on development.

Whichever implementation option is selected, **standards and performance criteria** will play an important role in ensuring implementation is effective, particularly where there is a principles-based and comparatively flexible approach to offsets. These should establish the benefits expected of the offsets and provide a benchmark for monitoring. Administrative and ecological performance standards can be included in mitigation or management plans, with the ecological performance standards being linked to credit release schedules. The EU and Member States should develop comparable, high quality standards for offsets, endeavouring to harmonize these with existing best practice (eg IFC PS6 and the BBOP Standard on Biodiversity Offsets) and standards that are about to be defined (eg the World Bank's revised Safeguards).

Certification and accreditation are often core to standards-based approaches, as they help to build confidence in offset provision. There are also benefits to the developer and/or provider, in terms of its license to operate and/or reputational advantages. The use of a certified pool can reduce the amount of compensation required. A range of mechanisms are available to implement certification. For instance, a habitat bank itself can be certified, and/or the consultants involved in designing and implementing the offset can be accredited.

Looking ahead, there are some crucial components for ensuring the sustainability and long-term benefits of offsets. These include:

- **monitoring and reporting requirements;**
- **compliance and enforcement mechanisms; and**
- **long term management and contingencies for failure.**

A key message from the offsetting policy workshop that was organised for this study was the fundamental need to put systems for **mandatory monitoring** in place in order to have the necessary information to support implementation, enforcement and improvement. This is currently an area of offset schemes in the EU that is particularly weak, including in Germany, France, Sweden, and the Netherlands (see Annexes 5-8). No official monitoring system for instance exists in the Netherlands, whilst in Sweden the requirements exist in principle but in practice are limited due to resource constraints. A lack of formal scrutiny and therefore accountability means it is unclear to what extent offsets are actually delivering NNL, if at all.

BBOP recommends that monitoring should cover implementation performance (ie the process, covering inputs, activities and outputs) as well the impact performance (ie ecological and biodiversity impacts). Stakeholders at the workshop felt that monitoring and/or auditing is most effective and carries more weight if done by an independent third party. There is considerable scope for various types of stakeholders to be involved in monitoring (eg communities and NGOs). An option that was mentioned was to give nature conservation agencies the authority to spontaneously conduct random spot checks at any time, which could reduce costs but still ensure that the mechanism for oversight is there.

Stakeholders also highlighted the need for **enforcement mechanisms** to be put in place. These are currently rare in the EU. Moreover, where they do exist (eg Sweden), there is no evidence of enforcement being used despite penalties being available for non-compliance. Similarly in the Netherlands, offsetting can be enforced with fines but enforcement is weak. This element is critical, as the ability of relevant bodies to discharge their enforcement obligations is linked to the efficacy of legislation and the financial and resourcing capacity of regulating bodies. Aside from fines and penalties, compliance can also be ensured through iterative stages whereby funds are released in phases. Without adequate enforcement, it is highly unlikely that an offsetting scheme will be effective.

Another area of improvement for current offsetting schemes in the EU, and a necessary component for a potential EU-wide scheme in the future, is **long term management plans and contingencies for failure**. These are important to ensure that the measurable conservation outcomes are actually delivered and that they endure over the long term and preferably in perpetuity. As with monitoring and enforcement, the quality of long term management is particularly poor and even, in some cases, absent in on-going EU offset schemes, including in Germany and France. This raises concerns about the quality of the offsets and means that the implementation of offsetting measures is sometimes incomplete.

Long term management can be facilitated in a range of ways, including through endowment funds for ongoing management, and through easements or other legal restrictions on land use. Land may also be transferred to government, or, where an offset provider retains ownership, a covenant can be required that runs with the land and binds any successors in title. The inclusion of the terms on the land title deeds can then be included in the Land Registry. In the case of habitat banking schemes, long term benefits can be ensured through mandatory renewal of credits subject to inspection (ie performance-based payments).

Contingency plans, which would come into play if the project fails, are also important. In the US, for instance, a 15 – 25% contingency fund is normally set aside for additional work in case a project fails to deliver. In Germany, authorities have the power under the Federal

Nature Conservation Act to request a security up to the value of the offset. For habitat banks, it may also be necessary to establish provisions for bankruptcy or guidelines on how to avoid financial failure.

Developing an Implementation Plan

Lastly, international experience (see Annex 10) clearly shows that the development of a policy and regulatory framework by itself is not enough to establish adequate levels of effective offsetting to achieve NNL. An **Offsetting Implementation Plan** is required to prepare for, initiate, roll out and support offsetting measures. The plan clearly describes and allocates responsibilities and milestones for actions that:

- complete the policy/regulatory framework;
- prepare and distribute operational guidance for the policy;
- ensure offset suppliers are sufficiently established to meet the new demands that will be triggered by the policy and regulations;
- initiate pilot projects to test and provide lessons that can be used to continuously improve the system;
- establish the required capacity for regulators, assessors, suppliers and others to implement the system;
- create and develop required institutions (eg brokers, registries etc); and
- define procedures and standards for monitoring, evaluation and enforcement.

5.10.5 Policy options

Offsetting Policy Option 1 (Of 1): EU Offsetting framework and implementation plan to promote agreed types of offsetting according to defined standards

This option would involve building on the existing EU *acquis*, with a new framework being put in place to encourage certain agreed types of offsetting according to defined standards. The current framework would therefore remain as it is, with the following additional measures put in place to facilitate offsets:

- **An EU policy statement** in support of the use of biodiversity offsets to compensate for unavoidable residual impacts on biodiversity, defining the role of offsets, principles for their application (see below), and the role of the EU, Member States and businesses in encouraging their use.

- The development of **EU guidance** designed to inform the development and application of offsets by EU institutions and Member States. This guidance would set out key principles and standards for the type, design and implementation of offsets, drawing on those developed by BBOP and others.

- **An EU platform** to encourage adoption of offsetting and to promote sharing of experience. This could include a website, promotional materials, working groups, conferences, events, demonstration projects and inter-regional co-operation projects.

- **Initiatives to encourage voluntary offsets** by businesses and other organisations, promoted through the EU Business and Biodiversity Platform and other programmes.

- **Mandatory monitoring and reporting** of offsetting in the EU (whether voluntary or under the existing EU Framework). This should measure the actual biodiversity impacts and ecosystem service of offsetting schemes (including comparisons of the effectiveness and efficiency of bespoke, fee-lieu and habitat banking) leading to an annual report and conference assessing progress, sharing experience and promoting good practice.

- **Development of an Offsetting Implementation Plan** (as described above), to prepare for, initiate, roll out and support offsetting measures.

To avoid the risks associated with poorly designed and regulated offsets, the **policy statement** and related measures should stress key principles in the design and implementation of offsets to achieve NNL, including adherence to the mitigation hierarchy, making reference to the accompanying guidance. On the basis of these principles, the EU guidance should specify comprehensive and stringent regulations and detailed procedures for the design, implementation and enforcement elements of offsets and habitat banks. This is because there is a risk that political desire for weak regulation, low transaction costs and the use of simplistic metrics (as discussed above) combined with commercial drivers to reduce costs would result in low offsetting standards.

Low offsetting standards were, for example, observed in the USA, which resulted in legislative changes and an improvement in offsetting effectiveness (see Annex 10). In Germany, some stakeholders consider that the use of basic metrics and offsetting standards is resulting in project proponents choosing the lowest cost offsets that meet minimum legal requirements (see Annex 6). This is the case for commercial developers, but also often for public authorities who have an obligation to minimise costs. In response to such economic motivators, competition will result in commercial habitat banks (or other offset providers) providing offsets at the lowest cost that meets the basic offset requirements. Consequently, as a result of these motivators, it is almost inevitable that NNL will not be achieved because the overall average biodiversity of each habitat type will be offset by the lowest acceptable quality examples (because cost is closely linked to restoration quality).

These motivators and trends therefore need to be countered by strong regulation, and most importantly sophisticated metrics that capture as much and as accurately as possible the full range of biodiversity values of importance in each habitat type. But even these metrics allow a great deal of flexibility in interpretation of habitat condition for example, and incorporate subjective judgements. Furthermore, the expected long-term condition of an offset is of most importance and this is difficult to assess. Therefore, in addition to strong regulation, careful consideration should also be given by the EU and Member States to identifying and recommending the most appropriate types of offset delivery mechanism for particular NNL goals, eg relating the levels of biodiversity and ecosystem services, types of impact and sectors being addressed. This should include consideration of the advantages and disadvantages of bespoke offsets, habitat banks and fee-in-lieu schemes outlined in Table 5-30.

As noted in chapter 3, outside Natura 2000 sites one of the main challenges and priorities for achieving NNL is to tackle the widespread low level impacts from small scale developments, agriculture and forestry etc, that together result in significant cumulative impacts. Consequently, there is a strong rationale for initially focussing the development of offsetting on these impacts, especially as the impacted habitats and species are not currently subject to effective protection measures, and thus there is little risk of offsetting undermining protection levels or the mitigation hierarchy. However, it would be unreasonable to expect such low-level individual impacts to be dealt with through project-level bespoke offsets due to their high transaction costs.

Some forms of fee-in-lieu system appear to be the most appropriate means of addressing low level impacts on biodiversity because of their low transaction costs, but also their ability to pool payments and use the funds to provide the most strategically beneficial offset (eg in terms of habitat type and required quality, size and location). Habitat banks could also play a role in offsetting low level impacts, eg through development of a simple checklist system for calculating impacts and required credits (EFTEC/IEEP, 2010). However, this would be dependent on the widespread establishment of habitat banks, as it would often be inappropriate to offset even low level impacts at great distances from impact sites (eg to avoid the loss of cultural services for communities). Furthermore, another key advantage of fee-in-lieu schemes is that they largely eliminate the commercial pressures associated with the delivery and purchase of offsets that drive down their quality and long-term benefits. Thus the risk of poor offset delivery under weakly regulated offset frameworks is likely to be much lower under fee-in-lieu schemes. Fee-in-lieu schemes do have disadvantages and risks, but these can be addressed largely through the design scheme as outlined in Table 5-31.

Table 5-31 Risks and mitigating design features in a fee in lieu of credit system

Risk	Design attribute
Funds used to purchase non-biodiversity related 'credits' (eg for political, commercial or criminal reasons)	Legal requirement to only use funds for biodiversity credits.
Setting the right fee level	Set fee, and adjust it over time, to ensure no net loss objective fulfilled; eg use public money to provide start-up funds to purchase credits, and base fees on actual purchase prices, with continuous feedback from credit price to fee.
Risks of not securing credits	Legal requirement that funds are only used to secure measurable biodiversity benefits directly, which must be monitored and publicly reported.
Loss of direct linkage between impact	Only applies to very low level (individually insignificant)

Risk	Design attribute
and compensation may risk loss of important elements of biodiversity	impacts on widespread biodiversity that would not normally be covered by conventional compensation systems, and for which like for like compensation would usually be inappropriate (see below).
Suppliers competing through lower fees	No competition; single independent body running fee-based system.
Temporal losses between payment and credit purchase	Put start-up money into the independent fund to commence credit generation in advance of damages.
Fees displace public funding for nature conservation	Legal requirement to only use funds for additional biodiversity credits.
Misuse of funds	Independent trust comprising governmental and non-governmental conservation bodies with legal obligation to use funds for no net loss of biodiversity and for transparent, audited and published purchases of credits.
Costs of administering systems	Premium on fee to cover administration.
Public sector biodiversity agencies become dependent on fees from compensation activities	Maintain legal and financial distinction between role of managing compensation system and other public duties.

Source: EFTEC/IEEP (2010)

Of fundamental importance is the need to ensure such schemes are administered by an independent environmental trust or similar body whose sole purpose is to use the fees to directly provide biodiversity outcomes that contribute to NNL (and wherever possible, net gain) of biodiversity. They should have multi-stakeholder governance and involve the competent nature conservation/environmental authorities, but in order to avoid political interference, should not be a purely government run body. To avoid conflicts of interest, they should not spend funds on the restoration or management of land owned by members of the trust. As with other offsets, to ensure measures provide benefits that are completely additional to mandatory or other expected conservation actions, they should not spend funds on the management of protected areas and nature reserves and should not apply to habitats and species of Community interest within Natura 2000 sites.

Bearing these considerations in mind, it is suggested that a suitable fee-in-lieu system which we call here a **Trust Administered Conservation Credits (TACC) system** to distinguish it from other less appropriate fee-in-lieu systems would have the following components and steps:

1. The cost of achieving NNL in response to significant residual impacts from any activity (including agricultural expansion and intensification, eg leading to the loss of a hedgerow) would be calculated, assuming like-for-like for compensation (thus, importantly, costs to the project proponent would broadly reflect biodiversity damage because biodiversity-rich habitats are expensive to restore).

2. The project proponent pays the calculated NNL cost fee to a regional independent environmental trust, which must be approved by and registered with the statutory nature conservation body, but is not paid to or part of government. Once paid the project proponent no longer has any responsibility for the achievement of NNL.

3. The Trust is required by law to only spend its funds on achieving NNL through measurable biodiversity outcomes (eg not on visitor centres or research).

4. The Trust, which comprises independent expert ecologists and a range of stakeholders as well as statutory agency representatives uses it expertise and regional/local knowledge to decide how best to use the pooled funds (ie credits) to achieve NNL in the region it covers (ideally a biogeographical region), although a portion could be used for larger-scale national initiatives, provided NNL is achieved regionally as well. In making its decision it would take into account the impacts that the offset payment arose from, but also the up-to-date status of biodiversity in the region and priorities for action. Thus the Trust would be well placed to direct the available funds to the most threatened habitats/species (ie to trade-up) and to the most strategically beneficial areas eg to support the implementation of ecological networks or Green Infrastructure strategies – provided there is clear additionality.

5. The Trust decides who to contract/pay to create or restore the targeted habitats within the target areas, which could be through bespoke contracts agreed with landowners as needs arise, but could also be through the purchase of registered credits from an established habitat bank if appropriate. To ensure additionality the measures would need to be spent outside Natura sites and other protected areas etc where there are government commitments to improve them. To avoid conflicts of interest (and possible additionality problems) it would also be advisable for the Trust to avoid placing measures within land owned by its members.

6. The impacts of the Trust's contracted measures and any habitat bank payments would be monitored and audited using appropriate biodiversity metrics, so that the overall credits can be compared with losses that contributed to the Trust's fee pool. Thus it would be possible to demonstrate that overall NNL is achieved.

Many of the benefits of such a TACC system, including the avoidance of commercial pressures to reduce offset quality, would also apply to the treatment of higher levels of biodiversity impact. However, it should be borne in mind that there is limited experience of the successful application of fee-in-lieu systems, especially in Europe. They have been used in the USA, where they were favoured by developers, but were subject to limited oversight and standards, and as a result they were often not implemented successfully in the longer term (see Annex 11). According to Morandeau & Vilaysack (2012), quoting Robertson and Hayden (2007), there is currently no study enabling the efficacy of the in-lieu fee programmes to be assessed. In Europe they do not seem to be commonly used, although they are in Sweden to offset impacts of river hydro-power schemes on fishing interests (Annex 8). A development tax is charged in France and the proceeds earmarked for protected area networks (see Annex 5), but this sort of tax system differs significantly from the TACC system recommended above. Therefore, although, as outlined in Table 5-31, risks can be managed, it would seem wise to test such offsetting approaches in the EU through the proposed TACC system that focuses on low level impacts, before considering its wider use on higher level impacts. For these reasons the 2010 Habitat Banking Study (EFTEC/IEEP, 2010) also recommended the consideration of fee-in-lieu systems, but only with respect to addressing low level impacts on biodiversity.

Policy Option Evaluation

Table 5-32 Evaluation of the effectiveness, efficiency and policy coherence of policy option Of 1: EU Offsetting framework and implementation plan to promote agreed types of offsetting according to defined standards

Evaluation criteria	Assessment for policy option 1: EU framework to promote offsetting
1. Effectiveness	
Mitigation hierarchy stages	Residual impacts.
Land use impacts	Relatively small impacts on land use might be expected, because of the voluntary nature of offsets.
Potential coverage and impacts on biodiversity	By itself relatively low impacts on biodiversity might be expected, because of the voluntary nature of offsets. Potentially high impacts if high standards linked to mandatory requirements.
Potential coverage and impacts on ecosystem services	By itself relatively low impacts on ecosystem services might be expected, because of the voluntary nature of offsets. Potentially high impacts if high standards linked to mandatory requirements.
Clarity	This would depend on the clarity of communications, policy statements and guidance at EU level, but there is good opportunity for high degree of clarity. The basic concept of offsets is well understood. There is ample language, and experience gained internationally and from Member States, that can be drawn upon to ensure clarity of this policy.
Measurability	Contribution is possibly not very measurable. The voluntary nature of the policy means that those participating would probably have carried out some sort of remediation action, even in the absence of the policy. So additionality is difficult to confirm.
Feasibility	Relatively high. Some additional training may be necessary, but there is experience internationally and within Member States that can support development of guidance and reporting for offsets at the EU level.
Enforceability	The voluntary nature of this policy option means there is no risk of non-compliance, and it is likely to be widely accepted. There may be reporting risk: because the policy is voluntary, government authorities will not be required to closely monitor activities and validate reports.
2. Efficiency	
Unit costs	
Public: 1-off (€)	Low. Development of guidance and statements, establishment of platform and reporting registry.
Public: Recurring (€/yr)	Low. Management of platform and reporting registry.
Private: 1-off (€)	Voluntary, so likely to be low, but would include costs of land (purchase or management agreement), habitat restoration/creation.
Private: Recurring (€/yr)	Voluntary, so likely to be low, but would include costs of ongoing management and administrative costs. Evidence indicates that offset requirements are usually equivalent to only a small fraction of total project costs (Conway et al, 2013; Rayment et al, 2011).
Distribution of costs	Polluter pays. If other policies like ELD remain as they are to cover certain damages to biodiversity, the voluntary offset policy option will likely distribute costs to development sectors (eg housing, infrastructure).

Benefits (other than NNL)	
Economic activity	Minimal impact.
Jobs	Low; job creation for creating and managing offset sites.
Health/quality of life	Low; dependent on where offsets are placed.
Other	
3. Coherence	Does not go against any EU policy, but only minimally improves coherence. Voluntary offsets do not ensure that biodiversity not previously protected will now be protected, and does not facilitate targeting of offset sites for improved biodiversity benefits.

Offsetting Policy Option 2 (Of 2): EU Framework with mandatory offsetting of residual impacts of EU funded development projects on scarce biodiversity and priority ecosystem services

This option would further develop the framework and implementation plan described in offsetting policy option 1, designed to encourage the uptake of offsets. However, the requirement to offset losses of scarce biodiversity and ecosystem services would be strengthened through targeted enhancements in EU policies and legislation. In this context scarce biodiversity and priority ecosystem services would be defined as:

- all globally and European threatened species as listed by the IUCN, whether protected under the Habitats and Birds Directive or not;
- all species of Community interest listed in the Habitats Directive and species listed in Annex I of the Bird Directive **outside** Natura 2000 sites, because impacts on these species are subject to mandatory compensation measures under Article 6.4 of the Habitats Directive;
- species and habitats identified as being a national conservation priority (eg because they are nationally threatened, endemic or occurring in internationally important numbers) in national biodiversity strategies and action plans, red data books or similar official documents;
- habitats occurring within officially recognised Green Infrastructure protection zones or ecological networks; and
- ecosystems that occur within officially recognised areas that provide important ecosystem services.

The main policy enhancement triggering the need for offsets would be **requirements for offsets for all EU funded projects** that have a significant impact on scarce biodiversity and ecosystem services. This requirement would apply to all instruments that fund development projects, including the Structural and Cohesion Funds, TEN-T and TEN-E, international development funding, and significant development projects receiving funding under EAFRD and EMFF (eg related to aquaculture).

Offsets would also be encouraged through linkages to other policy options, including:

- Changes to EIA and SEA Directives (under Policy Options EIA 1 and EIA 2) to require the mitigation hierarchy to be followed for all significant impacts on biodiversity identified by EIA/SEA, up to and including offsets for residual impacts. Moreover, mechanisms are to be put in place to ensure that measures (including offsets) identified under the EIA and SEA are implemented by Member States. Where they are not implemented, clear and reasoned justification should be provided.

- Review of ELD to require wider and more effective application of retrospective offsets (ie remedial measures) for impacts on nationally threatened biodiversity (see Policy Option ELD 2).

- Biodiversity proofing (Policy Option BP1).

Given that the focus of the policy is on scarce biodiversity, and taking into account the risks from the various offset delivery approaches (discussed under Offsetting Policy Option 1), the recommended first option for offset delivery is through **stringently regulated and enforced bespoke, project-specific offsets or habitat banks** for projects with significant impacts. Individually insignificant projects should also be addressed in order to achieve NNL (as cumulative impacts can be substantial), and the most appropriate means of doing this would probably be through a TACC system as described under Offsetting Policy Option 1. However, it would seem appropriate to consider greater use of TACC systems in future if monitoring and assessment of their performance shows that they are as or more effective than bespoke offsets.

Policy Option Evaluation

Table 5-33 Evaluation of the effectiveness, efficiency and policy coherence of option Of 2: EU Framework with mandatory offsetting of residual impacts of EU funded development projects on scarce biodiversity and priority ecosystem services

Evaluation criteria	Assessment for policy option 2: EU framework backed by enhanced policy measures
1. Effectiveness	
Mitigation hierarchy stages	Residual impacts.
Land use impacts	Low, because, although it cannot be easily quantified in this study the proportion of EU development projects receiving EU funding is considered to be relatively low.
Potential coverage and impacts on biodiversity	Low – moderate benefits, much scarce biodiversity already within Natura 2000 sites and therefore covered by Art 6.4 compensation.
Potential coverage and impacts on ecosystem services	Low – moderate, but uncertain benefits as priority ecosystem services are not defined and mapped and potentially significant overlap with Natura 2000.
Clarity	This would depend on the clarity of communications, policy statements and guidance at EU level, but there is good opportunity for high degree of clarity. The basic concept of offsets is well understood. There is ample language, and experience gained internationally and from Member States, that can be drawn

	upon to ensure clarity of this policy. Furthermore, the policy will in part inherently improve clarity for some of the policies that will be enhanced.
Measurability	Offsetting will be used for measures that would not have taken place otherwise, and with mandatory reporting required, so contribution to NNL can be measured if appropriate metrics are used, which for scarce biodiversity should take into account habitat importance, habitat condition and, if appropriate, specific requirements for particular species.
Feasibility	High. This option builds on policies already in place. Plus, additional actions included and encompassing Option 1 are also highly feasible.
Enforceability	Effective enforcement would be important (especially for commercially delivered offsets and habitat banks); this would require new administrative and regulatory mechanisms. As the policy option only applies to scarce biodiversity and certain sector and EU funded projects it is likely to be moderately accepted, although there may be some resistance, including from development interests.
2. Efficiency	
Unit costs	
Public: 1-off (€)	Development of guidance and statements, establishment of platform and reporting registry, administration to revise Directives.
Public: Recurring (€/yr)	Moderate, increased administration of enhanced regime, and monitoring of operation of regime at Member State and EU levels. Plus management of platform and reporting registry from Option 1. Recurring public costs might be in the order of a few hundred million Euros annually, at most.
Private: 1-off (€)	Low costs of adjusting internal management procedures.
Private: Recurring (€/yr)	Low-moderate depending on extent to which offset requirements can be avoided earlier in mitigation hierarchy. If offsets are required, evidence indicates that offset requirements are usually equivalent to only a small fraction of total project costs (Rayment et al, 2011; Conway et al, 2013).
Distribution of costs	Polluter pays. This policy option will likely distribute costs across sectors in relation to their current coverage under the relevant Directives.
Benefits (other than NNL)	
Economic activity	Minor impacts expected.
Jobs	Minor impacts expected.
Health/quality of life	Minor impacts expected.
Other	
3. Coherence	Would make greater contribution than Option 1 to, and improve coherence of, policies for biodiversity and Green Infrastructure objectives; opponents might cite potential conflicts with other objectives (eg growth).

Offsetting Policy Option 3: Mandatory requirements to offset significant losses of scarce biodiversity and priority ecosystem services

This option would introduce new EU rules that would make it mandatory for all Member States to require offsets for significant impacts on scarce biodiversity and priority ecosystems (see Offsetting Policy Option 2 for definition). Under scenarios B and C in Section 3 estimating land use change, it is estimated that approximately 4,050 km^2 of forest and (semi-)natural vegetation would be converted to built-up area in 2010-2020. That provides a high-end estimate of the area converted that might need to be offset under this policy option, of 40,500 ha/year.

The development and implementation of offsets would be guided by further development of the EU framework and implementation plan included in Options 1 and 2, with the framework being mandatory rather than voluntary. Common principles and standards would be defined at EU level, with Member States having the flexibility to determine how best to apply and enforce these, in line with existing nature conservation and planning policies. As the focus is again on scarce biodiversity and priority ecosystem services the recommended first option for offset delivery is as for Policy Option 2, ie bespoke offsets for individually significant impacts, and use of a TACC system for impacts that are individually insignificant but would result in substantial cumulative impacts.

Policy Option Evaluation

Table 5-34 Evaluation of the effectiveness, efficiency and policy coherence of Offsetting Policy Option 3: Mandatory requirements to offset significant losses of scarce biodiversity and priority ecosystem services

Evaluation criteria	Description of the criterion with respect to the assessment of the policy option's potential contribution to NNL
1. Effectiveness	
Mitigation hierarchy stages	Residual impacts.
Land use impacts	Would reduce impacts on forests, wetlands and many semi-natural habitats. Substantial amounts of habitat restoration and creation would occur.
Potential coverage and impacts on biodiversity	Moderate-High, as the policy would aim to achieve NNL of EU threatened species and habitats outside N2K and of national priority habitat and species, but much already within Natura and therefore covered by Art 6.4 compensation.
Potential coverage and impacts on ecosystem services	Moderate -High, but uncertain benefits as priority ecosystem services are not defined and mapped and potentially significant overlap with Natura 2000.
Clarity	Moderate. The basic concept of offsets is well understood and there is ample language and experience that can be drawn upon to ensure clarity of the technical details. Clear rules on which species, habitats and ecosystem services would require offsetting would be needed.
Measurability	Offsetting will be used for measures that would not have taken place otherwise, and with mandatory reporting required, so contribution to NNL can be measured if appropriate metrics are used (see offsetting option 2 for scarce biodiversity).
Feasibility	Moderate. Some additional training may be necessary, but there is experience internationally and within Member States that can support development of policy for offsets at the EU level.
Enforceability	Effective enforcement would be important (especially for commercially delivered offsets and habitat banks); this would require new administrative and regulatory mechanisms. As the policy option only applies to scarce biodiversity, it may be moderately accepted, although some resistance may arise.
2. Efficiency	
Unit costs	
Public: 1-off (€)	Development of guidance and statements, establishment of platform and reporting registry, strengthening other relevant policies, establishing enforcement systems, developing EU-level policy.
Public: Recurring (€/yr)	Management of platform and reporting registry, management and enforcement

	of enhanced policy regime for other Directives, management and enforcement of new offsetting practice. Based on the high-end estimate of the area impacted (see above), the public costs could be around EUR 500 million annually.
Private: 1-off (€)	Low costs of adjusting internal management procedures.
Private: Recurring (€/yr)	Based on the high-end estimate of the area impacted (see above), the costs of offsets could be in the order of EUR 4.3 billion/year (see Annex 12 for calculation details). Whatever the total EU costs, evidence indicates that offset requirements are usually equivalent to only a small fraction of total project costs (Rayment et al, 2011; Conway et al, 2013).
Distribution of costs	Polluter pays. Costs likely to be in proportion to damage to biodiversity (eg highly threatened biodiversity that is damaged will also be more costly to offset), but costs may exceed value of damage or benefits of activities involved.
Benefits (other than NNL)	Quantified where possible.
Economic activity	Low-moderate. New business opportunities would be created in offset provision.
Jobs	Low-moderate. Job creation for creating and managing offset sites.
Health/quality of life	Low; additional benefits for recreation, health and quality of life compared to Options 1 and 2, but dependent on location.
Other	
3. Coherence	Would make greater contribution than Option 1 and 2 to, and improve coherence of, policies for biodiversity and Green Infrastructure objectives; opponents might cite potential conflicts with other objectives (eg growth).

Offsetting Policy Option 4: Mandatory EU requirements to offset losses to all biodiversity and ecosystem services

This option would go beyond Option 3 in requiring all Member States to require offsets for impacts on all biodiversity and ecosystems, not just those affecting priority species, habitats or ecosystem services. Negative impacts on all biodiversity and ecosystems would therefore be subject to offsets. Guidelines would be issued regarding the conditions and thresholds that would trigger the requirement for offsets, and other principles established under Option 1 would also apply. A lower potential threshold could be set so that losses would not have to be 'significant', and so might also cover smaller but cumulative impacts.

As this option will cover all levels of biodiversity and ecosystem importance, it is envisaged that TACC systems (described under offsetting policy option 1) would have a much larger role to play then under offset options 2 and 3. However, the preferred option for tackling individually significant impacts on scarce components of biodiversity and ecosystem services would be as under options 2 and 3, ie stringently regulated project-specific bespoke offsets.

Policy Option Evaluation

Table 5-35 Evaluation of the effectiveness, efficiency and policy coherence of policy option Of 4: Mandatory EU requirements to offset losses to all biodiversity and ecosystem services

Evaluation criteria	Assessment for policy option 3: Mandatory requirements to offset all losses of Biodiversity and Ecosystem Services
1. Effectiveness	
Mitigation hierarchy stages	Residual impacts.
Land use impacts	Very high because the policy would tackle all types of impacts from all sectors, and extensive habitat restoration and creation would occur.
Potential coverage and impacts on biodiversity	Very high because the policy would tackle all types of impacts from all sectors and aim to achieve NNL of biodiversity overall.
Potential coverage and impacts on ecosystem services	Very high because the policy would aim to achieve NNL of ecosystem services overall.
Clarity	As with other options, this would depend on the clarity of communications, policy statements and guidance at EU level; and there is a lot of research and experience to build on. This option is the most complex, however, so care would need to be taken to ensure that policy and guidance for implementation are all well articulated.
Measurability	Offsetting will be used for measures that would not have taken place otherwise, and with mandatory reporting required, so contribution to NNL can be measured if appropriate metrics are used (see offsetting option 1 for scarce biodiversity).
Feasibility	This is the most complex option, but is nonetheless feasible due to the large volume of experience in Member States and internationally to draw on.
Enforceability	Effective enforcement would be important (especially for commercially delivered offsets and habitat banks); this would require new administrative and regulatory mechanisms, and because the policy covers all types of impacts and sectors it is likely to meet resistance.
2. Efficiency	
Unit costs	
Public: 1-off (€)	Higher cost option: Development of guidance and statements, establishment of platform and reporting registry, strengthening other relevant policies, establishing enforcement systems, developing EU-level policy.
Public: Recurring (€/yr)	Moderate-high. Increased administration of enhanced regime, and monitoring of operation of regime at Member State and EU levels. Public costs could be in the order of EUR 800 million/year.
Private: 1-off (€)	Low costs of adjusting internal management procedures. Moderate costs for significantly affected industries.
Private: Recurring (€/yr)	If all land converted to built-up area is subject to offsets, the costs could be in the order of EUR 7.4 billion/year (see Annex 12). Whatever the total EU costs, evidence indicates that offset requirements are usually equivalent to only a small fraction of total project costs (Rayment et al, 2011; Conway et al, 2013).
Distribution of costs	Polluter pays and costs likely to be in proportion to damage to biodiversity, but costs may exceed value of damage or benefits of activities involved.
Benefits (other than NNL)	
Economic activity	Opportunity costs of reductions in constrained activities in areas where offsets occur (ie location of compensatory mitigation), but also new business

	opportunities would be created in offset provision.
Jobs	Opportunity costs of reductions in constrained activities in areas where offsets occur (ie location of compensatory mitigation), but also new business opportunities would be created in offset provision.
Health/quality of life	Greatest benefits for recreation, health and quality of life compared to other options.
Other	
3. Coherence	Would make greater contribution to biodiversity and Green Infrastructure objectives than 1-3 and would also provide greatest coherence of policy across EU and MS; opponents might cite potential conflicts with other objectives (eg growth).

5.11 Other market based instruments for biodiversity and ecosystem services

5.11.1 Introduction

A variety of market based instruments (other than conservation banking, which is described above) can be used to reduce rates of loss of biodiversity and ecosystem services, or to reduce net losses by delivering gains in biodiversity and/or ecosystem services.

These instruments are potentially many and varied, and can include:

- **Environmental taxes** – such as taxes on pesticides, fertilisers, peat, energy use, landfill and other activities involving pollution or resource use, which may help to reduce activities that damage biodiversity and generate revenues that may in some cases be hypothecated to environmental enhancement projects (see Box 5.9).

- **Environmental tax credits** – where part of an environmental tax obligation can be discharged by funding environmental enhancement projects. For example, in the UK, the Landfill Communities Fund and the Aggregates Tax Sustainability Fund (the latter until 2011, after which the Fund was withdrawn) have both been used to fund projects that benefit biodiversity and ecosystems. Operators are able to reduce their tax liability by funding local environmental enhancement projects. These may deliver net gains in biodiversity, especially where projects with a biodiversity focus are used as compensation for more general environmental impacts.

- **Payments for Ecosystem Services (PES)** – arrangements in which the beneficiaries of ecosystem services make payments to ecosystem managers to reward the delivery of those services. Agri-environment schemes are the most prominent example of PES in the EU at present, and involve payments to farmers for the delivery of environmental public benefits (see CAP above). PES can potentially be applied to a variety of ecosystems – including forests, wetlands and marine systems, either through publicly funded schemes or through negotiated arrangements involving private buyers (such as water companies). By placing values on biodiversity and ecosystems they have the potential to reduce rates of loss, or to deliver gains that may contribute to NNL overall.

- **Carbon Markets** – ecosystems such as forests and peatlands play an important role in storing and sequestering carbon, and therefore contributing to climate change mitigation. Rewarding this role, by enhancing the participation of conservation schemes within carbon markets and offsets programmes, has the potential to reduce rates of loss of biodiversity and ecosystems. This can be achieved, for example, through the participation of forest conservation projects within carbon offsetting schemes.

- **Product Certification and Labelling Schemes –** there is potential to reward companies that implement voluntary no-net loss initiatives through appropriate standards and certification. For example, it would be possible to establish an initiative whereby companies that implemented actions to ensure that their operations had NNL of biodiversity – through implementation of the mitigation hierarchy including appropriate use of offsets – could apply to be certified under a "NNL" standard. Achievement of this standard could be independently audited and verified. Companies capable of demonstrating NNL would be able to label their products and services accordingly, thereby gaining advantages in the market place. Such a standard could potentially apply to a wide range of products and services, from food and timber to mineral-based products and financial services.

Box 5.9 Examples of taxes and charges on pesticides and fertilisers in Europe

Denmark – a tax on pesticides was introduced in 1986 and was increased in the 1990s. The tax was initially based on the value of pesticide sales but was recently replaced by a differentiated tax taking account of the impact of different products on health and the environment.

Norway – a tax on pesticides has been in place since 1988. This was originally a percentage of price, but was replaced by a new instrument in 1999 based on dosage, and differentiated according to impacts on health and the environment, with 5 different tax bands applied to pesticides for commercial use.

Sweden – a tax was introduced on nitrogen and fertilisers in 1984. This was initially a percentage of the price but was replaced in 1992 by a new environmental tax based on weight. Some of the tax revenues have been used to fund research and environmental improvements in the agricultural sector. Sweden also introduced a pesticides tax in 1984. This was initially based on weight of active ingredient, but was replaced in 1996 by a tax based on product price.

5.11.2 Strengths

Strengths of market based mechanisms include:

- they can help to address widespread negative impacts on biodiversity and ecosystems, eg those resulting from fertiliser and pesticide use;
- they can be an efficient means of disincentivising activities that damage biodiversity and ecosystems, by internalising externalities;

- they can help to raise revenues to finance compensatory actions, eg through hypothecated taxes or tax credits;
- as a result they may have a particularly strong role to play in delivering policy level offsets, where individual offsets are difficult to design and enforce; and
- they can help to enhance the effectiveness of voluntary action – eg certification and labelling schemes may help to reward voluntary offsets through the market.

5.11.3 Weaknesses

Key weaknesses of market based instruments include:

- the lack of existing instruments in most Member States;
- the difficulty of designing targeted instruments to minimise biodiversity loss and avoid perverse incentives (eg pesticide and fertiliser taxes);
- they are not well suited to addressing location-specific impacts on biodiversity and ecosystems;
- effects on biodiversity and ecosystem services may be uncertain and difficult to measure, providing a barrier to achieving NNL; and
- hypothecated taxes are not popular with policy-makers.

5.11.4 Opportunities

The above examples all have the potential to contribute to a no-net loss target. However, they apply to specific aspects of biodiversity loss, and are unlikely to be able to deal with all of the drivers of biodiversity loss in a comprehensive way. As a result, residual negative impacts on biodiversity may still occur.

Nevertheless, if used in an ambitious and structured way, market-based instruments could be applied in pursuit of no-net-loss objectives. For example, a hypothecated tax or charge on an activity that damages biodiversity could help to reduce these impacts while raising revenues that could be used to fund restoration and enhancement measures and hence deliver no-net-loss. Possible examples might include:

- a tax on peat or mineral extraction, with some or all of the proceeds used to fund site restoration;
- a tax on fertiliser use, with the funds raised used to restore grasslands and/or other farmland habitats;
- a tax on pesticide use, used to finance action to enhance biodiversity in agricultural landscapes;
- a tax on the landfill of waste, used to restore habitats on former landfill sites and/or to fund investments in waste minimisation and recycling; and
- a development tax, used to fund habitat restoration or re-creation schemes that offset the impact of development on biodiversity.

These are effectively examples of financial compensation schemes where a tax or charge is levied on a damaging activity and is then used to fund measures that offset the impact of that activity. This form of compensation is an alternative to individually determined offsets, as discussed in the next section. It has certain disadvantages compared with offsets. Because the firm or individual causing damage to biodiversity is not directly responsible for offsetting that damage, there is less of a direct incentive to reduce that damage, and less certainty that adequate compensation will be provided. The system may also be less fair than a system of individual offsets, because the tax or charge may not be directly proportionate to the damage caused. Another drawback is the intense political resistance to green taxes, especially in the farming sector. On the other hand, there may be significant practical advantages compared to individually determined offsets, particularly where impacts are widespread and difficult to measure on a case by case basis. For example, it would be difficult to envisage a system of offsets negotiated with individual farmers to deal with the effects of grassland intensification, and a fertiliser tax or charge linked to a grassland enhancement and restoration fund might offer a more workable (but not necessarily more politically feasible) alternative.

Other forms of market based instruments – such as certification and labelling schemes – also offer opportunities to enhance biodiversity conservation and reduce rates of loss. They are likely to meet less political resistance than taxes, and offer potential to raise awareness of the no-net loss principle and encourage its voluntary uptake by a range of businesses and products. However, because of their voluntary nature it is difficult to envisage how they could achieve – rather than merely contribute to – a NNL objective overall.

5.11.5 Policy options

Market Based Instrument Policy Option 1 (MBI 1): EU Guidance on the potential role of Market Based Instruments to deliver No Net Loss

This option would involve developing guidance about the potential role of market-based instruments in contributing to no-net loss targets. This would set out the role that different market based instruments could play in achieving NNL objectives, and how their design might contribute to this, in order to inform Member States on the potential role of such instruments in a no-net loss policy. In addition, practical guidance could be developed on assessing the impact on biodiversity of companies and their products, and on the design, implementation and monitoring of voluntary offsets. This guidance could help to stimulate the development of voluntary no-net loss certification and labelling schemes.

Events and communications could also support the sharing of ideas and experience by Member States and businesses.

Policy Option MBI 2: Develop an EU 'No Net Loss' Label

A new EU-wide standard on NNL could be established, with the necessary accompanying underlying scientific and technical methodologies. Companies achieving NNL could be certified against this standard, and be able to display a 'no-net loss' label on their products. This would help to incentivise voluntary offsets and corporate NNL initiatives by helping to reward them through the marketplace.

This standard could potentially be applied to:

- **Organisations** capable of demonstrating that their activities as a whole result in NNL of biodiversity. This would require examination and offsetting of the direct and indirect impacts of all activities, including those of the supply chain; and/or
- **Products and services** that are demonstrated to result in NNL of biodiversity. This would require a life cycle approach that took account of all direct and indirect impacts. It could potentially be applied to a wide range of products, from basic commodities to manufactured goods and services.

Policy Option Evaluation

Both options are voluntary in nature and would therefore be expected to have relatively high feasibility, low cost and limited conflicts with other objectives. Option 2 would offer greater challenges in terms of its feasibility, because of technical challenges in assessing the range of direct and indirect impacts of organisations, products and services. However, benefits for biodiversity and ecosystems would also be limited, and neither option could be expected to make a substantial contribution to achieving NNL at EU scale. Both options could be considered as potential tools that could contribute to NNL alongside other initiatives.

Table 5-36 Evaluation of the effectiveness, efficiency and policy coherence of MBI 1: EU Guidance on the potential role of Market Based Instruments to deliver No Net Loss

Evaluation criteria	
1. Effectiveness	
Mitigation hierarchy stages	All stages.
Land use impacts	No direct land use impacts.
Potential coverage and impacts on biodiversity	Low but widespread impacts on all biodiversity, particularly outside of N2K sites and EU priority habitats and species.
Potential coverage and impacts on ecosystem services	Low but widespread impacts on all ecosystem services, particularly outside of N2K sites and un-related to EU priority habitats.
Clarity	High. The policy option is designed to improve understanding of MBIs.
Measurability.	Low. Could attempt to identify new MBIs implemented to contribute to NNL, but unlikely to always be able to do so. Further, measuring the impact of those MBIs on NNL would be patchy at best.
Feasibility	High. EU has developed significant expertise on MBIs in the past.
Enforceability	Acceptance of this option would likely be high, unless some sectors (eg agriculture) felt they were targeted. Further considerations of enforceability are not relevant.
2. Efficiency	
Unit costs	
Public: 1-off (€)	Minimal, development and implementation of guidance.
Public: Recurring (€/yr)	Depending on level of guidance, could be EUR 0-500,000 annually (Lammerant et al, 2013).

Private: 1-off (€)	n/a
Private: Recurring (€/yr)	n/a
Distribution of costs	Public costs.
Benefits (other than NNL)	
Economic activity	Could indirectly alter patterns of economic activity, but the direct impacts would be attributable to any MBIs implemented to achieve NNL, and the direction and magnitude cannot be assessed at this stage.
Jobs	Could indirectly alter patterns of labour demand, but the direct impacts would be attributable to any MBIs implemented to achieve NNL, and the direction and magnitude cannot be assessed at this stage.
Health/quality of life	Could indirectly improve health/QoL, if there is a focus within the guidance on levies for polluting activities.
Other	Promoting internalisation of environmental externalities should broadly improve welfare.
3. Coherence	High. Coherent with a number of EU objectives and principles.

Table 5-37 Evaluation of the effectiveness, efficiency and policy coherence of MBI 2: Develop an EU 'No Net Loss' Label

Evaluation criteria	
1. Effectiveness	
Mitigation hierarchy stages	All stages.
Land use impacts	No direct land use impacts, but if certification were effective, may have low (but currently un-assessable) impacts.
Potential coverage and impacts on biodiversity	Low but widespread impacts on all biodiversity, particularly outside of N2K sites and EU priority habitats and species.
Potential coverage and impacts on ecosystem services	Low but widespread impacts on all ecosystem services, particularly outside of N2K sites and un-related to EU priority habitats.
Clarity	Moderate. Much clearer for consumers to support NNL objectives, but technical nature of labelling risks a lack of clarity on the procedures and requirements of certification.
Measurability	Moderate. Common measures of certification success are market-share or certified land area under management (for food, fibre, and other good derived from ecosystem provisioning services).
Feasibility	Moderate. It is feasible, but significant technical work is required to implement a NNL certificate: the standards and scientific methods do not yet exist.
Enforceability	The policy option should be widely accepted, due to its voluntary and positive nature. However, any certification requires strong reporting and monitoring to ensure the purported benefits are being delivered.
2. Efficiency	
Unit costs	
Public: 1-off (€)	Low-Moderate. Establishing the standards and scientific basis of NNL certification will take some time and resources.
Public: Recurring (€/yr)	Low. Businesses given the standard must be monitored, and the standard itself must be continually reviewed and updated to ensure it delivers the benefits it

	claims.
Private: 1-off (€)	Low-moderate (but voluntary). Adapting practices to meet certification requirements.
Private: Recurring (€/yr)	Low-moderate (but voluntary). Annual independent verification of meeting certification requirements.
Distribution of costs	Depends on the sectors the certification targets apply to.
Benefits (other than NNL)	
Economic activity	Will generate a need for consultants and auditors of certification.
Jobs	May result in a small increase in labour demand for new certification experts, but relevant expertise already exists in current businesses.
Health/quality of life	May have indirect benefits if certification leads to companies reducing bad practices.
Other	May provide a competitive advantage for businesses that participate in certification and sell to markets where consumers care about NNL.
3. Coherence	High. Coherent with various EU goals, and specifically aims to align NNL objectives with positive economic activity.

5.12 Summary of the options and their potential effectiveness, efficiency and coherence

A summary of the evaluations of the overall effectiveness, efficiency and coherence of each of the individual policy options is provided below in Table 5-38. The effectiveness of each policy option in terms of achieving NNL with respect to specific sectoral impacts is summarised in Table 5-39. Their combined impacts under each of the four study policy package scenarios are considered in the next chapter, with an overall summary of impacts presented in Table 6-10.

Taking into account the requirement to adopt options in accordance with the mitigation hierarchy (see section 4.2), the evaluations above, as summarised below, indicate that significant steps can be taken to achieving the NNL objective through the improvement of existing measures that aim to avoid and reduce impacts on biodiversity and ecosystem services. In this respect the options that would probably have the highest impact and show strongest coherence with other EU polices concern measures that would enforce and better implement the Habitats Directive, particularly in relation to the protection of the Natura 2000 network and the effective offsetting of unavoidable residual impacts (ie BHD 1 in particular) on species and habitats of Community importance within it. Although the network only covers some 18% of the EU, it has an exceptionally high value for the conservation of EU threatened habitats and species and their valuable ecosystem services, many of which are dependent on the maintenance of biodiversity and ecosystem processes within the Natura sites.

Improved SEA processes (particularly regarding cumulative impacts on Natura 2000 sites), EIAs (especially with respect to their application to agricultural and forestry activities) and spatial planning would also support the protection of the Natura network, and would be most effective in reducing impacts on habitats, species and ecosystem services in the wider environment.

Other policy options that could substantially avoid and reduce impacts from agriculture and forestry outside Natura 2000 sites seem to be limited. With respect to agriculture this is primarily due to the completion of the recent CAP agreement, which now limits options for EU level agricultural policy initiatives until the next reform, which is not due until 2020. Although some policy options are put forward that could be taken up by Member States, it seems unlikely that they would be widely adopted and/or of sufficient strength to be more than at best moderately effective. The most effective agricultural policy options considered would appear to be the mapping of semi-natural habitats (and other important features) combined with a new cross-compliance GAEC standard to maintain the mapped habitats and features. However, although the mapping could be usefully started now, the adoption of the new GAEC standard could not be achieved until 2020 at the earliest. The main constraint with respect to the conservation of forest biodiversity and ecosystem services is the EU's limited competency on forestry issues. In addition its recent development of a new Forest Strategy, which is based on the concept of Sustainable Forest Management, also limits the development of politically realistic new policy options.

Even with the strongest of policy responses that aim to avoid and reduce impacts it is inevitable that significant residual impacts will widely occur across all ecosystems, and therefore offsetting policy measures will need to be developed and implemented to achieve the EU's NNL objective. Offsetting policy option 1 sets out to establish a clear offsetting policy framework, with minimum standards for offsetting, and an implementation plan. By itself this would not have a significant impact as offsetting and adherence to the offsetting standards would be voluntary. Offsetting policy option 2 would bring in mandatory offsetting for EU funded projects, but strong implementation of policy option 3, which addresses all impacts on scarce biodiversity and priority ecosystems, would probably be required to make a substantial contribution to achieving the NNL target. Furthermore, as recognised by the NNL Working Group, offsetting would need to address impacts from agriculture and forestry, as well as from built developments and extraction industries which offsets are more typically applied to.

However, even full implementation of offsetting policy option 3 and other measures to reduce impacts would not achieve the EU's NNL objective, which as discussed in chapter 4 needs to address impacts on all species and ecosystem services. Thus, offsetting policy option 4 is the only one considered here that would achieve the objective, although as discussed further in the recommendations (see section 7.2) it is recognised that the effective establishment of offsetting systems takes time, and therefore it is unrealistic to consider that this policy option could be effectively implemented before 2020.

Table 5-38 Overall assessment of the potential effectiveness, efficiency and coherence of each policy option

Efficiency = the extent to which the contribution to the NNL objective may be achieved for a given level of resources/at least cost (cost-effectiveness)

Policy option	Effectiveness		Efficiency	Coherence	Comments
	Biodiversity	Ecosystem Services			
BHD 1: Improved and wider Appropriate Assessments and compensatory measures for unavoidable impacts	High	Moderate - High	Moderate	High	
BHD 2: Improve the implementation of Birds Directive Article 3 and Habitats Directive Articles 3 and 10	Moderate	Moderate	High	High	
ELD 1: Enhancement of the implementation of the Directive, through awareness raising, improved guidance and enforcement	Low-Moderate	Variable	Moderate	High	
ELD 2: Extension and clarification of damage significance threshold to reflect NNL biodiversity objectives	Moderate	Variable	Moderate	High	Could link metrics to those used for biodiversity offsets, and other policies.
ELD 3: Extension of coverage of the Directive to include nationally threatened species	Moderate-High	Variable	Moderate	Moderate	
EIA 1: Ensure key EIA reform proposals made by the Commission are adopted	Moderate	Moderate	Moderate	High	
EIA 2: Wider future reforms of the EIA Directive	Moderate	Moderate	Moderate	High	
EIA 3: Improve implementation of the EIAs through awareness raising and enforcement, especially for agriculture	Moderate - High	Moderate	High	High	
SEA 1: Improved implementation of SEA through capacity building and guidance	Moderate	Moderate	High	Moderate	
SEA 2: Improvements to the SEA Directive, including improved screening criteria	Moderate	Moderate	High	Moderate	
SP 1: Adoption and implementation of the proposed Directive	Moderate - High	Moderate - High	High	High	Supports SEA and EIA

Policy option	Effectiveness		Efficiency	Coherence	Comments
	Biodiversity	Ecosystem Services			
establishing a framework for maritime spatial planning and integrated coastal management Marine Spatial Planning Directive					
SP 2: Promotion of best practice spatial planning by Member States	Moderate	Moderate	Moderate	Moderate	
SP3: Development of a Directive establishing a framework for terrestrial spatial planning	Moderate - High	Moderate - High	Moderate	High	Supports SEA and EIA
CAP 1: Raise awareness amongst land managers about the importance of maintaining semi-natural habitats, with a particular focus on HNV farmland	Low-Moderate	Low-moderate	High	High	Low effectiveness by itself, but moderate if supporting other policies
CAP 2: Include suitable indicators within the Monitoring and Evaluation Framework to allow progress to be evaluated against NNL objectives.	Moderate	Moderate	High	High	
CAP 3: Encourage and support all Member States to put in place a system of mapping and recording of all semi-natural habitats and landscape features on agricultural land	Low-High (uncertain)	Low-High (uncertain)	Moderate	Moderate	Depends on Member State uptake, if taken up, low effectiveness by itself, but high if supporting other policies
CAP 4:Encourage Member States to require all land holdings entering land management options under EAFRD to have an environment plan in place against which changes can be assessed, approved etc.	Low-Moderate (uncertain)	Low-moderate (uncertain)	High	Moderate	As CAP 3, but impact in support of other policies only moderate
CAP 5: Encourage Member States to apply the Pillar 1 greening requirement for permanent grassland in a way that protects valuable semi-natural grasslands	High (uncertain)	High (uncertain)	High	Moderate	Depends on Member State uptake, possibly some declines in provisioning services
CAP 6: Encourage Member States to implement the EAFRD agri-environment-climate and forest-environment-climate measures (and other	Moderate - High (uncertain)	Moderate – High (uncertain)	Uncertain	Moderate	Depends on Member State uptake. Efficiency uncertain, as it will depend on the resulting changes in use of specific

Policy option	**Effectiveness**		**Efficiency**	**Coherence**	**Comments**
	Biodiversity	**Ecosystem Services**			
measures) in ways that deliver greater contributions towards NNL.					measures
Option CAP 7: Include 'preservation of semi-natural habitats, including semi-natural grassland, peatlands, wetlands [others]' in the cross-compliance framework as a GAEC standard as an alternative to CAP Option 4.	Moderate – High	Moderate - High	High	Moderate-high	High benefits if linked to maps (CAP 3). Impacts would be post 2020
SD 1: Adoption of the proposed Soil Directive	Moderate (uncertain)	High (uncertain	Moderate	High	Impacts would be post 2020
FP 1: Develop a rigorous standardised accountable forest monitoring and evaluation system	Moderate	Moderate	Moderate	High	
FP 2: Include targets that contribute to NNL of biodiversity and ecosystem within Sustainable Forest Management in the new EU Forest Strategy and Action Plan	Moderate - High (uncertain)	Moderate (uncertain)	Moderate	High	Depends on Member State uptake and interpretation of SFM
BP 1: Ensure all EU funds, especially those related to regional policy, transport and energy fully integrate requirements relating to biodiversity and ecosystem services and are subject to biodiversity proofing procedures	Moderate-high	Moderate - high	Variable	High	This could have a more explicit NNL requirement, thereby linking to Of 2
Of 1: EU Offsetting framework and implementation plan to promote agreed types of offsetting according to defined standards	Low – High	Low - High	Low - High	Low - High options	Low by itself, high if linked to mandatory offsetting
Of 2: EU Framework with mandatory offsetting of residual impacts of EU funded development projects on scarce biodiversity and priority ecosystem services	Low - moderate	Low – moderate (uncertain)	Moderate	High	Difficult to quantify
Of 3: Mandatory requirements to offset significant losses of scarce biodiversity and ecosystem services	Moderate-High	Moderate – High (uncertain)	High	High	

Policy option	Effectiveness		Efficiency	Coherence	Comments
	Biodiversity	Ecosystem Services			
Of 4: Mandatory EU requirements to offset losses to all Biodiversity and Ecosystem Services	Very high	Very high	Moderate	High	Essential to achieve full NNL for biodiversity; some ecosystem trade-offs would be necessary
MBI 1: EU guidance on the potential role of Market Based Instruments to deliver NNL	Low	Low	Moderate	High	
MBI 2: Development of an EU 'No Net Loss' Label	Low	Low	Moderate	High	Could support other voluntary initiatives, eg Of 1

Table 5-39 Summary of the degree to which the options address each of the main impacts on biodiversity and ecosystems

Key. Overall impact: ● = Detrimental for biodiversity; ○ = beneficial. Magnitude: ● = low; ●● = moderate; ●●● = high magnitude. Source: Table 3-12

	Overall impact	Expected effectiveness in contributing to the NNL objective		
Impact source/impact type		Low	Moderate	High
Housing and non/light-industrial commerce: Buildings and associated lighting[*1]	●●	BHD2 EIA3 SP2 SD1 Of1	BHD2 EIA1,2 SEA1,2 SP3 Of3	BHD1 Of4
Recreation, sports and leisure: buildings, playing fields , stadia, tracks, marinas etc	●	EIA3 SEA1,2 SP2,3 Of1	EIA1,2 SP2 Of3	BHD1 Of4
Terrestrial transport and infrastructure: roads & vehicles, railways	●●	BHD2 EIA3 SP2 Of1	BHD2 EIA1,2 SEA1,2 SP3 BP1 Of2,3	BHD1 Of4
Air transport: aircraft and airports	●	EIA3 SP2 BP1 Of1,2	EIA1,2 SEA1,2 SP3 Of3	BHD1 Of4
River transport:	●●	BHD2 ELD1,2 EIA3 SP2 BP1 Of1,2	BHD2 ELD3 EIA1,2 SEA1,2 SP3 Of3	BHD1 Of4
Marine transport: shipping and ports	●●	EIA3 Of1	EIA1,2 SEA1,2 BP1 Of2,3	BHD1 SP1 Of4
Industrial/energy built developments: chemical plants, incinerators and power stations etc	●●	BHD2 ELD1,2 EIA3 SP2 SD1 Of1	BHD2 ELD3 EIA1,2 SEA1,2 SP3 BP1 Of2,3	BHD1 Of4
Terrestrial extraction sites: mines open cast/underground, aggregate extraction & spoil heaps etc	●●	BHD2 ELD1,2 EIA3 SP2 SD1 Of1	BHD2 ELD3 EIA1,2 SEA1,2 SP3 Of3	BHD1 Of4
Marine extraction sites: marine oil & gas exploration and production, marine aggregate & mineral extraction; dredging	●●	ELD1,2 EIA3 Of1	ELD3 EIA1,2 SEA1,2 Of3	BHD1 SP1 Of4
Flood control and coastal protection: flood embankments, washlands, land reclamation	●●●	EIA3 SP2,3 Of1	EIA1,2 SEA1,2 BP1 Of2,3	BHD1 Of4
Water treatment (raw and waste) infrastructure: plants, drains & outfalls	○○○	ELD1,2 EIA3 SP2 BP1 Of1,2	ELD,3 EIA1,2 SEA1,2 SP3 Of3	BHD1 Of4
Water supply: impounded reservoirs: for hydro-power or water storage, and water abstraction	●●●	EIA3 SP2 Of1	EIA1,2 SEA1,2 SP3 BP1 Of2,3	BHD1 Of4
Waste disposal: land fill sites and at sea dumping	●	ELD1,2 EIA3 SP2 SD1 Of1	ELD3 EIA1,2 SEA1,2 SP3 Of3	BHD1 Of4
Communications: telephone lines, aerials and masts	●	EIA3 Of1	EIA1,2 Of3	BHD1 Of4

	Overall impact	Expected effectiveness in contributing to the NNL objective		
Impact source/impact type		**Low**	**Moderate**	**High**
Terrestrial energy production structures: wind turbines, hydro-power pipelines, solar farms	●●	EIA3 SP2 Of1	EIA1,2 SEA1,2 SP3 BP1 Of2,3	BHD1 Of4
Marine energy production structures: wind turbines, wave power, tidal flow turbines, tidal impoundments	?	EIA3 Of1	EIA1,2 SEA1,2 BP1 Of2,3	BHD1 SP1 Of4
Energy supply: Overhead electricity transmission lines	●	EIA3 SP1 Of1	EIA1,2 SP3 BP1 Of2,3	BHD1 Of4
Energy supply: Underground electricity transmission lines, gas and oil pipelines and storage	●	EIA3 SP1 Of1	EIA1,2 SP3 BP1 Of2,3	BHD1 Of4
Energy supply: Dedicated bioenergy crops	●?	BHD1,2 EIA3 SP2 CAP1 Of1	BHD1,2 EIA1,2 SP3 CAP2,3,5,6 SD1 BP1 Of3	EIA3 CAP7 Of4
Agriculture: food, biofuels etc	●●●	BHD1,2 EIA3 SP2 CAP1,4 Of1	BHD1,2 EIA1,2 SP3, CAP2,3,5,6 SD1 BP1 Of3	EIA3 CAP7 Of4
Forestry	●●	BHD1,2 EIA3 SP2 Of1	BHD1,2 EIA1,2 SP3 CAP6 BP1 Of3	EIA3 Of4

6 ASSESSMENT OF THE POTENTIAL COMBINED IMPACTS OF POLICY PACKAGE SCENARIOS

6.1 Description of the policy scenario developed for this study

6.1.1 Introduction

This chapter attempts to assess the potential net impacts of combining the most promising (in terms of effectiveness, efficiency and coherence) individual policy options described in Chapter 5 according to four main scenarios – ie policy packages. As for the individual policy options the impact assessments of each policy package scenario have been carried out in relation to three key qualities: effectiveness (through a qualitative assessment and quantitative modeling as much as feasible) efficiency, and coherence.

6.1.2 The four scenarios

The four scenarios used in this contract are described below, and the individual policy options that are included under each (and their scenario-specific variations) are indicated in Table 6-1.

Scenario A: Better enforcement and implementation of existing measures, and encouragement of voluntary offsetting

Underlying assumptions*: Better implementation is sufficient to make a significant first step towards the NNL objective, especially regarding the avoidance and reduction of impacts relating to habitats and species of Community interest; and a voluntary approach is sufficient to secure these improvements.*

This policy package includes increased EU guidance, coordination, targeting, capacity building, and enforcement of key instruments (eg Habitats and Birds Directives, ELD, SEA, EIA, CAP RDP funding and targeting to biodiversity and ecosystem services, Forest Action Plan and CFP). It also entails raising awareness of the NNL objective (eg amongst key sectors) and measures to support and encourage voluntary offsetting for private business (eg through promotion of certification, guidance, bench-marking etc) and public sectors (eg promoting green procurement processes). This would be supported through the development and promotion of an offsetting policy framework and delivery plan with guidance on key principles and minimum standards that Member States would be encouraged to follow (eg the mitigation hierarchy, additionality requirements for offsets and Member State monitoring and public reporting).

Scenario B. New and enhanced measures to avoid and reduce impacts, and mandatory offsetting for residual impacts from EU funded developments

Underlying assumptions: *Some changes to a number of key existing policy instruments and development of new measures would address key policy gaps concerning the avoidance and reduction of impacts; and mandatory requirements to offset EU funded development projects would make an important further step towards the NNL objective.*

In addition to measures under A, this scenario includes changes to the instruments to increase their effectiveness, such as extending the type of actions or thresholds that trigger the requirements for SEA and EIA, addressing loopholes that enable division of projects into smaller subprojects that do not trigger EIA requirements, stronger requirements to document residual impacts and potential means of achieving NNL, requiring Member States to cover a wider range of species and habitats under the ELD, and creating new CAP cross-compliance standards. Significant policy gaps would be filled through the adoption of the proposed Marine Spatial Planning Directive and the Soil Directive and the development of a terrestrial spatial planning Directive (although these measures are not modelled as their impacts would occur after 2020).

To avoid EU policy inconsistencies, projects and programmes receiving EU funds (eg under Cohesion Policy) would be required to achieve NNL, including through offsetting where residual impacts remain after biodiversity proofing measures (included in Scenario A). Offsets would be required to adhere to principles and minimum standards based on the policy framework and guidance included under Scenario A. The common standards would provide for flexibility in implementation whilst ensuring a certain level of consistency across Member States.

Scenario C. Development of a policy framework with mandatory NNL objectives for scarce biodiversity and priority ecosystem services and minimum key standards for offsetting at the EU level

Underlying assumption: *Further new measures with minimum standards are required at the EU level to ensure NNL of the most important and threatened ecosystems and their related species and ecosystem services, and to encourage NNL of other biodiversity and ecosystem services.*

In addition to measures under A and B, permitting decisions for developments and land use changes would only be granted if it is possible to convincingly demonstrate that there will be NNL of scarce biodiversity and priority ecosystem services through measures taken accordance with the mitigation hierarchy. This in practice would result in a requirement for mandatory offsetting of <u>all residual impacts</u> from <u>all sources</u> (including agriculture, forestry and fisheries) on <u>scarce biodiversity and priority ecosystem services</u>. As under Scenario B offsetting would be required to adhere to principles and minimum standards based on guidance and sharing of good practice included under Scenario A.

It is anticipated that this option would be implemented through a Framework Directive, which would define the NNL objectives, standards for potential measures, key steps to be taken and a timetable for completion of each step.

Scenario D. Development of a policy framework for NNL with mandatory NNL objectives and key implementation standards for all biodiversity and ecosystem services

Underlying assumption: *Further new measures with minimum standards are required to ensure NNL of all biodiversity and ecosystem services, and therefore the EU's NNL policy objectives as a whole.*

Building on the measures under A and B (unless redundant) and C, this scenario results in a requirement for mandatory offsetting of <u>all residual impacts</u> from <u>all sources</u> (including agriculture, forestry and fisheries) on <u>all in situ (ie wild) native biodiversity and ecosystem services</u>. As under C it would involve the setting of minimum standards for offsetting, but might involve the differentiation of standards according to the importance and threat levels of biodiversity and ecosystem services being addressed.

As for C, this would be implemented through a Framework Directive.

Table 6-1 Inclusion and adaptation of individual policy options in each policy package scenario

Policy option	Scenario A	Scenario B	Scenario C	Scenario D	Comments
BHD 1: Improved and wider Appropriate Assessments and compensatory measures for unavoidable impacts	Yes	Yes	Yes	Yes	
BHD 2: Improve the implementation of Birds Directive Article 3 and Habitats Directive Articles 3 and 10	Yes	Yes	Yes	Yes	
ELD 1: Enhancement of the implementation of the Directive, through awareness raising, improved guidance and enforcement	Yes	Yes	Yes	Yes	
ELD 2: Extension and clarification of damage significance threshold to reflect NNL biodiversity objectives	Yes	Yes	Yes	Yes	
ELD 3: Extension of coverage of the Directive to include nationally threatened species		Yes	Yes	Yes	
EIA 1: Ensure key EIA reform proposals made by the Commission are adopted		Yes	Yes	Yes	
EIA 2: Wider future reforms of the EIA Directive		Yes	Yes	Yes	
EIA 3: Improve implementation of the EIAs through awareness raising and enforcement, especially for agriculture	Yes	Yes	Yes	Yes	
SEA 1: Improved implementation of SEA through capacity building and guidance	Yes	Yes	Yes	Yes	
SEA 2: Improvements to the SEA Directive, including improved screening criteria		Yes	Yes	Yes	
SP 1: Adoption and implementation of the		Yes	Yes	Yes	Marine policies

Policy option	Scenario A	Scenario B	Scenario C	Scenario D	Comments
proposed Directive establishing a framework for maritime spatial planning and integrated coastal management Marine Spatial Planning Directive					& impacts are not modelled
SP 2: Promotion of best practice spatial planning by Member States	Yes	Yes	Yes	Yes	
SP3: Development of a Directive establishing a framework for terrestrial spatial planning		Yes	Yes	Yes	Not modelled as impacts would be post 2020
CAP 1: Raise awareness amongst land managers about the importance of maintaining semi-natural habitats, with a particular focus on HNV farmland	Yes	Yes	Yes	Yes	
CAP 2: Include suitable indicators within the Monitoring and Evaluation Framework to allow progress to be evaluated against NNL objectives.		Yes	Yes	Yes	
CAP 3: Encourage and support all Member States to put in place a system of mapping and recording of all semi-natural habitats and landscape features on agricultural land		Yes	Yes	Yes	
CAP 4:Encourage Member States to require all land holdings entering land management options under EAFRD to have an environment plan in place against which changes can be assessed, approved etc.		Yes	Yes	Yes	
CAP 5: Encourage Member States to apply the Pillar 1 greening requirement for permanent grassland in a way that protects valuable semi-natural grasslands		Yes	Yes	Yes	
CAP 6: Encourage Member States to implement the EAFRD agri-environment-climate and forest-environment-climate measures (and other measures) in ways that deliver greater contributions towards NNL.	Yes	Yes	Yes	Yes	
CAP 7: Include 'preservation of semi-natural habitats, including semi-natural grassland, peatlands, wetlands [others]' in the cross-compliance framework as a GAEC standard as an alternative to CAP Option 4.		Yes	Yes	Yes	Not modelled as impacts would be post 2020
SD 1: Adoption of the proposed Soil Directive		Yes	Yes	Yes	Not modelled as impacts would be post 20200
FP 1: Develop a rigorous standardised accountable forest monitoring and evaluation system	Yes	Yes	Yes	Yes	
FP 2: Include targets that contribute to NNL		Yes	Yes	Yes	

Policy option	Scenario A	Scenario B	Scenario C	Scenario D	Comments
of biodiversity and ecosystem within Sustainable Forest Management in the new EU Forest Strategy and Action Plan					
BP 1: Ensure all EU funds, especially those related to regional policy, transport and energy fully integrate requirements relating to biodiversity and ecosystem services and are subject to biodiversity proofing procedures	Yes	Yes	Yes	Yes	
Of1: EU Offsetting framework and implementation plan to promote agreed types of offsetting according to defined standards	Yes	Yes	Yes	Yes	
Of 2: EU Framework with mandatory offsetting of residual impacts of EU funded development projects on scarce biodiversity and priority ecosystem services		Yes	Yes	Yes	
Of 3: Mandatory requirements to offset significant losses of scarce biodiversity and ecosystem services			Yes	Yes	
Of 4: Mandatory EU requirements to offset losses to all Biodiversity and Ecosystem Services				Yes	
MBI 1: EU guidance on the potential role of Market Instruments to deliver NNL	Yes	Yes	Yes	Yes	
MBI 2: Development of an EU 'No Net Loss' label		Yes	Yes	Yes	

6.2 Impact assessment of policy scenarios

6.2.1 Qualitative assessment of effectiveness

Given the incomplete and mostly qualitative information that is available on the extent and magnitude of current biodiversity and ecosystem service impacts, and uncertainties over the implementation and effectiveness of proposed individual policy options, it is clearly not possible to produce a comprehensive quantitative assessment of the likely impacts of each policy scenario. However, a preliminary qualitative assessment is provided below of the likely impacts on each of the main biodiversity and ecosystem service impact sources and types identified in Chapter 3. This assessment is based on the study team's judgements taking into account the individual policy impact assessments provided in the preceding chapter and all other relevant evidence documented in this report.

The results of the qualitative assessment and the modelling are discussed in section 6.2.2.

Table 6-2 Overall effectiveness in relation to addressing key impacts and achievement of no net loss

Key. Overall BaU impact: ● = Detrimental; ○ = Beneficial. **Magnitude** ● = low; ●● = moderate; ●●● = high. Source: Table 3-12. **Scenario impacts**: ≈ = no significant change compared to baseline scenario; ↓ = limited decrease compared to baseline scenario; ↓↓ = moderate decrease compared to baseline scenario; ↓↓↓ = major decrease compared to baseline scenario; ↓↓↓↓ = only minor impacts remain, so NNL objective achieved to the extent that it is practical if all measures effectively implemented where necessary. ? = uncertainty over impact as highly dependent on discretion and interpretation of Member States. Note: impacts of climate change, airborne pollution, invasive alien species and fisheries are not covered by this study.

Impact source / impact type	Overall impacts under BaU Scenario	Effect of Scenario A	Effect of Scenario B	Effect of Scenario C	Effect of Scenario D	Comments
Housing and non/light-industrial commerce: Buildings and associated lighting[*1]	●●	↓↓	↓↓	↓↓↓	↓↓↓↓	
Recreation, sports and leisure: buildings, playing fields , stadia, tracks, marinas etc	●	↓↓	↓↓	↓↓	↓↓↓↓	
Terrestrial transport and infrastructure: roads & vehicles, railways	●●	↓↓	↓↓	↓↓↓	↓↓↓↓	
Air transport: aircraft and airports	●	↓	↓↓	↓↓↓	↓↓↓↓	
River transport	●●	↓	↓↓	↓↓	↓↓↓↓	
Marine transport: shipping and ports	●●	↓↓	↓↓↓	↓↓↓	↓↓↓↓	
Industrial / energy built developments: chemical plants, incinerators and power stations etc	●●	↓↓	↓↓	↓↓↓	↓↓↓↓	
Terrestrial extraction sites: mines open cast / underground, aggregate extraction & spoil heaps etc	●●	↓↓	↓↓	↓↓↓	↓↓↓↓	
Marine extraction sites: marine oil & gas exploration and production, marine aggregate & mineral extraction; dredging	●●	↓↓	↓↓	↓↓↓	↓↓↓	Many impacts not offsetable
Flood control and coastal protection: flood embankments, washlands, land reclamation	●●●	↓↓	↓↓	↓↓↓	↓↓↓↓	
Water supply, treatment and disposal infrastructure: plants, drains & outfalls	○	↓	↓↓	↓↓↓	↓↓↓↓	
Water supply - impounded reservoirs: for hydro-power or water storage	●●●	↓↓	↓↓	↓↓↓	↓↓↓↓	
Waste disposal: land fill sites and at sea dumping	●	↓↓	↓↓	↓↓	↓↓↓↓	
Communications: telephone lines, aerials and masts	●	↓↓	↓↓	↓↓	↓↓↓	Many impacts not offsetable
Terrestrial energy production structures: wind turbines, hydro-power pipelines, solar farms	●●	↓↓	↓↓	↓↓	↓↓↓	Some impacts not offsetable
Marine energy production structures: wind turbines, wave power, tidal flow turbines, tidal impoundments	?	↓↓	↓↓↓	↓↓↓	↓↓↓	Some impacts not

Impact source / impact type	Overall impacts under BaU Scenario	Effect of Scenario A	Effect of Scenario B	Effect of Scenario C	Effect of Scenario D	Comments
						offsetable
Energy supply: Overhead electricity transmission lines	●	↓↓	↓↓	↓↓	↓↓↓	Many impacts not offsetable
Energy supply: Underground electricity transmission lines, gas and oil pipelines and storage	●	↓↓	↓↓	↓↓	↓↓↓↓	
Energy supply: Dedicated bioenergy crops	?	↓	↓↓	↓↓↓	↓↓↓↓	Some impacts too gradual to identify and offset in practice
Agriculture: food, biofuels etc	●●●	↓	↓↓?	↓↓↓	↓↓↓↓	As above
Forestry	●●	↓	↓↓?	↓↓↓	↓↓↓	As above

6.2.2 Modelled assessment of effectiveness

Model scenario settings

The nature of the policy proposals and the uncertainty over their possible implementation and effectiveness means that it is not possible to directly incorporate them into the model used in this contract. Instead, it is necessary to add a phase where the combined impacts of all the policy options within each scenario are assessed with respect to the model parameters that can be adjusted (see Annex 2). This assessment primarily focuses on the degree to which overall land type conversion pressures are affected by each of the scenarios (as impacts on ecosystem quality cannot be readily modelled) and the degree of offsetting of each type of conversion that would occur. It should, however, be noted that it is very difficult to make assessments of these overall impacts on land use change and offsetting and therefore these settings should be seen as overall effect assumptions that are incorporated into the model, rather than robust predictions that are closely linked to the policy options.

European policies can be relevant for land use change in two ways. Firstly, *policies influence the demand for land*, such as stimulation of agriculture through the CAP. This policy influences the amount of land in use for different agricultural commodities within the EU. Secondly, a group of *policies exists that influence land-use configurations*, for example excluding or favouring some regions for a specific type of land use. Differences between scenarios are obtained by differences in data inputs and variable settings that affect the behaviour of the model. Next to (1) demand for land, four categories of settings and data inputs can be distinguished that together define the set of preferences and constraints for which the allocation routine determines an optimal solution; (2) location suitability; (3) neighbourhood settings; (4) area-specific conditions; and (5) land use type specific conditions.

Below, we describe how the four categories of input data affect the behaviour of the model and how they can be used to parameterize each policy scenario package. These model scenario settings illustrate the possibilities of the model with examples of settings used in previous applications.

The actual settings used in this study are given in Table 6-3 (qualitative overview) and Annex 2. Annex 2 explains these model parameters in detail, presents all included spatial data sets and discusses related implementation issues.

1. Land requirements

The land requirements of the different land use types determine the actual area of the different land use types that is allocated by the model. These demands are specified for each country or country-group. The demand is specified for built-up area and agricultural land (arable, pasture, permanent crops). Changes in natural area follow land availability after accounting for changes in agricultural and built-up area. If land is available, forest and semi-natural habitats can occur spontaneously on abandoned lands or more directly through active management of former agricultural areas.

Land requirements are specified relative to the BaU, based on expert estimates of the effect of the policy options on the land demands. These settings directly influence the amount of land that is allocated and with that the ecosystem coverage.

In addition to the overall land use requirements that are a function of EU policies, (macro-) economic development and demographic changes, the policy scenarios can differ in the level and type of offsetting required according to the various offsetting policy options. Factors that can vary are (1) which types of land take (eg conversions built development) would need to be offset; (2) the percentage land take that would be offset; (3) the location of offsetting, such as in relation to restrictions (eg no offsetting in Natura 2000 sites) or targeting of offsetting (eg to areas that would contribute to Green Infrastructure development priority goals). (1) and (2) directly influence the land requirements in the model and with that the ecosystem coverage. Several ways of incorporating (3) into the model can be envisaged. This could include, for example, requirements to offset biodiversity losses in the direct vicinity or allowing offsetting further away, and specification of the area where offsetting is allowed or not.

2. Location suitability

Location suitability is a major determinant of the competitive capacity of the different land use types at a specific location. Besides the commonly considered biophysical suitability in terms of crop growth potential, other factors, such as accessibility, should be considered as factors influencing suitability as perceived by the decision maker.

Land use is allocated as a function of the location suitability (Section 3.3.). Additional to this component of the suitability that captures the historic and current location preferences in response to location characteristics, the suitability as perceived by decision makers is included. This is modelled by adapting the suitability for land use types based on area-specific conditions. An example of this is conversion of arable land on erosion sensitive places to grassland and forest under the current CAP. Such a policy measure will decrease the perceived suitability of erosion sensitive areas and increase the likelihood that these areas are actually converted to grassland or forest. If the suitability of arable land is decreased in areas with a high erosion risk (for a definition see Annex 2), this change in perception of suitability is simulated in a realistic way (Verburg et al, 2006).

3. Neighbourhood settings

In addition to the location suitability described above, the suitability and allocation of land use types can depend on the land use in the vicinity (ie neighbourhood characteristics). This is particularly common for built-up areas: new built-up areas are more likely to develop close to existing built-up areas than elsewhere. To include this in the land use change modelling, the fraction of the neighbourhood of each grid cell covered by a land use type can be used as a factor explaining the suitability for the land use type. By varying the size of the neighbourhood and the strength of the effect in calculating the suitability, policies on fragmentation or urban sprawl can be simulated. Although urban sprawl is currently not managed at the EU level, some urban growth control measures can be included to demonstrate their potential impact (ie what could be the consequences of more active policies controlling urban growth). Secondly, policies aiming at limiting fragmentation of nature can be simulated using neighbourhood settings. Although there is no binding European-wide policy on natural corridors, there are obligations regarding the coherence of the Natura 2000 network and initiatives to further enhance Green Infrastructure (as discussed in chapter 5). The policy scenarios differ in how such a policy is adopted, and how strongly it is enforced.

4. Area specific conditions

Many spatial policies are targeted towards specific areas. Some of these policies are implemented in the model as a restriction on all conversions in the specified areas (eg protected areas) or as a restriction on specific conversions (eg no new arable land in erosion sensitive areas). The extent of the areas where restrictions apply and the restricted conversions is scenario specific. For example, in the BaU scenario, no conversion of forest and semi-natural habitats to arable land is allowed in Natura 2000 areas. In a scenario with a more strict nature protection, a larger area can assumed to be protected, such as all semi-natural grasslands.

5. Land use type specific conditions

Land use types often have specific characteristics that influence their conversion and that cause differences in their spatio-temporal behaviour. While urban growth in almost all cases results in a one-way conversion of other land uses into built-up area, arable areas can still increase in part of the region while the region as a whole faces a decrease. Therefore each land use type is characterised in the model by a conversion elasticity and a set of plausible conversions. Conversion elasticities ensure that the current land use pattern is an important determinant of future land uses as has frequently been indicated in land use change literature. Unrealistic conversions are not allowed while others are only allowed in designated areas (See 3 – Area specific conditions). Some other conversions are only realistic after a minimum time period: the spontaneous development of nature on abandoned farmland does not directly lead to a land cover type that can be classified as nature.

Land use type specific conditions, thus, describe how the land use types behave relative to each other. This behaviour will differ under different scenarios. First, the land use conversions that are allowed can differ. For example, while conversion of pasture is to arable land is allowed in the BaU, this can be restricted in other scenarios. Second, the conversion elasticity can be used to simulate financial incentives that are the same throughout Europe. For example, policies that promote permanent grassland can be simulated by increasing the conversion elasticity of pasture. This causes fewer gross changes of grassland.

Land use modelling storylines

The policy scenarios are translated into model settings for the CLUE-scanner framework. Scenarios were elaborated in four steps: First, for each policy option we evaluated whether it has impact on the demand for land and the spatial distribution of land use at the scale of the land use change modelling. Second, for the policy options that do have an effect on the demand for land or the spatial distribution of land use, we evaluated the character and strength of the effects (Table 6-3). Third, we used the overview of the policy options included in each scenario (Table 6-1) to evaluate the combined effects of the policy options per scenario. The evaluation of the effects of the policy options, the demand for land, and the spatial distribution of land use is based on expert knowledge gained from previous European-scale impact assessments. Finally, the effects of the individual policy options are combined for each scenario. When the effects of policy options overlap, we adopted the option with the strongest effect. Details of how each policy option has been incorporated into the modelling are provided below. Table 6-4 describes their combined effect on each model parameter and Annex 2 gives an overview of all model parameters.

Table 6-3: Expert evaluation of the effects of policy options on land demand and spatial allocation of land use. Policy options that are not listed in this table are assumed not to influence land demand or spatial allocation of land use at a scale that can be captured with the CLUE-scanner.

Policy option	Assumed effect and resulting incorporation into the CLUE model compared to the BaU Scenario
BHD1: Improved and wider Appropriate Assessments and compensatory measures for unavoidable impacts	Expected to result in prohibition of conversion in Natura 2000 sites of any land use to build up land or arable, semi-natural to pasture, forest to pasture; and prohibition of conversion to built-up area within 2km of Natura 2000 sites
BHD2: Improve the implementation of Birds Directive Article 3 and Habitats Directive Articles 3 and 10	Hedgerows, trees and small semi-natural habitats patches etc in the landscape will be better protected, but this cannot be modelled directly. It will be assumed that fragmentation will be reduced compared to the BAU. This is implemented using the neighborhood settings, by increasing the location suitability of forest and nature close to forest and nature patches.
EIA 1: Ensure key EIA reform proposals made by the Commission are adopted	Built-up area expansion into areas with valuable ecosystem services discouraged. To implement this, the location suitability of areas with valuable ecosystem services for built-up area is reduced. Conversion to built-up area in nationally protected areas (outside Natura 2000) reduced by decreasing the location suitability of nationally protected areas for built-up area, and by discouraging conversion of semi-natural vegetation to pasture in protected areas.
EIA 2: Wider future reforms of the EIA Directive	As EIA 1, but in combination with policy options Of 1 and Of 2 would lead to some offsetting, assumed 10% of land take by built-up area are offset – see Table 6.3 for details. Offsetting of other ecosystem impacts is assumed to be minimal.
EIA 3: Improve implementation of the EIAs through awareness raising and enforcement, especially for agriculture	Expected to result in a higher protection for permanent grassland, i.e. an increase in resistance to change is used to simulated this policy option.
SEA 1: Improved implementation of SEA through capacity building and guidance	This policy option will help protect Natura 2000 and nationally protected areas from direct impacts and fragmentation impacts and support EIA – but no additional significant effects to those above are assumed.
SEA 2: Improvements to the SEA Directive, including improved screening criteria	Reduced built-up expansion into areas with valuable ecosystem services is expected, similar as for EIA1. Conversion to built-up land in nationally protected areas (outside Natura 2000) will be reduced, and conversion of semi-natural vegetation to pasture will be reduced in protected areas. As nature outside protected areas will be better protected, a lower level of fragmentation compared to the BaU is simulated.
SP2: Promotion of best practice spatial planning by	Expected to reduce urban demand slightly (change relative to BaU too small to include realistically), to reduce urban sprawl, and to support green infrastructure , reducing fragmentation. Implemented by increasing the

Policy option	Assumed effect and resulting incorporation into the CLUE model compared to the BaU Scenario
Member States	location suitability for built-up area close to existing built-up area, using the neighborhood settings.
SP3: Development of a Directive establishing a framework for terrestrial spatial planning	As SP3 but with greater impacts, assumed 4% decline in urban demand, and reduction in urban sprawl and habitat fragmentation as in SP2 and EIA1.
CAP 1: Raise awareness amongst land managers about the importance of maintaining semi-natural habitats, with a particular focus on HNV farmland	This option would result in some reduction in the conversion of semi-natural habitats, but the effect is too small to include in the model
CAP 5: Encourage Member States to apply the Pillar 1 greening requirement for permanent grassland in a way that protects valuable semi-natural grasslands	In combination with CAP 2,3 , 4 and 5 this option would strengthen the constraints on conversion of semi-natural vegetation and pasture to arable under Pillar 1 Greening measures, but effect difficult to assess as it is not mandatory.
CAP 6: Encourage Member States to implement the EAFRD agri-environment-climate and forest-environment-climate measures (and other measures) in ways that deliver greater environmental benefits contributing towards NNL	Would reduce abandonment and intensification of semi-natural ecosystems, but effect difficult to assess as it is not mandatory – assumed to result in reduction in conversion of semi-natural to pasture, arable or forest. This is simulated by increasing the resistance to change of semi-natural vegetation.
SD 1: Adoption of the proposed Soil Directive	Transposition of the Directive would take several years and therefore the measure is unlikely to have an effect before 2020
F 1: Strengthen SFM in the new EU Forest Strategy and Action Plan so that it that benefits biodiversity and ecosystem services	This measure primary affects forest management and condition rather than extent and location, so cannot be include in the modeling
BP 1: Ensure all EU funds, especially those related to regional policy, transport and energy are better targeted towards biodiversity and subject to biodiversity proofing procedures	The effect of this option is difficult to quantify as the proportion, type and location of developments receiving EU funds are uncertain; also the policy measure overlaps with EIA and SEA measures – so the effect of this policy option is not explicitly included in model.

Policy option	Assumed effect and resulting incorporation into the CLUE model compared to the BaU Scenario
0f 2: EU Framework with mandatory offsetting of residual impacts of EU funded development projects on scarce biodiversity and priority ecosystem services	The effect of this option is difficult to quantify as proportion, type and location of developments receiving EU funds uncertain; but assumed 10% of urban conversions are offset, which overlaps with the other Offsetting policy options – see Table 6-4 for details .
Of 3: Mandatory requirements to offset significant losses of scarce biodiversity and ecosystem services	Significant offsetting is expected due to this option, but difficult to quantify as the proportion of biodiversity and ecosystem services that would qualify as scarce is uncertain. For this modelling of possible impacts, it is assumed that 100% of semi-natural vegetation, 75% of forest and 25 % of pasture and 10% of arable conversions would be offset, but this is a rough estimate based on expert judgement for the scenario modelling and not a prediction. See Table 6-4 for details and Annex 2 for the offsetting procedure.
Of 4: Mandatory EU requirements to offset losses to all biodiversity and ecosystem services	All conversions to urban, and semi-natural vegetation and forest to pasture or arable would be offset – see Table 6-4 for details and Annex 2 for the offsetting procedure.
MBI 1: EU Guidance on the potential role of market instruments to deliver NNNL	This option would mainly support the maintenance of ecosystem services, but the likely effects are too uncertain and small to include in this modelling. This policy option also overlaps with the offsetting policy options and is expected not to have additional effects.
MBI 2: EU “No Net Loss” Label	This option would encourage a small amount of voluntary offsetting, but unlikely to be sufficient before 2020 to lead to an effect large enough to include in the modelling. This policy option also overlaps with the offsetting policy options and is expected not to have additional effects.

Scenario A: Better enforcement and implementation of existing measures, and encouragement of voluntary offsetting

- A stronger protection level of Natura 2000 areas: through prohibition of conversion of any land use to built-up land or arable, semi-natural to pasture, forest to pasture under BHD1.
- Improved implementation of EIAs especially for agriculture (EIA3) will result in improved protection of semi-natural grassland and pasture, incorporated into the model by increasing the resistance to change.
- Improved protection of landscape features under the Habitats Directive (BHD2), EIA (EIA3), SEA (SEA1) and spatial planning (SP2) will result in a slight increase in the protection of nationally protected areas outside the Natura network, incorporated into the model by disincentives for conversion to arable, pasture or permanent crops in these areas.

- Improved spatial planning (SP2) will also result in a lower amount of urban sprawl.

- Improved EIA, spatial planning and SEA will also result in a slight decrease in loss of landscape features (eg hedgerows, trees and small habitat patches) leading to an assumed reduction in fragmentation.

- Policy option CAP6 to increase EAFRD spending on measures that will maintain biodiversity and ecosystem services (especially to promote increases of carbon sequestration / avoid carbon emission from LULUCF), is assumed to reduce conversion of semi-natural vegetation and pasture to arable and conversion of arable land to pasture in areas with a high soil organic carbon content.

Scenario B: New and enhanced measures to avoid and reduce impacts, and mandatory offsetting for residual impacts from EU funded developments

Additional to the measures simulated for scenario A:

- The wider scope of EIAs (EIA2) is simulated by further limiting expansion of built-up areas.

- The spatial planning policy options (SP1, SP3) are simulated by assuming incentives to protect land use that has a high biodiversity or high provision of ecosystem services. In areas with a low biodiversity or low provision of ecosystem services, incentives are assumed for converting arable land into more natural land use or pasture.

- The encouragement of offsetting through EIA reform (EIA3) market-based instruments (MBI 2), and the mandatory NNL requirements for scarce biodiversity and priority ecosystem services resulting from EU funded development projects (Of2) is expected to result in offsetting of 10% of conversions of forest and semi-natural habitats to urban land (including infrastructure developments).

Scenario C: Development of policy framework with mandatory NNL objectives for scarce biodiversity and priority ecosystem services and minimum key standards for offsetting at the EU level

Additional to the measures simulated for scenario B:

- The mandatory EU requirements for offsetting land take that results in "significant losses" of scarce biodiversity and priority ecosystem services (Policy option Of3) is simulated by full offsetting of all conversions of forest and semi-natural habitat to built-up land take, and all conversions of forest and semi-natural habitat to arable land take in areas with a high provision of ecosystem services and biodiversity or in national protected areas. Offsetting for losses of semi-natural and forest habitats is like-for-like and at a ratio of 1:1.

Scenario D: Development of policy framework with mandatory NNL objectives for scarce biodiversity and priority ecosystem services and minimum key standards for offsetting at the EU level

Additional to the measures simulated for scenario C:

- The mandatory EU requirement for offsetting (Policy option Of4) is simulated by full offsetting of all conversions of forest and semi-natural habitat to built-up land. Within areas with a moderate or high provision of ecosystem services and biodiversity, offsetting also occurs of pasture conversions to built up land and arable, and arable conversions to built up land. Offsetting for losses of semi-natural and forest habitats is like-for-like and at a ratio of 1:1. Offsetting of pasture is through semi-natural habitat creation at a ratio of 1:0.5. Offsetting of arable is through semi-natural habitat creation at a ratio of 1:0.3.

Table 6-4: Summary of incorporation of policy package scenario effects into the model settings

Parameter		Impact compared with BaU			
	BaU	A	B	C*	D*
1a. Land demand	Impact of policy options on the areas land use, in % relative to the BaU. The demand for natural land use types is calculated from the demand of the land use types indicated here.				
Built up area		As BaU	-4% (ie 2020 built-up area in scenario B is 4% lower than 2020 built-up area in the BaU, consistent with VOLANTE Compact Cities scenario)	As B	As B
Arable land including arable biofuels		As BaU	As BaU	As BaU	As BaU
Permanent crops		As BaU	As BaU	As BaU	As BaU
Pasture		As BaU	As BaU	As BaU	As BaU
1b. Offsetting*	Policy scenarios most probably differ in rules with respect to nature compensation. Parameters that can be varied: - *Which land take should be compensated;* - *Fraction land toke to be compensated;* - *Where can offsetting be done: on which land use types; preferred areas; excluded areas (N2K, ...);*				
Forest > built-up	No offsetting required	As BaU	10% offsetting is required. Offsetting occurs on agricultural land, preferably on areas with a low suitability for agriculture. Offsetting is done within the Pan European Ecological Network (PEEN) where feasible and avoids N2K and HNV areas.	100% offsetting is required for land take in areas with high biodiversity value or ecosystem service provision. Offsetting occurs on agricultural land, preferably on areas with a low suitability for agriculture. Offsetting is done within the Pan European Ecological Network (PEEN) where feasible and avoids N2K and HNV areas.	10% offsetting is required for land take in areas with biodiversity value or ecosystem service provision. Offsetting occurs on agricultural land, preferably on areas with a low suitability for agriculture. Offsetting is done within the Pan European Ecological Network (PEEN) where feasible and avoids N2K and HNV areas.
Forest > Arable	No offsetting required	As BaU	As BaU	100% offsetting as above	100% offsetting as above
Semi-natural > built-up	No offsetting required	As BaU	10% offsetting as above	100% offsetting as above	100% offsetting as above

Parameter		Impact compared with BaU			
	BaU	A	B	C*	D*
Semi-natural > arable	No offsetting required	As BaU	As BaU	100% offsetting as above	100% offsetting as above
Pasture > arable	No offsetting required	As BaU	As BaU	As above	100% offsetting as above
Pasture > built-up	No offsetting required	As BaU	As BaU	As above	100% offsetting as above
Arable > built up	No offsetting required	As BaU	As BaU	As above	100% offsetting as above
2. Modifications of location conditions	(Dis)incentives for specific land use types in specific areas. These are simulated as changes of the location suitability for the land use type, that change the competing power of the land use type at the specified locations. The can, eg, be used to provide incentives to favour pasture and nature relative to arable land in areas with a high provision of ecosystem services.				
Built-up	Disincentives in N2K areas	As BaU	Disincentives for conversions that require offsetting to reflect additional cost	As B	As B
Arable	Incentives in LFA and currently cropped areas in N2K (as this is often HNV farmland); disincentives in areas with high erosion risk	As BaU	Disincentives for conversions that require offsetting to reflect additional cost	As BaU	As BaU
Pasture	Incentives in LFA's	As BaU	As BaU	As BaU	As BaU
Permanent crops	Incentives in LFA's	As BaU	As BaU	As BaU	As BaU
Semi-natural areas	n/a	As BaU	Incentives for areas that were (Semi-)natural in 2000 in N2K and nationally protected areas.	As B	As B
3. Neighbourhood settings	Settings to control fragmentation. These are commonly used to simulate policies that limit urban sprawl or fragmentation of nature.				
Built-up areas	No policies to control urban sprawl	Some policies to control urban sprawl: New built-up areas concentrated close to existing built-up areas.	Strict policies to control urban sprawl: New built-up areas concentrated close to existing built-up areas.	As B	As B

Parameter		Impact compared with BaU			
	BaU	A	B	C*	D*
Nature	No policies to control nature fragmentation	Increased protection for small patches of nature – which are otherwise easily prone to loss (land suitable to agri for example) – large patches of nature are less vulnerable in general to this process.	As A, but stronger effects	As B	as B
4. Area specific restrictions	Definitions of protected areas where (specific) land use conversions are restricted				
Nature areas: restricted conversions (these are not allowed in the scenario, within protected areas)	Forest & Nature > agriculture Forest & Nature > Built-up	Forest & Nature > agriculture Forest & Nature > Built-up Pasture > arable Pasture > Built-up	As A	As B	As C
Other protected areas: definition	N/A	2km buffer around N2K	As A	As A	As A
Other protected areas: restricted conversions	N/A	Conversion to built-up	As A	As A	As A
5. Land use specific settings	Settings to describe the competitive power of land use types relative to each other.				
Built-up area	N/A	As BaU	As A	As B	As C
Arable land	N/A	As BaU	As A	As B	As C
Pasture	High resistance to change to limit conversion of permanent pasture.	Higher resistance to change than in BaU.	higher resistance to change than in A	As B	As B
Semi-natural vegetation	N/A	As BaU	As BaU	As BaU	As BaU
Forest	N/A	As BaU	As BaU	As BaU	As BaU

Offset ratios are as follows: Land take of $1km^2$ seminatural and forest needs to be compensated with $1km^2$ semi-natural vegetation; land take of $1km^2$ of arable needs to be compensated with $0.3km^2$ semi-natural vegetation; land take of $1km^2$ of pasture needs to be compensated with $0.5km^2$ semi-natural vegetation.

Modelling results

Land use

In scenarios B, C and D, decreases in built-up area relative to the BaU are expected (Figure 6-1) as a result of the more restrictive spatial planning assumed under policy option SP3. In the scenarios, larger amounts of forest and semi- natural vegetation are maintained than in the BaU. For all scenarios A-D, the forest area is larger than in the BaU. The area of semi-natural vegetation decreases by 0.3% in scenario A relative to the BaU, but increases in the other scenarios. The differences in scenario A are due to the somewhat higher resistance to change of pastures, resulting in less conversion of pasture into semi-natural vegetation (Table 6-7). The increases relative to the BaU in the scenarios B through D are a result of the lower demand for built-up area, resulting in a lower pressure on semi-natural vegetation near cities. Additionally, offsetting of land take following the policy options Of2 through Of4 increases the area of semi-natural vegetation. All scenarios expect a lower amount of recently abandoned farmland than the BaU (Figure 6-1). The land use in the policy scenarios is less dynamic than in the BaU due to several spatial restrictions, resulting in less gross land use changes. Also, abandoned farmlands are generally favourable locations for offsetting losses of ecosystems, thus reducing the area of abandoned farmland in scenarios B-D, in favour of semi-natural vegetation and forest.

Besides changes in the total areas of land use types, the scenarios differ in spatial patterns of land use. As these are of importance for several of the ecosystem quality indicators, the differences are illustrated for a small area in Figure 6-2. In the BaU scenario, the region faces expansion of built-up area and arable land, as a consequence of the ongoing population growth in this region and favourable conditions for arable production. The built-up expansion is particularly clear around Dortmund. The expansion of arable land (Blue circle NW of Osnabrück) results in disappearing patches of forest and semi-natural vegetation. In scenario A, a higher protection level for biodiversity outside protected areas is expected following the improved implementation of the Birds and Habitat Directives, resulting in less decrease of patches of forest and semi-natural vegetation. This can be seen in the blue circle NW of Osnabrück. In Dortmund, the more densely clustered built-up area expansion relative to the BaU scenario can be observed. This decreases the built-up sprawl elsewhere. Some effects can be seen north of Dortmund, but as this example region is highly urbanized, it will most importantly decrease urbanization in other parts of Germany. In scenario B, additionally, the lower overall rate of built-up area increase due to more restrictive spatial planning is visible, most clearly around Bielefeld. More forest and semi-natural vegetation remains (Blue circle NW of Osnabrück) and some new semi-natural vegetation appears, which is due to offsetting of built-up land take (purple circle east of Osnabrück). In the scenarios C and D, these offsetting effects become clearer because offsetting of land take is required for more types of land take, and a higher amount of offsetting is required.

Figure 6-1 Relative differences between scenarios A-D and the BaU scenario

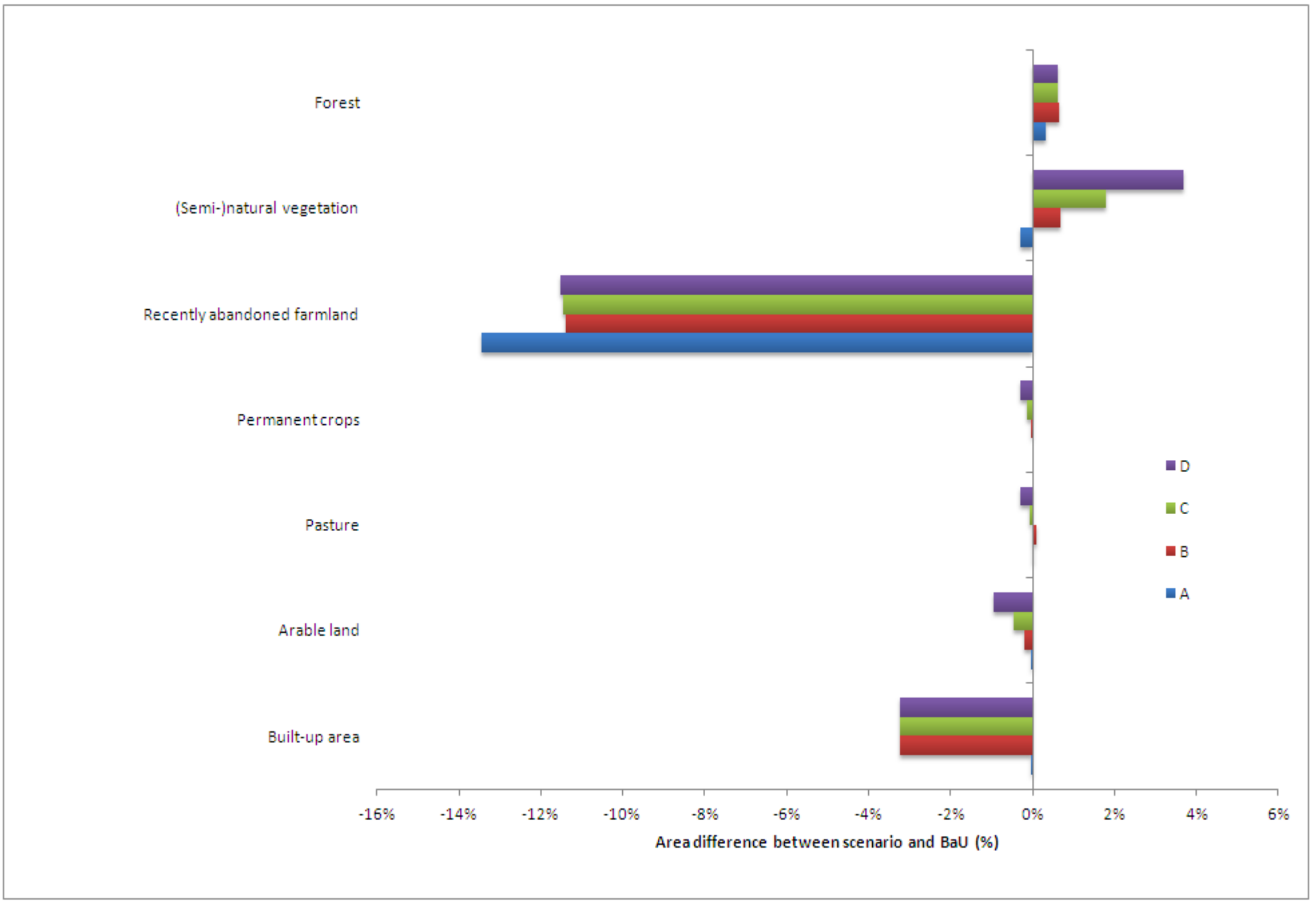
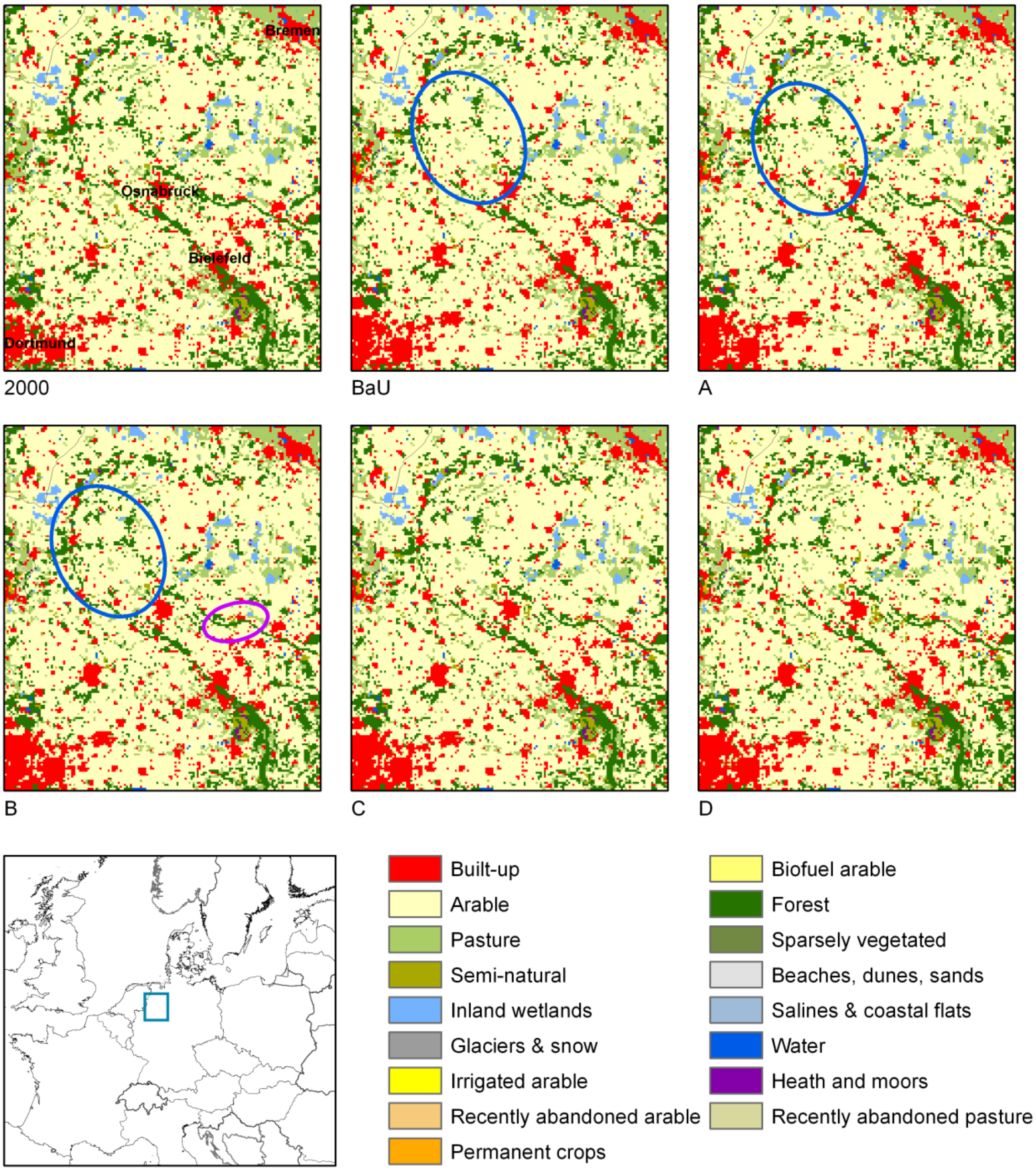


Figure 6-2 Example of land use patterns in BaU and policy scenarios



Ecosystem coverage and quality

Land take: The policy options show a strong decrease (7 to 21%) in the total amount of land take compared to the BaU (Table 6-5 and Table 6-6). All types of land take are reduced under the scenarios (Table 6-5). As in all scenarios the overall population growth results in a demand for built-up area (+16% over 2000-2020 in BaU and scenario A, +12% in scenarios B through D), land take by built-up expansion remains in all scenarios. This land take is, however, increasingly compensated for in scenario B through D, resulting in an increased land gain and an overall increase of ecosystem coverage. Comparing levels of land take versus levels of land gain, the loss : gain ratio changes from about 1 : 0.5 (BaU scenario) to 1 : 0.87 (scenario D) (Table 6-6), thus approaching NNL in terms of more natural land cover compared to the BaU. Note, however, that this indicator is summed over all EU27 countries, and does not account for effects of the spatial configurations of ecosystem networks, habitat regeneration time or habitat quality. Land gain first decreases compared to the BaU, after which it increases again for scenarios B-D (see Table 6-5, and additional Figures in Annex 3). The initial slight decrease under scenario A can be explained by the stricter regulations to maintain pastures, thus reducing succession towards semi-natural vegetation and forest. The subsequent increase in land gain in scenarios B-D is a consequence of the increasing offset requirements in policy scenarios B-D. For the Natura 2000 areas, land take that occurred still under the BaU scenario is now halted (Table A3-6 in Annex 3), with considerable amounts of land gain in Natura 2000 areas. Land gain is higher under the BaU scenario, because under the policy scenarios farmland in Natura 2000 areas is assumed to be High Nature Value farmland, conversion of which to semi-natural vegetation or forest is restricted.

Table 6-5 Land take and land gain, specified by type, in EU27 (in km^2)

Land use types as indicated in Table 3-4, with "Agricultural land" referring to the combined area of the land use types non-irrigated arable land, irrigated arable land, permanent crops, pasture, and recently abandoned arable land and pasture following Table 3-4.

			Land use in 2020		
			Forest & semi-natural vegetation	Agricultural land	Built-up area
Land use in start year	Forest & semi-natural vegetation	Scenario BaU		36,194	9,732
		Scenario A		31,583	7,481
		Scenario B		29,284	4,050
		Scenario C		29,101	4,050
		Scenario D		28,794	4,050
	Agricultural land	Scenario BaU	33,975		19,029
		Scenario A	30,630		21,278
		Scenario B	33,016		17,928
		Scenario C	37,243		17,928
		Scenario D	44,410		17,928
	Built-up area	Scenario BaU	0	0	
		Scenario A	0	0	
		Scenario B	0	0	
		Scenario C	0	0	
		Scenario D	0	0	

Table 6-6 Land take versus land gain in EU27 (in km^2)

Scenario	Land Take (km^2)	Land Gain (km^2)	Ratio lost :	gained
BaU	64,955	33,975	1 :	0.52
A	60,342	30,630	1 :	0.51
B	51,262	33,016	1 :	0.64
C	51,079	37,243	1 :	0.73
D	50,772	44,410	1 :	0.87

Table 6-7 Land take and land gain, for individual land use classes, in EU27 (km^2)

			Land use in 2020						
			Built-up area	Arable land	Pasture	Permanent crops	Abandoned farmland	(Semi-)natural vegetation	Forest
Land use in 2000	Built-up area	BaU		0	0	0	0	0	0
		A		0	0	0	0	0	0
		B		0	0	0	0	0	0
		C		0	0	0	0	0	0
		D		0	0	0	0	0	0
	Arable land	BaU	7,669		7,948	6,673	16,093	26,673	55
		A	9,148		6,159	7,608	15,152	24,912	20
		B	7,384		6,009	7,717	16,288	27,218	43
		C	7,384		6,007	7,690	16,273	30,476	43
		D	7,384		6,002	7,680	16,258	36,082	43
	Pasture	BaU	10,257	5,994		3,442	9,094	5,271	26
		A	10,741	6,858		2,701	6,400	3,993	20
		B	8,954	8,537		2,576	5,834	4,082	16
		C	8,954	8,487		2,573	5,827	4,938	16
		D	8,954	8,351		2,572	5,825	6,202	16
	Permanent crops	BaU	1,103	6,860	4,677		988	1,946	4
		A	1,389	8,013	3,524		1,106	1,653	3
		B	1,590	8,471	2,989		1,075	1,654	3
		C	1,590	8,449	2,989		1,075	1,767	3
		D	1,590	8,397	2,988		1,075	2,064	3
	(Semi-)natural vegetation	BaU	2,646	7,307	4,014	69	0		97,206
		A	2,014	6,129	3,679	26	0		97,296
		B	1,232	5,119	3,822	61	0		97,367
		C	1,232	4,949	3,809	61	0		97,285
		D	1,232	4,707	3,744	61	0		97,146
	Forest	BaU	7,086	22,196	2,544	64	0	0	
		A	5,467	19,273	2,453	23	0	0	
		B	2,818	17,509	2,720	53	0	0	
		C	2,818	17,509	2,720	53	0	0	
		D	2,818	17,509	2,720	53	0	0	

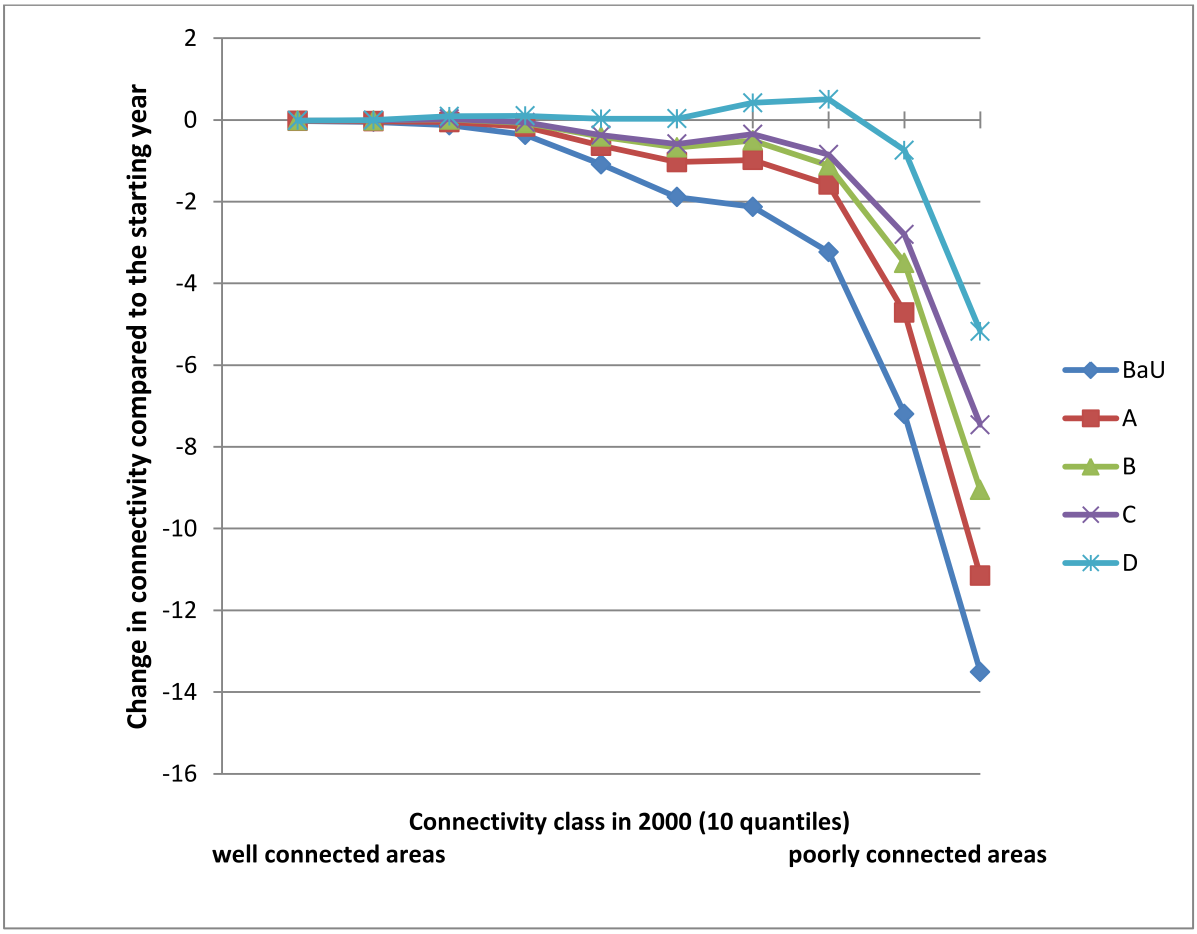
Table 6-8 Percentage land take and land gain, for individual land use classes, in EU27 (% compared to the BaU). Empty cells have a zero value in the BAU in Table 6.6

			Land use in 2020						
			Built-up area	Arable land	Pasture	Permanent crops	Abandoned farmland	(Semi-)natural vegetation	Forest
Land use in 2000	Built-up area	BaU							
		A							
		B							
		C							
		D							
	Arable land	BaU							
		A	19%		-23%	14%	-6%	-7%	-64%
		B	-4%		-24%	16%	1%	2%	-22%
		C	-4%		-24%	15%	1%	14%	-22%
		D	-4%		-24%	15%	1%	35%	-22%
	Pasture	BaU							
		A	5%	14%		-22%	-30%	-24%	-23%
		B	-13%	42%		-25%	-36%	-23%	-38%
		C	-13%	42%		-25%	-36%	-6%	-38%
		D	-13%	39%		-25%	-36%	18%	-38%
	Permanent crops	BaU							
		A	26%	17%	-25%		12%	-15%	-25%
		B	44%	23%	-36%		9%	-15%	-25%
		C	44%	23%	-36%		9%	-9%	-25%
		D	44%	22%	-36%		9%	6%	-25%
	Semi-natural vegetation	BaU							
		A	-24%	-16%	-8%	-62%			0%
		B	-53%	-30%	-5%	-12%			0%
		C	-53%	-32%	-5%	-12%			0%
		D	-53%	-36%	-7%	-12%			0%
	Forest	BaU							
		A	-23%	-13%	-4%	-64%			
		B	-60%	-21%	7%	-17%			
		C	-60%	-21%	7%	-17%			
		D	-60%	-21%	7%	-17%			

Land cover connectivity potential: Under all scenarios, the more isolated areas become even more isolated in general because of urban expansion, but the policy scenarios A-D are able to reduce the negative effects compared to the BaU scenario (Figure 6-3). Under scenario D there is even some improvement for moderately connected regions. The best connected regions show no change, as connectivity is already very good in these areas. Annex 3, Fig 3-13 shows the spatial distribution of changes in connectivity, which reflects that under scenarios A-D isolation is less severe than under the BaU scenario, a pattern that is apparent across the EU, which can be attributed to the combination of measures related to reduction in urban expansion and sprawl and offset requirements near impact locations.

Figure 6-3 The change in the connectivity measure under the five scenarios

The regions are classified into 10 quantiles ranging from well-connected areas in the year 2000 (left), to the least connected (most isolated) areas in the year 2000 (right). The graph shows the change in mean connectivity for areas in each of these quantiles. Positive values indicate improvement in connectivity, negative values indicate more isolation compared to the year 2000.



Bird species-richness: At an aggregate EU level, overall bird species richness improves considerably for scenarios B, C and D (Figure 6-4), improving species richness compared to the BaU by 55%, 68% and 92% respectively. Scenario A does not yield similar benefits in terms of bird species richness, the overall reduction is 31% compared to the BaU. Under scenario A there are fewer sites that lose large numbers of species than under the BaU scenario (ie for poor quality areas); so in this respect scenario A outperforms the BaU scenario. However, scenario A is not able to realise the same yields in species richness for sites with higher species richness – the BaU scenario results in more sites with larger increases in species richness. There are four possible explanations for this. First, under scenario A, small patches of forest are better protected than under BaU. As a consequence, forest loss could 'leak' to larger patches, which possibly have higher species richness. Second, protected areas are better protected under scenario A, but protection levels are not necessarily directly linked to bird species richness, leaving potentially species rich areas unprotected. Third, farmland in Natura 2000 areas is maintained under scenario A as HNV Farmland, but this may not be reflected in the bird species richness indicator, as it cannot account for ecosystem quality. Fourth, and probably most importantly, many of the measures included in Scenario A are difficult to incorporate into the land use model (eg the improved protection of Natura sites and the wider environment. The results of scenario A should therefore be treated with particular caution. In contrast the effects of offsetting requirements under scenarios B-D are more effectively incorporated into the model and their benefits clearly outweigh the possible negative effects of scenario A, resulting in increases in terms of species richness.

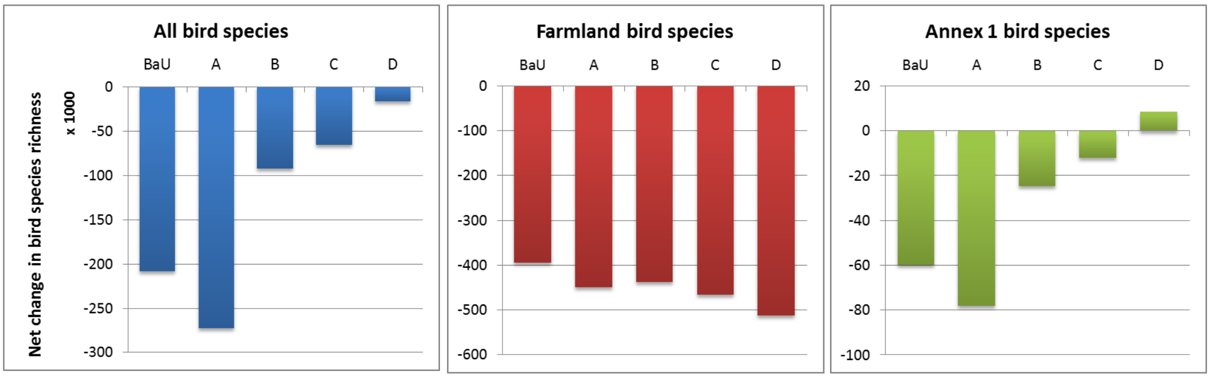
For farmland bird species, the trends are negative under the policy scenarios, with losses of species richness compared to the BaU of up to 30% under scenario D (Figure 6-4). This is directly related with the offset requirements for forest and semi-natural vegetation, which replaces agricultural land. It should, however, be noted that measures to improve the environmental quality of agricultural land, such as agri-environment measures, HNV farmland etc, are not reflected in the bird species richness indicator, as it is based on quantity, not on quality of land use types.

For Annex 1 bird species, the offset policies are projected to be very effective, halting the loss and even projecting a net increase of Annex 1 species under the D scenario (Figure 6-4). Scenario D improves conditions compared to the BaU scenario by 115% due to the increases in land gain and reductions in land take. Also for Annex 1 species the A scenario performs the worst, for reasons outlined above.

At the NUTS2 level, the average changes in bird species richness appears much more marginal due to averaging effects over space and trade-offs between species (eg changes from farmland to forest and semi-natural habitat will benefit some species, while it will be detrimental for other species) (Annex 3, Figure 3-17). The spatial patterns are consistent under the BaU and the policy scenarios: the urbanising regions are the ones where largest amounts of losses are expected, while regions with increasing bird species richness are found in parts of Portugal, Spain and Central Europe. In the scenarios where offset is required (B through D) species richness also increases in parts of the UK, and negative effects in the urban regions are reduced.

Figure 6-4 Cumulative change in bird species richness over the EU27, compared to the starting year

Negative values indicate an overall net loss, positive values indicate an overall net gain.



Mean Species Abundance index: The MSA index was already somewhat positive for the BaU scenario (as explained in Chapter 3), but the policy scenarios are all able to further improve MSA (Figure 6-5), with 1.2% (scenario A) to 10% (scenario D) to values over MSA=50 (see also Annex 3). For the BaU scenario, improvements of the MSA index are anticipated for all countries except Malta and Slovenia (Figure 6-6). Scenarios A-D all improve the MSA index further, for all countries (Figure 6-6) and all NUTS2 regions (Annex 3). This is due to the increased ecosystem coverage and the improved connectivity throughout the scenarios. The number of NUTS2 regions that experience reductions in the MSA index decreases, and the strength of the decrease also becomes less severe with policy options B, C and D in particular. The MSA indicator clearly shows the effect of the increasing offset requirements in the various policy scenarios: urban regions that show decreases in the MSA index under the BaU scenario (several capital regions such as Paris, Madrid, London, Stockholm, Helsinki, Athens), show fewer or even no negative effects anymore under scenarios B-D.

Figure 6-5 Average values for Mean Species Abundance for all scenarios, calculated over EU27

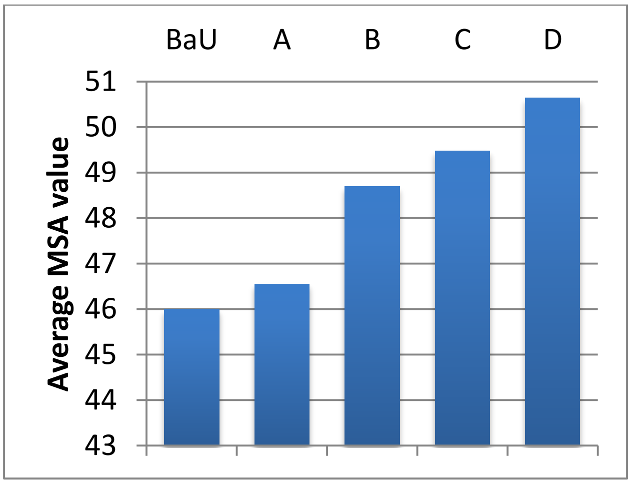
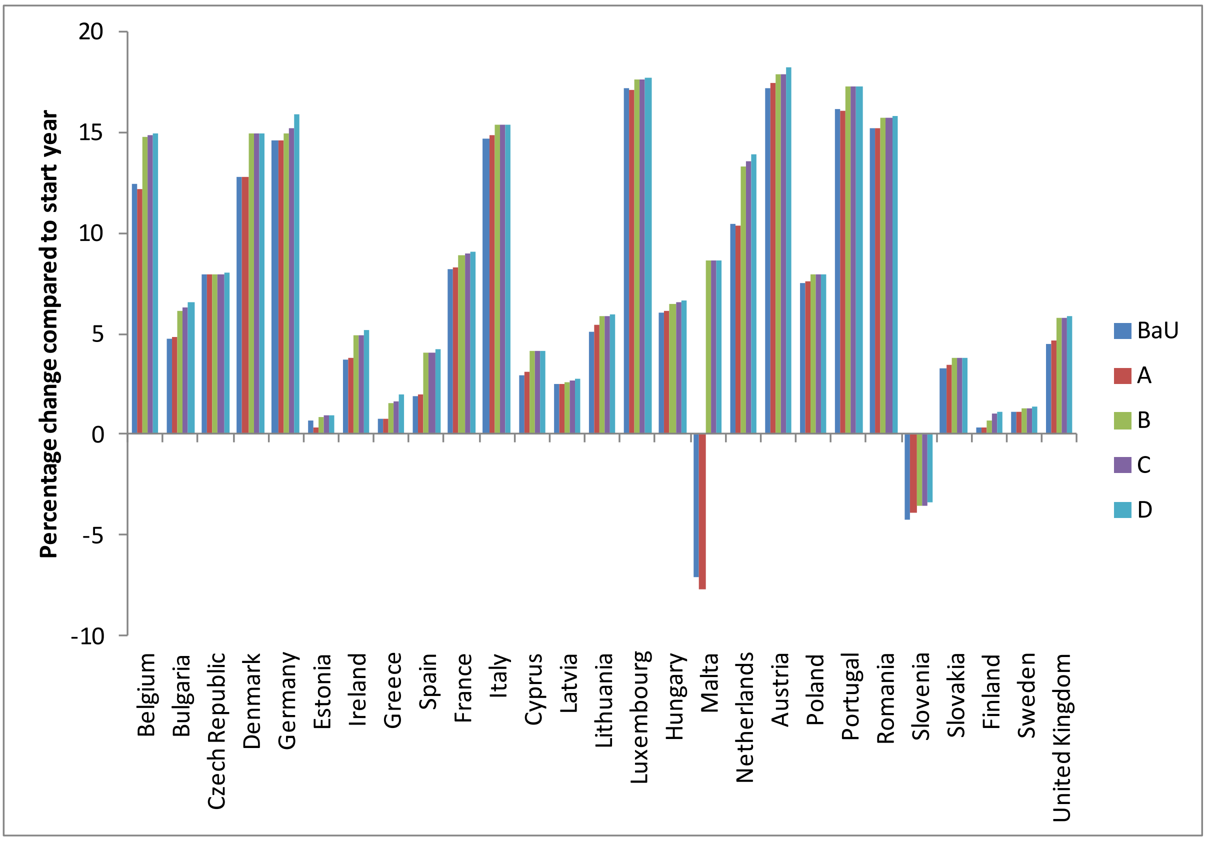


Figure 6-6 Relative changes in the Mean Species Abundance index per country, for all scenarios



To summarise, the stricter regulations and offsets requirements under the scenarios A-D are clearly reflected in the four indicators of ecosystem quality. Overall, compared to the BaU scenario, land take is reduced (with increases in semi-natural vegetation and forest), connectivity loss becomes less severe, the Mean Species Abundance index improves by 1.2-10% and bird species richness increases overall with 92% for the D scenario compared to BaU, with even 115% for Annex 1 species (ie net gain), but with the trade off on farmland bird species, which reduce by 30% under the D scenario.

Ecosystem services

Table 6-9 summarises the trends of changes of the ecosystem services at country scale. A more detailed analysis, including maps of the changes of the individual ecosystem services, is given in Annex 3.

Crop production: In Scenario A, measures to limit land take in Natura 2000 buffer areas and measures to limit urban sprawl slightly reduce the gross cropland area changes compared to the BaU. This also applies in scenarios B, C and D. However, in scenarios B through D, increasing amounts of land take that can be harmful to ecosystems or biodiversity are being compensated by creating new semi-natural habitats. This offsetting often is at the cost of arable land and reduces the cropland area in several countries: fewer countries with an increase in crop production are seen in the scenarios B through D while more countries show a decrease. This decreases the area of cropland in the EU and will increase the demand for crop production (and cropland) outside the EU. This effect is increasingly strong in the scenarios B through D, with a demand for cropland outside the EU of more than 10,000 km^2 (assuming equal cropland production).

Forest biomass: As in the BaU scenario, the area of forest is expected to increase in the policy scenarios and some increases in the biomass stock per km^2 are expected. The lower demand for built-up land in the scenarios B through D results in a lower pressure on forests. As a consequence, in these scenarios the forest biomass stock increases or remains stable in all countries. The major differences among the scenarios B through D are the increased areas of semi-natural vegetation; little differences in forest area are expected. Consequently, similar changes of the forest biomass stock are expected in scenarios B through D.

Water provision: Scenario A shows small changes of the water supply : demand ratio compared to the BaU, because both the areas that supply water and the areas with a demand for water (built-up area, arable land) hardly change. Some changes in land use allocation patterns are expected, resulting in small changes in the water supply and demand areas at the watershed scale. In the scenarios B through D, due to the offsetting the amount of arable land decreases relative to the BaU. Therefore, the balance between water supply and demand improves. In a few countries (NL, DE, SE, AT) a decrease of the service remains in scenario D and overall, approximately a quarter of the EU land area is expected to face a decrease in the water supply : demand ratio. These countries either have a large supply of potable water from groundwater resources (NL, DE, SE) or glacier water (AT) and therefore do not depend on surface water alone.

Air quality regulation: In all scenarios, more natural vegetation remains than in the BaU scenario, resulting in improvements of the air quality regulation. This is both due to a reduction in land take as a result of spatial policies and EIA measures, and due to the offsetting. However, in all scenarios expansion of built-up areas is expected. In countries with a high rate of urban expansion, consequently, decreases of the service relative to the base year remain. This is both due to insufficient expansion of nature areas directly adjacent to built-up area, as to the low capacity of semi-natural vegetation to capture air pollutants relative to farmland. In the scenarios B through D, the increases of the air quality regulation occur in the same regions (ie in the direct vicinity of existing and new built-up areas). Consequently, the area where improvements are expected changes little over the scenarios (Table 6-9). Within the regions, the increases of the air quality regulation are stronger over the scenarios.

Carbon sequestration: In most countries, carbon sequestration decreases in all scenarios. The policy scenarios show positive effects relative to the BaU scenario, with the strongest positive effects over the largest area in the D scenario. The decreases of carbon sequestration are mostly lower than the BaU and in one country (NL), the policy measures that are assumed in scenario D are expected to counteract the decreases in carbon sequestration that are expected in scenarios BaU and A. In most countries, decreases of carbon sequestration remain because the measures in the scenarios have limited effect on the gross land take, and because of time lag effects. Land take from forests and semi-natural habitats to other land uses results in large carbon emissions from the biomass lost. Carbon sequestration rates in semi-natural habitats that are established to compensate for the lost areas are too low to compensate the carbon emission upon deforestation.

Erosion prevention: In all policy scenarios, more natural vegetation remains or is established in the BaU. The natural vegetation provides a better protection against erosion, leading to no change or improvement of the service in all countries considered in the scenarios B through D, with the strongest positive effects over the largest area in the D scenario. The changes in land use allocation in scenario A are not sufficient to result in clear improvements of the erosion prevention. Decreases of erosion prevention remain where expansion of built-up area or arable land results in land take of forest. The land take is offset through expansion of semi-natural vegetation, but as semi-natural vegetation provides less protection against erosion than forest, offsetting does not completely recover the original erosion prevention capacity. This occurs most importantly in northwestern Europe. These are mostly areas with a relatively low erosion risk.

Flood protection: Negligible differences in the flood protection capacity relative to the BaU are expected in the policy scenarios. In 18 countries, no change or improvement of flood protection is expected while in eight countries the provision decreases irrespective of the scenario. These are mostly urbanized countries with a strong further increase of urbanization (BE, CY, NL) or countries with a lot of arable land (DK, DE, UK). These land use types provide very little flood regulation. Additionally, measures in the scenarios B through D have little effects on the flood regulation. To improve the flood regulation supply, avoidance or compensation measures should be targeted at very specific locations to be effective. A policy scenario specifically targeted at improving flood regulation in the VOLANTE study did result in significant changes of this indicator. In this policy scenario, upper zones of river basins were assigned a higher protection status to avoid land take and stimulate land gain (Verburg et al, 2013b).

Storm protection: In the scenarios B through D, improvements of the ecosystem service provision are seen relative to the BaU. This is due to the increased forest and semi-natural habitat area and the decreased built-up area. For this service, offsetting of land take in the direct vicinity of the land take is highly favourable because it results in joint increases of sensitive areas (mainly built-up) and protecting areas (nature). In the D scenario, marginal decreases (<1%) remain in FR and NL. In all other coastal countries the provision of the service does not change or increases in the D scenario.

Pollination: In all countries, the provision of pollination improves relative to the BaU. From scenarios A through D there is an increasing trend in total pollination provision compared to the BaU. No Net Loss of pollination is achieved in the D scenario in 11 countries while in 15 countries decreases in the provision of the service are expected. In most countries the decreases are marginal. Large overall decreases are expected only in Cyprus, Spain and Ireland. The offsetting of land take is reasonably effective for this service. Losses of forest and semi-natural habitat through land take by cropland are compensated by creation of new forest and semi-natural habitat in the direct vicinity of the cropland expansion. These patches are assumed to be suitable pollinator habitats, thus ensuring a good provision of pollination.

Soil quality regulation: In all scenarios, marginal changes relative to the base year are seen. This is because this service changes too slowly to result in significant differences over the timeframe considered.

Recreation: The policy scenarios decrease the service provision relative to the BaU. The reason for this is the land use change in easily accessible areas. A mosaic landscape is favourable for the capacity of the landscape to provide recreation and accessible areas, particularly close to cities, as these are the main recreation areas. Due to the offsetting of land take in many areas close to cities, the variation of the land use decreases in the model, while insufficient new forest and semi-natural habitats emerge to compensate for this decrease. This reduces the recreation capacity, although in most countries the decreases are marginal. Only in BE (-7%), CY (-6%), GR (-7%), IE (-6%) and LX (-15%) substantial changes are expected. Although these effects might be overestimated because of variation in the newly established semi-natural land use that is not captured in the model, such effects have actually been observed in case studies (eg van Berkel and Verburg, 2014).

Table 6-9 Trend directions of ecosystem service change in the policy scenarios (Area (x1000 km2) per trend per ecosystem service)

Cell shading indicates the trend in the scenarios. Areas were calculated on a NUTS2 basis to ensure comparability among the services. Not all areas per service-scenario combination add up to the same area because (i) not all ecosystem services are relevant throughout the EU (eg storm protection), and (ii) some data gaps exist.

Key:	
	No Net Loss
	Improvement relative to the BaU
	No effects relative to the BaU
	Detoriation relative to the BaU

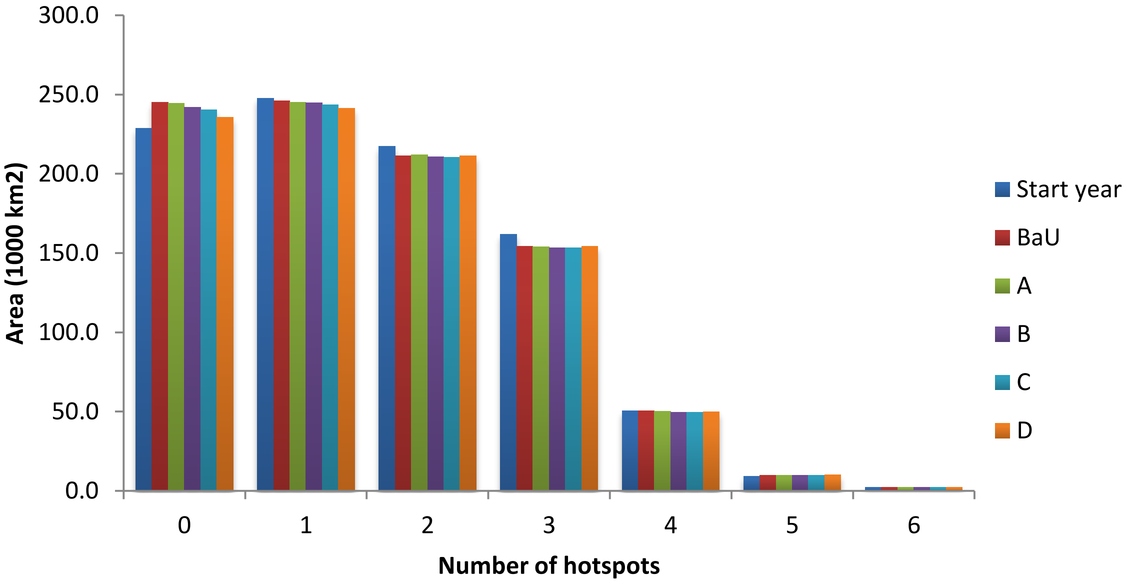
Category, Service		Scenario			
	Trend 2000-2020	A	B	C	D
Provisioning services					
Crop production	Increase	1037	1022	925	636
	Neutral	1211	1165	1219	1487
	Decrease	1816	1877	1920	1942
	% change in scenario relative to BaU	0.0%	-0.1%	-0.3%	-0.7%
Forest biomass	Increase	3948	3980	3980	3971
	Neutral	73	63	63	73
	Decrease	220	197	197	197
	% change in scenario relative to BaU	0.4%	0.7%	0.7%	0.7%
Water provision	Increase	948	1010	1010	1018
	Neutral	1818	1892	2113	2192
	Decrease	1476	1340	1118	1031
	% change in scenario relative to BaU	-0.1%	0.6%	1.3%	1.4%
Regulating services					
Air quality regulation	Increase	1934	1953	1953	1933
	Neutral	679	933	933	953
	Decrease	1628	1355	1355	1355
	% change in scenario relative to BaU	0.3%	0.7%	0.7%	0.7%
Carbon sequestration	Increase	1371	1404	1404	1408
	Neutral	196	312	292	317
	Decrease	2681	2532	2551	2523
	% change in scenario relative to BaU	0.7%	3.4%	3.4%	3.6%
Erosion prevention	Increase	2588	2550	2667	2727
	Neutral	695	671	733	799
	Decrease	968	1030	850	725
	% change in scenario relative to BaU	0.1%	0.1%	0.3%	0.7%
Flood regulation	Increase	2138	2222	2222	2222
	Neutral	1122	1040	1063	1078
	Decrease	982	979	956	941
	% change in scenario relative to BaU	0.0%	0.1%	0.2%	0.2%
Storm protection	Increase	12	12	12	48
	Neutral	643	646	654	615
	Decrease	45	42	34	37
	% change in scenario relative to BaU	-2.8%	-1.0%	-1.0%	-1.0%

Category, Service		**Scenario**			
	Trend 2000-2020	**A**	**B**	**C**	**D**
Pollination	Increase	974	988	1030	1157
	Neutral	809	812	618	1051
	Decrease	2452	2435	2587	2027
	% change in scenario relative to BaU	0.5%	1.3%	1.7%	3.0%
Soil quality regulation	Increase	899	899	875	875
	Neutral	3055	3055	3088	3088
	Decrease	282	282	272	272
	% change in scenario relative to BaU	0.0%	0.0%	0.0%	0.0%
Cultural services					
Recreation	Increase	1986	1054	1054	1054
	Neutral	2126	836	834	789
	Decrease	129	2351	2353	2397
	% change in scenario relative to BaU	0.0%	-2.4%	-2.4%	-2.5%

To summarise overall changes in the supply of regulating services, Figure 6-7 shows the area of hotspots of single or multiple ecosystem services. A hotspot is defined as a place where ecosystem service map values are in the upper tail of the distribution of the map values. The upper quartile was used as a threshold. Hotspot maps were made for each of the regulating services and an overlay was made, indicating how many regulating services have a hotspot value at each location. In the BaU scenario, the area where no regulating service has a supply hotspot expands by 7% relative to the base year while the area where one or more regulating services have a supply hotspot decreases. In the policy scenarios, these overall changes are offset to some extent. In the D scenario, the area with no regulating service supply hotspots still increases, but by a smaller amount (3%). The area with hotspots of multiple regulating services increases relative to the base year. These improvements are seen in all EU countries (See Annex 3). Thus, in the start year, considerable areas supply a broad range of ecosystem services. This multifunctionality decreases in the BaU: the area with a low supply of multiple ecosystem services expands. In the policy scenarios, this expansion is partly being offset.

Figure 6-7 Overall supply of regulating services

The chart shows the area where 0 to 6 of the regulating services have a hotspot.



In summary, it is impossible to achieve NNL of all ecosystem services due to trade-off effects; because each land use type supports a different set of ecosystem services, a land use change that is favourable for the supply of one service is therefore likely to decrease the supply of other services. Most importantly, there is a trade-off between crop production and the supply of regulating services, because croplands support less regulating services than pastures and natural land use. An increase of the provision of regulating services will therefore be accompanied by a decrease of cropland production.

Additional to the impact of area changes, the provision of several ecosystem services is influenced by changes in land use patterns. Consequently, for these ecosystem services only measures targeted at specific locations where these services are provided are effective for ensuring a sustainable supply.

6.2.3 Overall assessment of potential impacts

Effectiveness

The analysis of the effectiveness of individual options in chapter 5, and the qualitative analysis of the combined effects of the policy package scenarios in Table 6-2, indicates that IF properly implemented the scenarios would differ considerably in their potential impacts on biodiversity and ecosystem services. Given the generally increasing ambition and scope of the scenarios, the effectiveness of the scenarios in contributing to the NNL objective would certainly increase from package A to D but particularly under Scenarios C and D where substantial levels of offsetting would occur. These expectations are also broadly supported by the modelling results, despite the difficulties of incorporating the policy measures into the land-use model and the limitations of the available land use data and biodiversity and ecosystem service indicators. Thus, for example, there are significant increases in semi-natural vegetation, connectivity, Annex 1 birds and the MSA indicator under Scenarios B-D (see Figures 6-1 to 6.4 respectively). Modelled ecosystems service impacts tend to show a similar pattern of response (Table 6-9), but the overall large-scale magnitude of the effects are much lower, probably in part because of the inevitable trade-offs that occur.

Impacts under Scenario A are difficult to model, but would probably be moderate overall, mainly because many of the actions are marginal changes to existing measures and/or rely on voluntary measures, many of which are unlikely to be taken up widely due to the additional costs that they incur (although many costs are modest). However, it is important to note that some of the policy options have individually important impacts. Measures that would enhance the implementation of the Birds and Habitats Directives, especially strengthening the protection of Natura 2000 sites (through wider adoption of Appropriate Assessments) and better implementation of compensatory measures for unavoidable impacts, are likely to have particularly significant biodiversity and ecosystem service benefits. This scenario therefore makes an important contribution to the achievement of NNL of habitats and species of Community importance within biogeographical areas of the Natura 2000 network. However, although the package includes a policy framework and delivery plan for offsetting it is unlikely to have a significant effect on addressing residual impacts outside the Natura network, as offsetting would be entirely voluntary. Indeed, the modelling suggests that according to the farmland bird indicator the package of measures might increase some losses outside protected areas. However, this may well be due to limitations of the modelling and indicators, and is unlikely to be significant. In contrast, it can be concluded with certainty that the improvement of Natura 2000 site protection and offsetting under this scenario would provide particularly high benefits for biodiversity and associated ecosystem services.

Most of the additional policy options included in Scenario B have moderate individual impacts, but in combination they take an important additional step towards the NNL objective. Of particular importance would be the EIA reforms and additional spatial planning and SEA measures that could synergistically interact, supporting the protection of Natura sites but also addressing biodiversity losses in the wider environment. Important benefits would also come from the effective protection of semi-natural grasslands through additional CAP cross-compliance measures. However, this and other options concerning the adoption of the proposed Soil Directive and Marine Spatial planning Directive and the option of developing a proposal for a directive on terrestrial spatial planning, would not result in impacts before 2020.

Even if all the scenario B measures are implemented fully and effectively, it is inevitable that substantial residual impacts would occur, especially over the next 10-20 years whilst some of the measures discussed above are developed and rolled out. Offsetting of these residual impacts would be relatively low under this option (other than for Natura 2000 related impacts already covered under Scenario A). Although offsetting policy option 2 introduces a mandatory requirement for the offsetting of residual impacts from EU funded projects, these would probably only comprise a small proportion of remaining impacts outside the Natura 2000 network.

Scenario C only adds further mandatory requirements for offsetting. Although these directly focus on residual impacts, it is important to note that the additional cost of offsetting impacts on biodiversity and ecosystem services can be expected to be an effective disincentive to damage in the first place, thereby resulting in increased avoidance and reduction measures. Under this scenario offsetting would be mandatory for all significant impacts on scarce biodiversity and priority ecosystem services. Importantly, this includes requirements to offset residual impacts from agricultural, forestry and fishery activities, and all other sources of significant impact. Accordingly, Scenario C would result in a major increase in offsetting, and therefore a further major step towards the NNL target.

Scenario D adds the policy option of mandatory offsetting for all significant residual impacts, resulting from all sources, on all habitats, species and ecosystem services. Therefore, this option alone is essential for the full achievement of the NNL objective (as defined in chapter 4). This scenario therefore results in extensive offsetting, and because large areas of low quality habitats are to be offset (eg arable and agricultural improved grasslands) then a substantial amount of trading up would be expected to occur. As indicated by the modelling results (discussed above) an important outcome of this will be a substantial increase in semi-natural habitat, though it is should be remembered that this does not necessarily result in a net gain of biodiversity and associated ecosystem services. In fact, widespread trading up in offsetting could lead to biodiversity losses in agricultural habitats. It should also be borne in mind that some impacts cannot be easily or practically offset (eg on habitats that cannot be recreated within reasonable timeframes) and therefore some residual impacts will not be effectively and fully compensated for. Thus although the policy package in scenario D aims to achieve NNL and, if fully implemented, may be able to achieve this for some ecosystems and types of impact, in practice some biodiversity and ecosystem losses would remain. This underlines the importance of ensuring measures under this, and all other policy scenarios, follow the mitigation hierarchy and firstly attempt to avoid and reduce impacts wherever this is possible and appropriate.

Lastly, it should be borne in mind that achievement of NNL in all ecosystems will also be dependent on measures to address other key impacts that were beyond the scope of analysis in this study, most notably widespread airborne pollution (including nutrient deposition, acidification, and ozone pollution), invasive alien species and direct exploitation, especially from commercial fishing.

Efficiency

The efficiency (ie cost effectiveness) of achieving the NNL objective under each of the scenarios is very difficult to assess as there is little relevant information on key costs, and many costs (and particularly opportunity costs) will depend on the way measures are implemented. Furthermore, many costs may also be counteracted by economic benefits, for instance reducing business risks (eg avoiding unforeseen project delays or damage costs), enabling acceptable developments to go ahead, improving the strategic use of resources, protecting and enhancing ecosystem services and stimulating new markets and businesses. For example, in the UK the annualised cost of marine spatial planning is estimated to be €5 million per year, but the benefits are considered to be 4-5 times greater (see Table 5-14). Although supporting evidence is lacking, other planning instruments and impact assessment procedures might be expected to have similar benefits that would at least partly compensate for the costs.

Even without the ability to take into account the likely economic benefits of the policy scenarios, available evidence suggests that the cost of implementing each of the scenarios is probably reasonable compared to other costs. For example, according to the Commission's impact assessment (European Commission, 2013d) EIA costs are typically about 1% of the total project costs (on average €41,000 per EIA), and the proposals would only increase the costs by 5-25%. Furthermore, in some cases these increases would be compensated for by some simplification changes that would produce savings of 5-10%. The highest costs of achieving the NNL target would probably arise from offsetting, especially under Scenario D (see Table 5-35). However, evidence suggests that offsetting requirements are usually equivalent to a small fraction of the total project costs (Rayment et al, 2011; Conway et al, 2013). Moreover, offsetting and some other costs associated with damage (eg remediation requirements under the ELD), are only potential costs that can often be avoided through forward planning, avoidance and mitigation measures, and due diligence over activities. This highlights the efficiency of supporting such measures through coherent and integrated strategic planning and impact assessment policies and tools, as these are often best able to avoid and minimise impacts.

In conclusion, with the information available it is not possible to carry out a detailed comprehensive quantitative analysis of the costs of each policy option, but available evidence illustrates that in many cases the costs of the proposed policy options and the policy packages are likely to be small compared to development costs and especially the private economic benefits that come from the developments. Furthermore, many policy options will give rise to substantial public economic benefits, and other welfare benefits that cannot be easily monetised. Although it is very difficult to quantify the efficiency of each scenario it seems likely that Scenarios A and B will be moderately efficient as they have relatively low benefits and costs (Table 6-10). Scenario C would be more efficient as it focuses on scarce biodiversity and priority ecosystem services, and avoidance of offsetting requirements by avoiding residual impacts would often be feasible. However, Scenario D may be less efficient as it would require much more extensive offsetting that would be difficult to avoid, and would tackle biodiversity and ecosystem services of lower intrinsic and economic value.

Policy coherence

All of the proposed policy options and, therefore, each of the scenarios are broadly coherent with other EU policy objectives. In addition to supporting environmental objectives, such as the overarching 2020 biodiversity target, the policy options also support economic growth and related objectives, including those in Europe 2020 Strategy. This is through the explicit inclusion of ecosystems services in the NNL target, and such services provide substantial economic and other human welfare benefits (TEEB, 2010a; TEEB, 2010b).

However, many options, especially in Scenario A are discretionary measures aimed at Member States, and therefore may not be taken up, leading to potential inconsistencies between some instruments and EU policies. This is particularly the case with the CAP where options to address clear on-going biodiversity and ecosystems pressures and resulting impacts are constrained by the recent CAP agreement. Although the recent reforms have incorporated some greening measures it is unlikely that these will make a significant contribution to achieving the NNL objective in agricultural ecosystems. Further measures are therefore needed especially to avoid and reduce the ongoing loss and damage of semi-natural grasslands and other areas of High Nature Value farmland. Scenario B includes options that are more consistent with requirements to achieve the EU's environmental objectives. However, residual impacts from most activities would remain unaddressed, which is not consistent with the NNL objective or the EU's headline biodiversity target. Wider mandatory offsetting requirements are introduced in Scenario C with full offsetting requirements include in Scenario D. Offsetting is typically applied to residual impacts from built developments and extractive industries, but there is no clear case for excluding agriculture and forestry, and other activities that result in significant biodiversity and ecosystem service impacts. Therefore, to ensure a consistent and equitable policy on offsetting, it is proposed that the requirement would apply uniformly to all activities that result in significant residual impacts that can be feasibly offset.

Taking these considerations into account, and the evaluations of individual policy options, it may be concluded that Scenarios A and B are moderately coherent with other EU policies in that they will contribute to environmental objectives without introducing measures that would significantly constrain sustainable economic growth and other EU goals. However, the predominance of voluntary measures reduces their coherence with environmental objectives. Scenarios C and D therefore have greater overall coherence as they would contribute more to the overall headline biodiversity target, through measures that efficiently implement the polluter-pays principle, whilst avoiding substantial constraints on economic growth. Furthermore, as discussed above, the maintenance and enhancement of ecosystem services would also support many other EU objectives including those related to climate change mitigation and adaption, resource efficiency and the Europe 2020 Strategy.

Table 6-10 Summary assessment of impacts with respect to the achievement of no net loss of biodiversity and ecosystem services

Scenario	Scenario A	Scenario B	Scenario C	Scenario D	Comments
Effectiveness	**Low-moderate**	**Moderate**	**High**	**Very high – ie as close to NNL achievement as feasible**	Many policy impacts expected post 2020
Efficiency	**Moderate**	**Moderate**	**High**	**Moderate**	Difficult to assess and likely to vary according to circumstances
Policy coherence	**Moderate**	**Moderate**	**High**	**High**	

7 OVERALL CONCLUSIONS AND POLICY RECOMMENDATIONS

7.1 The challenge of achieving no net loss

The analysis carried under the present contract suggests that there are two major barriers to achieving NNL of biodiversity and ecosystem services in the European Union. Firstly, there is a complex and wide range of significant pressures on ecosystems that are proving to be difficult to address. These are likely to continue affecting biodiversity and ecosystem services to 2020 and beyond, as is evident from the review of studies of recent and expected trends in land and sea use to 2020 (in chapter 3). Although some data are lacking and regional variations will undoubtedly occur, the assessment of evidence of the impacts of the principal land and sea uses indicates that the most influential detrimental pressures have been and probably will remain:

- Local (direct, indirect) and cumulative impacts of built developments and extractive industries.

- Wide-scale pollution impacts, and in particular eutrophication of sensitive terrestrial habitats (from air-borne nitrogen deposition) and pollution of fresh and marine waters from sewage and waste-water (although declining), but also nutrient-rich run-off that is increased as a result of agricultural and forestry activities.

- Expansion of forest plantations and intensive forest management, which may increase in response to rising demands for energy from wood biomass.

- Impacts from past agricultural improvements and specialisation, and on-going intensive management practices, exacerbated by expected further intensification in parts of the EU, such as some biodiversity-rich areas of Eastern Europe.

- Agricultural abandonment, leading to the loss of traditionally managed semi-natural habitats such as some grasslands, heaths and pastoral woodlands (many of which are habitats of Community interest under the Habitats Directive).

- Continued high levels of commercial fishing, with direct impacts on target species, and by-catch and habitat damage from bottom dredging/trawling.

- On-going impacts, and further spread, of invasive alien species (IAS) within the EU and the arrival of new IAS, which is exacerbated by a number of commercial activities, most notably international transport.

It is difficult to assess the combined effects of these and other pressures on biodiversity and ecosystem services. However, the land-use modelling carried out in this study suggests that, under a Business as Usual scenario (ie according to expected trends in drivers and existing and anticipated policies), impacts that are primarily negative will predominate up to 2020. These include significant declines in semi-natural habitats, reduced ecological connectivity and declines in biodiversity (according to bird indicators), and most ecosystem services (see section 3.3.3 for details). The assumptions made in such modelling exercises vary considerably, but the broader literature supports the conclusion that the overall balance of pressures is likely to be negative.

The second key obstacle to achieving the NNL objective is the need to address some current weaknesses in existing environmental policy, from the EU down to the more local scale. Although EU legislation contains many measures designed to avoid and reduce detrimental impacts on biodiversity and ecosystem services, there is evidence that these measures are not being implemented either sufficiently or always effectively by Member States. A similar conclusion was drawn by the European Commission when it examined the reasons for the EU's failure to meet its 2010 objective of halting of the loss of biodiversity[132]. It considered that, even with the development of the 2006 Biodiversity Strategy and Action Plan, there was incomplete implementation of existing legislation, insufficient funding, limited awareness about biodiversity, inadequate governance and administrative capacity, and gaps in skills and knowledge.

Notwithstanding the adoption in 2011 of the Commission's vision for a new EU Biodiversity Strategy and the positive response from the other EU institutions, up until now, there has been little evidence of any significant step change in biodiversity conservation actions within the EU. Some policies have been adjusted to give biodiversity greater priority, such as the CFP. For others, such as the CAP, the outcome is highly uncertain. For example, there is a new emphasis on a greener CAP, but Member States are able to move significant sums from Pillar 2 to Pillar 1, thereby potentially reducing the funding for agri-environment schemes, which are by far the largest contributors to biodiversity conservation spending in the EU.

In addition, although existing EU biodiversity measures are an essential foundation for achieving NNL, they were not introduced with this objective in view. Much could be achieved by more stringent implementation but there also appear to be some policy gaps, most notably concerning the treatment of unavoidable residual impacts from developments and other anthropogenic pressures on biodiversity outside Natura 2000 sites. This is critical because it is not possible, even with the most stringent application of existing measures (ie following the mitigation hierarchy – see section 4.1), to completely avoid deleterious impacts or to reduce residual impacts to insignificant levels although every effort should be made to do so. Therefore, an appropriate form of offsetting measures, which are designed to address residual impacts, will be required if the NNL objective is to be fully achieved.

Furthermore, this policy gap is not just an EU level issue. The Habitat Banking Demand, Supply and Design study for the Commission (Conway et al, 2013) indicated that, apart from requirements to compensate for adverse impacts on Natura 2000 sites, offsetting is not currently a legal requirement in most EU Member States and therefore occurs at low levels. Even where it is carried out, for example in Germany, it generally only addresses impacts from built developments and extractive industries. Therefore, some form of mandatory requirement for offsetting would seem to be necessary to make substantial progress

132 http://ec.europa.eu/environment/nature/biodiversity/comm2006/pdf/bap_2010/4%20EC_Knowledge_Base_Assessment_BAP_final.pdf

towards those elements of the NNL objective that could be achieved through the mechanism of offsets. Similarly, the NNL Working Group noted that 'most informed opinion holds that a mandatory approach is required to go to scale'.

As discussed earlier in this report, there is strong evidence that some of the most widespread and significant impacts on biodiversity and ecosystem services arise from agriculture, forestry and other land uses, and therefore NNL measures need to address these sectors fully, including through the development of offsetting measures to address unavoidable residual impacts. However, there is little knowledge or experience of offsetting in these sectors and there are practical difficulties in dealing with their residual impacts because individually they are often gradual and insignificant, and therefore not routinely subjected to assessment or permitting requirements. Nevertheless, they build up to create a chronic impact that is detrimental to biodiversity and ecosystems and needs to be addressed for NNL to be achieved.

Therefore, as further described in section 7.2 below, the achievement of the NNL objective will require the development of a NNL policy framework that seeks to improve the implementation of existing policies **and** carefully designs and develops requisite new policy measures However, even if enacted vigorously at the EU and more local levels, experience from the EU and elsewhere indicates that policy measures will not be enough; substantial public and private support will be needed, including commitment to awareness raising, guidance, training, capacity building and monitoring and assessment.

7.2 Recommendations for a no net loss policy framework

7.2.1 The advantages of a comprehensive integrated and common no net loss policy framework

A wide range of existing EU and national instruments can potentially reduce rates of biodiversity loss, and move the EU towards its NNL objective (eg nature protection laws, planning policies, pollution legislation, incentive measures etc). Applying, effectively enforcing and building on such existing policy instruments, in accordance with the mitigation hierarchy, will therefore be important to achieve NNL. Analysis of the individual policy options investigated in this study, and their overall impacts under the four policy package scenarios, indicates that significant steps can be taken towards achieving the NNL objective through the better implementation of existing instruments (under Scenario A) and their enhancement (under Scenario B).

However, recent experience and forecasts confirm that losses of *biodiversity and ecosystem services are on-going and widespread, and that*, even with renewed efforts to address these, residual impacts inevitably will continue. Therefore, the evidence of future trends reviewed here suggests that, as foreseen by the Council in its 21st June 2011 meeting (see section 1.1.2), the achievement of the EU's NNL objective will require some policy measures that stimulate further offsetting beyond the existing requirements for compensation under the Habitats Directive and ELD.

It is therefore recommended that a comprehensive strategy and common policy framework for NNL could be developed to address all stages of the mitigation hierarchy through initiatives to improve and better use existing policy instruments where feasible, complemented where necessary and appropriate by new policy measures to fill significant gaps. Furthermore, to achieve the NNL objective the framework would need to address all of the most significant pressures on ecosystems listed above that arise from all sectors (because biodiversity and ecosystem service losses may result from just one significant pressure).

7.2.2 Measures to reduce and avoid impacts under existing instruments

In accordance with the principles of the mitigation hierarchy, the improvement and enhancement of existing policies and instruments should focus firstly on measures that primarily avoid or reduce impacts. Although it was not feasible within this study to identify all possible relevant policy options[133], or to consider each option in detail, all of those described in chapter 5 have the potential to make a significant contribution to the NNL objective. Those that appear to have the greatest potential beneficial impact are described below.

First, and foremost, all activities that may potentially have a significant impact on designated habitat and species features within Natura 2000 sites should be subject to an Appropriate Assessment, and avoided if at all possible, in accordance with Articles 6(2) and 6(3) of the Habitats Directive. Such activities should include potentially environmentally damaging changes to agricultural and forestry management, as well as built developments etc. Therefore, for example, the ploughing or fertilisation of semi-natural grasslands or the clear felling of forests within Natura 2000 sites should be subject to Appropriate Assessments in nearly all cases. Accordingly, systems are required for screening proposed activities with respect to the need for an Appropriate Assessment (ensuring thresholds are not set at levels that may potentially allow significant damage to occur). Capacity also needs to be increased within competent authorities so that they can provide screening and scoping opinions and process Appropriate Assessments adequately within suitable time-frames. Where Appropriate Assessments are not carried out adequately, or where impacts are allowed that contravene the Habitats Directive, such failings need to be identified clearly and appropriate action taken.

Maintaining and improving the implementation of the Habitats Directive's requirements to avoid impacts on the Natura 2000 sites is especially important given their particularly high biodiversity value, and that they also provide additional ecosystem service benefits that have been estimated to outweigh the costs of protecting and managing the sites (ten Brink et al, 2011). Moreover, many of the habitats present within Natura sites cannot in practice be re-created, so cannot be adequately compensated for if they are lost.

However, the Habitats Directive requires that together the Natura sites create a coherent network, and that habitats and species of Community interest are maintained in Favourable Conservation Status across their range (ie not just within Natura 2000 sites). Furthermore,

[133] Policy measures to tackle widespread pollution and invasive alien species are particularly important, but it was beyond the scope of this study to consider these complex issues at all.

as discussed above, the NNL objective also applies to species and habitats that are not protected by EU legislation. Therefore it is also important to ensure additional supporting and complementary measures are taken to avoid and reduce impacts in the wider environment.

In this respect, as discussed in chapter 5, the following measures at EU level probably have the potential to make the most effective and efficient contributions to the NNL objective.

- Improved protection of landscape features outside Natura sites in accordance with Article 10 of the Habitats Directive.

- Adoption and implementation of the Commission's 2010 proposals for amending the EIA Directive and in particular the reference to the need to consider impacts on biodiversity (and not just fauna and flora as in the current directive).

- Full application of EIA to agriculture and forestry (taking into account appropriate assessment scales and proportionality with respect to biodiversity priorities).

- Measures to improve and integrate more strategic spatial planning approaches, such as mechanisms to better avoid impacts, and the identification of strategic opportunities for Green Infrastructure enhancement and the location of offsets (see below) through wider and improved application of the SEA Directive and national spatial planning standards.

- Adoption of the proposed Marine Spatial Planning Directive (or a similar measure), and, in the longer term, the development of a similar Directive for terrestrial spatial planning.

- Thorough Biodiversity Proofing of all EU funding instruments.

Evidence clearly shows that there is still a considerable way to go before NNL goals are achieved in relation to agricultural land, despite the critical role that many farmers and the CAP (most notably through agri-environment measures) play in maintaining biodiversity and delivering ecosystem services. This is particularly the case in relation to semi-natural habitats, especially semi-natural grassland, which continues to decline. The recent conclusion of negotiations on revisions to the CAP for the 2014-2020 period mean that any fundamental changes to the CAP before 2020 are highly unlikely. However, there are considerable opportunities for Member States to help meet the NNL objectives by making the most of the flexibilities that they have to design CAP measures in ways that conserve those habitats that are most valuable environmentally. This includes making the most of options to use the permanent grassland Pillar 1 green measure to protect important semi-natural habitats outside protected areas from being ploughed, as well as making sure that sufficient resources are allocated to the agri-environment-climate measure under Pillar 2 and that the measure is designed, targeted and implemented in ways that incentivise the continued management and enhancement of semi-natural habitats. To achieve this, an adequate level of funding within national Pillar 2 budgets, and, within them, for well-designed agri-environment-climate measures, would be an important first step. To achieve adequate Pillar 2 funding, opportunities to transfer funding from Pillar 1 will probably need to be maximised in Member States. Within the CAP as a whole a greater focus on supporting High Nature Value farmland as a means of maintaining semi-natural habitats would be particularly valuable.

There are further actions that would help to underpin CAP measures that aim to maintain and protect biodiversity and associated ecosystem services by providing incentives to land managers. These are: a) better enforcement of environmental regulations; and b) improved digital mapping of semi-natural habitats and features on farmland in Member States to enable improved targeting of support and monitoring, and assessment against NNL objectives. To encourage more Member States to invest in detailed mapping exercises, the EU could consider ways in which it could assist, for example by providing support (both financial and advisory). In addition, the Commission has a key opportunity to ensure, via the approvals process, that all RDPs demonstrate how they plan to use their RDP budget to deliver the Biodiversity Strategy goals and contribute towards achieving NNL in their territories.

7.2.3 Offsetting of unavoidable residual impacts under existing instruments

Despite strengthening measures to avoid and reduce impacts, inevitably some residual impacts will remain, and therefore offsetting measures to address them will be required if the NNL objective is to be achieved. Currently the only mandatory EU requirement to compensate for unavoidable residual impacts on habitats and species of Community interest is through the Habitats Directive (under Article 6.4). This is supported through provisions under the ELD, which require remediation for 'significant damage' to biodiversity resources and services. These also focus on habitats and species of Community interest, although Member States can extend the coverage to other biodiversity components. If this is not possible, further compensatory measures need to be undertaken. So, these provisions are explicit and no revision is considered necessary in terms of the requirements of the Directives. These provisions have the potential to make a substantial contribution to securing the NNL objective, but evidence shows that the measures are not consistently applied, despite Commission guidance being available, and there is considerable scope for improving the level of implementation.

To achieve this, no further clarification of the clear requirements for compensatory measures under the Habitats Directive is necessary, but there needs to be a greater emphasis on implementation and enforcement. Improved guidance for national authorities (eg on the best practice use of biodiversity metrics) could play a part in this. The aim would be to better ensure that compensatory measures are only taken as a last resort, are strictly like-for-like and result in direct measurable beneficial outcomes that achieve, as a minimum, NNL for the habitats and species concerned.

The ELD implementation processes could also be strengthened by increasing the scope of the biodiversity and ecosystem services' damages to which the Directive applies, and by making this more consistent across Member States. This could be done by lowering and more accurately defining the ‘significant damage’ threshold. However, this cannot be done by simply establishing standard thresholds for significant damage, as damage is context specific. Instead, a case could be made by the European Commission to persuade Member States that lowering the significant damage threshold is an efficient approach to achieving NNL for two main reasons. Firstly, it deters damage, and secondly, it implements the polluter pays principle, placing responsibility for repairing damaging incidents on those causing the damage, rather than requiring spending from public budgets.

7.2.4 The need for new offsetting instruments

To achieve the NNL objective, both offsetting and remediation will need to be extended beyond the treatment of residual impacts under the Habitats Directive and ELD, to cover significant impacts on all species and habitats, wherever they occur. A possible comprehensive framework for offsetting that could achieve NNL, in combination with avoidance and minimisation measures, is set out in Table 7-1 **Error! Reference source not found.**below.

Previous studies have concluded that offsets and habitat banking can provide a cost-effective means of achieving NNL for many habitats, species and ecosystem services if they are well designed and adequately regulated. However, there is an important policy design issue here. Evidence from practical experience of operational offset schemes reviewed in this study (eg from experiences in England, France, Germany, Sweden, the USA and Australia) indicates that to make a significant contribution to the NNL objective, mandatory requirements for the offsetting of residual impacts are needed: voluntary requirements consistently result in very low levels of offsetting. Thus, it is recommended that, in addition to taking the above steps to strengthen existing impact avoidance, minimisation and offsetting measures, adequately regulated offsetting is considered as a mandatory requirement for all activities that have the potential to cause a significant, detrimental, residual impact on biodiversity and ecosystem services. This could be achieved at an EU level through a framework directive, or similar instrument. As concluded by the majority of stakeholders in the NNL Working Group, the activities covered should go beyond built developments and extractive industries and include agriculture, forestry and fisheries (NNLWG, 2013a, page 8).

Table 7-1 Summary of potential offsetting objectives and delivery mechanisms to achieve NNL of biodiversity and ecosystem services in the EU

Biodiversity/ecosystem service level	Impact level/type	Suggested offsetting objective	Suggested means of delivery
Habitats and species of Community interest within Natura 2000 sites	Individually distinct and significant	Strict like-for-like offsetting to maintain integrity of the network	Bespoke offsets in accordance with Commission guidelines
	Individually insignificant or indistinct	As above	Policy or sector level measures
Habitats and species of Community interest outside Natura 2000 sites	Individually distinct and significant	As above	Stringently regulated bespoke offsets
	Individually insignificant or indistinct	Maintenance of overall Favourable Conservation Status	Policy or sector level measures
Other scarce biodiversity and ecosystem services	Individually distinct and significant	Presumption of like-for-like, but some discretion on trading up allowable, eg if not locally threatened	Effectively regulated bespoke offsets, or in future Trust Administered Conservation Credits if these prove to be effective when used for low level impacts.
	Individually insignificant or indistinct	Maintenance of populations or achievement of national targets	Policy or sector level measures, or Trust Administered Conservation Credits
Other biodiversity and ecosystem services	Individually distinct and significant	Equivalent NNL through trading up where appropriate	Trust Administered Conservation Credits, or for large projects, bespoke offsets may be a suitable alternative option
	Individually insignificant or indistinct	Maintenance of populations or achievement of national targets	Policy or sector level measures

Note: Individually distinct and significant impacts typically arise from built developments and extractive industries etc and therefore require some form of environmental assessment or permit, which can be linked to offsetting requirements. Insignificant or indistinct impacts typically arise from land use management changes such as increases in fertilisation of grassland, increased forest management practices, and increased bottom trawling of benthic habitats, and therefore do not normally require environmental assessments or permits.

To achieve NNL requirements, offsets need to be triggered for individually significant impacts, irrespective of the cause. Thus, for example, project level offsets would be required for built developments and minerals projects, but also for significant agricultural improvements (eg ploughing of semi-natural grasslands, or removal of landscape features). However, this may overlook individually insignificant impacts that result in substantial cumulative impacts. Therefore offset needs should also be identified through wider-scale assessments of impacts, such as through an SEA procedure for built developments etc, or through Rural Development Programme level assessments.

To ensure that offsetting does not weaken existing protection levels, it would be appropriate for project-level permitting procedures to require evidence from the project proponent that NNL will be achieved through measures taken in accordance with the mitigation hierarchy. To be effective, this process should include a critical review of the likely long-term effectiveness of avoidance and mitigation measures, arising at preceding stages in the mitigation hierarchy. Thus, in the estimation of residual impacts the achievement of uncertain mitigation outcomes should not be assumed. Furthermore, there should also be a procedure that requires additional offsetting later if monitoring reveals that residual impacts are greater than estimated as a result of unimplemented or ineffective avoidance and mitigation measures.

Although offsetting is necessary to achieve the NNL objective, designing and implementing the necessary policy instruments will be very challenging and there are a number of legitimate concerns regarding the potential risks which will need to be fully addressed. The principal concern is that the inclusion of offsetting within a legal framework could be instrumentalised in a way that encourages developers to forego the proper application of the mitigation hierarchy and jump straight to offsetting. Some fear that this could even lead to the weakening of current levels of protection enshrined in the Habitats' Directive and the ELD. There are also many other challenges with offsetting including: i) how to ensure losses and gains are appropriately measured; ii) the issue of additionality; iii) ensuring that offsets are guaranteed over time; and iv) making sure that offsets are adequately monitored and assessed. All this must be addressed by making sure that future policies are well designed and robust and that effective implementation is assured through rigorous monitoring and enforcement. One of the challenges at present is that there is limited experience of implementing offsetting in Europe and a lot of the technical tools required to underpin the policy are still under development.

Given these risks and practical challenges, it is recommended that offsetting should only be further extended through new legislation and made a mandatory requirement on condition that all the following criteria are satisfied:

- It is regulated according to clear principles and standards that are compatible with international best practice, with rules that:
    - ensure the mitigation hierarchy is followed appropriately, in particular ensuring offsetting does not result in a weakening of existing protection levels (eg by obliging developers to provide adequate reasons for unavoidability);
    - avoid inappropriate trading (ie defining like-for-like requirements and equivalency rules);
    - set standards for metrics, avoiding the use of simplistic metrics that do not adequately capture the full range of biodiversity and ecosystem service values that are negatively impacted and thus do not result in NNL;
    - deal with ecosystem service requirements as far as this is practical (eg regarding bundling of services and avoidance of double-counting);

- ensure additionality, that in particular avoids the placement of offsets in Natura 2000 sites or other areas where the offset would duplicate measures that should be taken under existing obligations;
- ensure the use of appropriate delivery mechanisms (eg such that risk aversion offsets are only used in the EU with particularly stringent safeguards, and when they provide the only reliable option for achieving NNL);
- identify locational requirements with regard to biodiversity needs (eg ecological connectivity) and ecosystem service benefits, which should avoid simplistic rules that require on-site offsetting, especially where this results in poor (eg small and fragmented) offsets;
- require adequate measures to ensure the long-term provision of the offset (which in principle should be for as long as the impacts exist that are being offset) and contingency measures to address offset failures and ensure NNL is achieved;
- set requirements for the timing of offset provision; and
- define requirements for independent monitoring and publicly reporting on offset objectives and outcomes.

- It is monitored by competent environmental and nature conservation authorities, with clear enforcement measures triggered if the offset does not comply with agreed standards and/or meet its objectives and achieve as a minimum NNL.

- It is supported and administered through appropriate governance procedures and institutions (with clear regulatory duties, and not just powers). To be effective these need to be backed up with adequate resources and expertise to undertake the provision of necessary guidance, awareness raising, training, processing of offset proposals, compliance monitoring, reporting, and the enforcement actions necessary to achieve the objectives over the long-term.

Notwithstanding the requirements listed above, to meet the environmental goals the costs and administrative burdens for those proposing and/or undertaking the offset should be proportionate to the expected impacts and risks associated with the required and proposed offset measures. For example, streamlined and rapid procedures should be available for projects/activities that have:

- low level impacts;
- only impact on biodiversity components/ecosystem services of low importance; and
- only impact on biodiversity components/ecosystem services that can be offset with a low risk of failure (for example through well-established practices or through purchasing offsets already created in habitat 'banks').

Potential strategic benefits of offsets (eg in terms of linking up fragmented habitats and enhancing Green Infrastructure) can be maximised if they are linked to other policy instruments. For instance, SEA might identify broad needs for offsetting (including from cumulative impacts) at a higher level, which can then be taken into account in developing mitigation strategies for development projects; or regional spatial plans might identify and safeguard areas that would be suitable for offsets or which are needed as part of an offset strategy. This could help link up fragmented habitats, buffer protected areas and increase the area of small habitat patches to increase their resilience, which can be done through planning on a geographical basis (national, regional, local) or thematic/sectoral basis (eg water, waste, transport or energy). Offsets may then be directed to identified priority areas by regulations, incentives (eg through a metric weighting) or informed choice such as by environmental trusts who administer pooled offset fees (see discussion of Trust Administered Conservation Credits (TACC) schemes in section 5.10.5).

Such planning and measures can enhance the potential for offsets to contribute to strategic goals such as the enhancement of Green Infrastructure, ecological networks or climate adaptation. The results of the scenario modelling carried out in this study support this view, suggesting that mandatory offsetting for all significant residual impacts could lead to the restoration of large areas of semi-natural habitat, with the potential to significantly reduce habitat fragmentation compared to the BaU scenario (see 6.2.2). However, offsets will not contribute to NNL unless they are genuinely additional to biodiversity and ecosystem service conservation and restoration actions that would have been taken in their absence. NNL will also not be achieved if offsets 'crowd out' other anticipated conservation measures or raise their costs such that they are no longer taken.

7.2.5 Developing future policies.

It is clear from the work carried out under this contract that the further development of an EU policy on NNL is both necessary, if we are to halt biodiversity loss, but also politically and technically challenging. If the political will exists, many of the gaps in the existing legislation and policies can be addressed on the basis of existing knowledge. However, the big challenge for the future will be the development of a comprehensive and technically robust policy framework for offsetting that will guarantee that it is applied in a manner that is consistent across the EU, is fully coherent with the mitigation hierarchy and delivers real, net benefits for biodiversity. International experience also shows that effective implementation will require significant EU and Member State level support in terms of investment in institutional capacity building, awareness raising, guidance, training and data collation and provision.

Policy options that require changes to existing legislation or the introduction of new legislation will require a certain amount of time to be developed, negotiated, adopted and implemented. In the meantime, many components of biodiversity continue to decline. It therefore seems appropriate to take urgent steps to improve the implementation of existing measures and in particular the offsetting requirements under the Habitats Directive and remediation under the ELD in relation to species and habitats of Community interest. This could be achieved through stronger enforcement and the development of guidance.

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