DEPARTMENT OF ENERGY & CLIMATE CHANGE

Appraisal of Sustainability for the revised draft National Policy Statement for Renewable Energy Infrastructure (EN-3)

Planning For New Energy Infrastructure

October 2010

Preface

This document is the Appraisal of Sustainability report (AoS) for the revised draft Energy National Policy Statement for Renewable Energy Infrastructure (EN-3). EN-3 is one of a suite of National Policy Statements (NPSs) which the Government intends should form the basis for decision-making on development consent for a new generation of large-scale energy infrastructure. EN-3 is one of five energy NPSs covering specific technologies, such as nuclear power or electricity networks: each of these needs to be read in conjunction with the Overarching Energy National Policy Statement (EN-1), which deals with matters common to all new large-scale energy infrastructure and sets out certain policies which apply to more than one type of such infrastructure.

The main function of this report is to set out the likely significant effects on the environment of developing new renewable energy infrastructure of the types, and on the scale, envisaged by EN-1 and EN-3, as well as indicating how the policies set out in EN-3 are consistent with the principles of sustainable development more generally.

The AoSs are designed to inform consultation on the revised drafts of the NPSs with which they are being published. If you have any comments on them, please respond as part of the re-consultation on the revised draft NPSs. The documents are available at www.energynpsconsultation.decc.gov.uk. The re-consultation will be open for 14 weeks from the 18th October 2010.

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1. Introduction

1.1. Context

This is the revised Appraisal of Sustainability (AoS) Report for the National Policy Statement (NPS) on Renewable Energy Infrastructure (EN-3). NPSs are made under the Planning Act 2008. The Act requires AoSs to be prepared for NPSs. The Introduction to the AoS of the Overarching Energy National Policy Statement (EN-1) contains a general explanation of the relationship between the Planning Act 2008 and UK energy policy, and the functions of NPSs and AoSs.

This Report provides information on:

- the NPS for Renewable Energy Infrastructure (Section 1.2);
- alternatives considered (Section 1.3);
- findings of the AoS for EN-3 (Section 3); and
- proposed measures for monitoring significant effects (Section 4).

This report should be read in conjunction with the revised AoS Report for EN-1 (AoS-1) which provides information on the:

- suite of six Energy NPSs (EN1-6) (Section 1);
- methodology (including when the AoS was undertaken and by whom) (Section 2);
- scope of the appraisal (Section 2);
- method for collecting and presenting baseline information (Section 2);
- approach to completing the appraisal (including the AoS Framework with objectives for sustainability), assumptions and difficulties encountered during the appraisal (Section 2).
- assessment of alternatives (Section 3);
- overall appraisal of the NPS policies (Section 4); and
- monitoring proposals and next steps (Section 5).

Paragraph 2.6.1 of AoS 1 explains how the results of the assessment of likely significant effects are shown. For ease of reference, the table is reproduced here.

Key to Appraising Significance of Predicted Effects

Likely Significant Effects:		
Major positive	++	Policy would resolve an existing sustainability problem; effect considered to be of national/international significance
Minor positive	+	No sustainability constraints ; effect considered to be of regional/ national/international significance
Neutral	0	Neutral effect ie no overall effects or not-applicable
Minor Negative	-	Potential sustainability issues, mitigation possible; effect considered to be of regional/ national/international significance
Major Negative	--	Problematical because of known sustainability issues; mitigation difficult and/or expensive; effect considered to be of national/ international significance
Uncertainty	**?**	Where the significance of an effect is particularly uncertain, eg insufficient information is available at the plan stage to fully appraise the effects of the policy or the potential for successful mitigation, the significance category is qualified by the addition of the symbol “?”

1.2. The NPS for Renewable Energy Infrastructure

EN-3 in conjunction with EN-1 sets out the relevant planning factors that should be considered by the IPC when determining whether development consent should be granted for a proposed scheme.

EN-3 has been developed via an iterative process, taking account of the ongoing appraisal of the predicted sustainability effects. As the revised draft NPS was developed, specific topic sections were reviewed by technical specialists and recommendations made by the AoS team to the Government for its consideration. A record of some of these recommendations and responses to them, highlighting how the NPS was developed was provided in Section 2 of the AoS-3 published for consultation in November 2009. Iterative working continued with the revisions to EN-3 and AoS-3 made as a result of the public consultation.

1.2.1. The Content of the NPS for Renewable Energy Infrastructure (EN-3)

The definition of what is a nationally significant energy infrastructure project (and therefore requires consent under the Planning Act 2008) varies between technologies. In the case of renewable energy infrastructure, the relevant definition is electricity

stations generating more than 50 MW onshore or more than 100 MW offshore, and the particular kinds of generating station covered by EN-3 are:

- Energy from biomass and/or waste (>50 megawatts (MW))
- Offshore wind (>100MW)
- Onshore wind (>50MW)

EN-3 does not cover other types of renewable energy generation, such as schemes that generate electricity from tidal or wave power.

EN-1 identifies the need for new energy generation capacity and a diverse mix of fuels and technologies, including renewable energy infrastructure in order to meet energy policy objectives. EN-3 covers impacts that are specific to renewable energy and should be read in conjunction with EN-1 which covers the general impacts of energy infrastructure. ,

The way in which the need for new energy infrastructure is established in EN-1 means that there is no need to consider at the level of individual projects whether there is a need for new energy infrastructure development of a particular type (see Part 3 of EN-1). However, when an application is made for development consent, the decision-maker will have to consider whether the benefits arising from the proposed development (including the contribution which it would make towards satisfying the need for new energy infrastructure) outweigh any adverse impacts which it would have (see Section 4.1 of EN-1).

Certain impacts may result from the development of new energy infrastructure regardless of the specific technologies involved. EN-1 identifies (in Part 5) the potential generic impacts of new energy infrastructure and provides the basis for decision making with respect to each impact topic (i.e. landscape and visual or socio-economic impacts) but does not cover impacts that would be specific to a particular energy technology.

Generic Impacts detailed within EN-1	
• Air emissions; • Biodiversity and geological conservation; • Civil and military aviation and defence interests; • Coastal change; • Dust, odour, artificial light, smoke and insect infestation; • Flood Risk & Coastal Change; • Historic Environment.	• Landscape and visual impacts; • Land-use including open space, green infrastructure and greenbelt • Noise; • Socio-economic; • Traffic and transport Impacts; • Waste management; and • Water quality and resources.

EN-1 also contains (in Part 4) information about other matters which may be of relevance to the handling of any application for development consent for new large-scale energy infrastructure, such as adaptation to the effects of climate change, and the relationship between the planning regime and other statutory controls such as those on pollution and hazardous substances. The main topics where renewable energy infrastructure detailed in EN-3 may result in technology-specific impacts in addition to those set out in EN-1, are as follows.

Technology-Specific Impacts detailed within EN-3

- Biomass and Waste Combustion:
  - Air Quality and Emissions
  - Landscape and Visual
  - Local and Regional Waste Management
  - Residue Management
- Onshore Wind
  - Biodiversity and Geological Conservation
  - Historic Environment
  - Landscape and Visual
  - Noise
  - Shadow Flicker
  - Traffic and Transport
- Offshore Wind
  - Biodiversity
  - Fish
  - Intertidal
  - Marine Mammals
  - Ornithology
  - Subtidal
  - Commercial Fisheries And Fishing
  - Historic Environment
  - Navigation and Shipping
  - Oil, Gas and Other Offshore Infrastructure and Activities
  - Physical Environment
  - Seascape and Visual Effects

1.3. Alternatives Considered

As explained in Section 1.3 of the AoS for EN-1, the AoS exercise for the energy NPSs also fulfils the requirements of the Strategic Environmental Assessment (SEA) Directive (2001/42/EC) to produce an environmental report on certain types of “plan or programme”. The energy NPSs are such a plan or programme because they set the framework for the granting of development consent to large-scale energy infrastructure.

The SEA Directive requires that when an environmental report on a proposed plan or programme is prepared, it must identify, describe and evaluate the likely significant effects of implementing reasonable alternatives to the plan or programme which it assesses, as well as the likely significant effects of the plan or programme itself. The analysis of reasonable alternatives is to take into account “the objectives and the geographical scope of the plan”.

Certain strategic alternatives to the draft NPS as a plan were appraised and reported in the draft AoSs published as part of the November 2009 consultation. As a result of this consultation, Government decided to look again at the AoSs and the draft NPSs, including the analysis of alternatives. The work presented in this section cannot be

compared directly with that reported in the November 2009 draft AoSs and is intended to take the place of the earlier assessment.

The analysis of reasonable alternatives provides a strategic context for the detailed assessment of the likely significant effects of NPS policies, as well as a means of evaluating them by comparing them with other ways of achieving the same wider energy policy objectives through the planning regime – both in terms of their comparative merits as ways of achieving those objectives and in terms of their environmental, social and economic impacts.

Section 3 of AoS-1 contains a strategic-level analysis of alternatives to the policies in EN-1 and describes the process of identifying and evaluating alternatives in more detail. This AoS for EN-3 is concerned with the analysis of alternatives to those policies in the NPS suite which are of most direct relevance to renewable energy infrastructure. Although, as noted above, EN-3 contains information on the renewable-specific aspects of issues and impacts which are considered in EN-1, such as land use and biodiversity, the key points of policy on these are laid down at a generic level in EN-1 and alternatives to them are considered in AoS-1. In its treatment of alternatives, this AoS, like the other technology-specific AoSs, concentrates on different approaches to reducing or eliminating the impacts of the technology concerned which experience shows are most objectionable, namely (in the case of EN-3) the noise and shadow flicker effects of onshore wind farms and the sustainability or otherwise of fuel used in biomass-fuelled power stations.

The reasonable alternatives for consideration in AoS-3 are:

(a) adopting a policy that would be less tolerant of the adverse visual, noise and shadow flicker impacts of onshore wind farms;

(b) adopting a policy that would mean consents set more stringent criteria for the fuel for biomass / waste combustion facilities based on sustainability considerations

1.3.1. The NPS policies

EN-3 recognises that the operation of onshore wind farms can give rise, in certain circumstances, to unacceptable landscape and visual impacts, levels of noise, and shadow flicker effects. In summary terms, the approach prescribed in EN-3 in relation to these effects is as follows:

- each of these impacts should be assessed on a case by case basis – the NPSs do not impose any hard and fast rules about where wind turbines should be sited relative to, for example, houses;

- by their nature, wind turbines cannot fail to have significant landscape and visual impacts: developers should seek to minimise these while meeting technical and operational siting requirements;

- potential noise impacts should be assessed using ETSU-R-97 in accordance with latest industry good practice and guidance accepted by Government; and

- shadow flicker should not be a problem beyond 10 rotor diameters of an occupied building, and should generally be capable of being satisfactorily mitigated where it is a concern.

The case for biomass as a renewable alternative to fossil fuels powering combustion plants is based on the proposition that the CO2 released when it is used to create energy can be offset by the CO2 it consumes when growing. Biomass fuel may be said to be “sustainable” when it comes as close as possible to achieving this. It has been argued by some that biomass generating stations should only be consented subject to a condition requiring them to use only sustainable fuel. Government has not adopted this approach, proposing instead (subject to the outcome of an ongoing consultation) to incentivise the use of sustainable biomass through the Renewables Obligation on which all biomass plants rely to a greater or lesser extent.

1.3.2. Discussion of Alternatives

Alternative (a) focuses on those issues which experience (and responses to the November 2009 consultation on the draft NPSs) shows give rise to most acute concerns in relation to onshore wind farms (and, as regards landscape and visual impacts, also in relation to offshore wind farms located closer to land). Those opposed to the policies set out in the NPSs on these issues tend to advocate alternatives that involve exclusion zones of one form or another – for example, a prohibition on wind farms in certain designated landscapes, or a presumption against consenting wind farms within a certain distance of existing buildings (with a view to avoiding noise or shadow flicker effects). Since the overall purpose of such proposals is clear and the AoS is an appraisal of options at a strategic level, alternative (a) has been defined in broad, generic terms as “adopting a policy that would be less tolerant of the adverse visual, noise and shadow flicker impacts of onshore wind farms”. It is implicit in this alternative that it would represent a change from the purely case by case approach of the current NPS text, and that restrictions aimed at reducing the visual impacts of onshore wind farms would also apply to offshore wind farms close to land.

Alternative (b) represents the possibility of reversing the policy set out in EN-3, of not making consent for biomass plants subject to the imposition of fuel sustainability criteria.

2. Assessment of NPS Alternatives

2.1. Introduction

The scope and methods of appraisal are detailed in AoS-1. The two strategic alternatives identified for the EN-3 were assessed using Sustainable Development themes that better keep the appraisal at the higher and strategic level. The preferred policy approach, which was likely to better promote the implementation of the aims of the NPS, was appraised further in detail using the AoS framework of objectives.

2.2. Alternatives

The findings of the appraisal of the strategic alternatives for EN-3 are set out arranged by Sustainable Development theme.

Alternative (a) - Adopting a policy that would be less tolerant of the adverse visual, noise and shadow flicker impacts of onshore wind farms;

It is considered that if more stringent criteria on adverse visual noise and flicker impacts of onshore wind were set, the number of facilities that could be developed would be reduced. An example of how this alternative policy would be implemented would be through requirements of fixed distances from developments/buildings. If distances to adjacent buildings were fixed at a distance greater than that currently indicated from modelling results, this would potentially exclude many areas for development. The consequences of these potential reduced numbers of wind farm developments are considered in the discussion below.

It might be possible to avoid reducing the overall amount of wind farm development by keeping fixed distances from developments/buildings but adopting a more tolerant approach towards landscape and visual effects by taking a more permissive approach towards wind farm development in National Parks and Areas of Outstanding Natural Beauty. However, we have not considered this sub-alternative further as it does not appear to be in keeping with the general thrust of what most of those who oppose the wind farm policies in EN-3 want.

2.2.1. Climate Change

Wind energy is renewable and is a low carbon source of energy. The contribution to climate change of this alternative would be positive, but reduced, relative to the proposed policy in EN-3.

Headline SD themes	EN-3	Alternative (a)
Climate Change		**-?**

2.2.2. Security of Energy Supply

Implementing this alternative would effectively reduce the available locations for wind farm developments. As a consequence, the amount of electricity that could be generated would be lower than that under the proposed policy in EN-3. This, in turn, would lead to a reduction in the security of supply. This impact is particularly significant since it is noted in EN-1 that onshore wind generating capacity is expected to play a significant part in meeting renewable energy targets.

Headline SD themes	EN-3	Alternative (a)
Security of Energy Supply		**-**

2.2.3. Health and Well-Being

The rationale for introducing Alternative (a) would be to remove or limit the adverse impacts of wind farms on health and well-being. The disturbance of background or low frequency noise from operational wind turbines complying with current legislation depends largely on the sensitivity of receptors and wind direction. Reducing the permitted noise levels would, therefore, potentially reduce the impacts on well-being for some individuals, but not necessarily all individuals with heightened sensitivity. At the strategic level, this is considered to be little different from the policy proposed in EN-3. These impacts, are, however considered to last for the short and medium term, approximately the operational life of the facilities.

Shadow flicker is a phenomenon restricted to a certain area around wind turbines and results from particular combinations of sun direction and height behind turbines. It is assumed that in order to function effectively, wind turbines which form part of developments that require consent under the Planning Act 2008 would be located in rural locations. The number of affected buildings would, therefore, be limited. Consequently, reducing the potential impact further is considered to have limited effect at the strategic level of this policy.

As a consequence of reducing the number of wind farms likely to be developed, the employment opportunities during construction or in manufacturing, in the longer term, would be reduced. This would be associated with reduced improvements in health and well-being compared to the currently proposed option.

Headline SD themes	EN-3	Alternative (a)
Health & Well-Being		**0**

2.2.4. The Economy

Applying more stringent noise, flicker and visual impact criteria to wind farms is considered to reduce the number of wind farms developed. Currently wind turbines are imported and the impact on skills and employment is greatest in the short term, during construction. These employment opportunities would be reduced if this alternative were implemented. If sufficient demand for wind turbines develops, there may be the development of local manufacturers of turbines. However, if the number of wind farms is reduced, this is considered an unlikely outcome for the long-term.

Headline SD themes	EN-3	Alternative (a)
The Economy		**-**

2.2.5. The Built Environment

The impacts on the built environment are likely to be similar in kind to those of adopting the policy in EN-3, but reduced in extent as a consequence of fewer wind farms being developed.

The impacts on traffic and transport on rural roads during construction would remain, regardless of the more stringent implementation criteria. Similarly, the potential impact on archaeology and cultural heritage would be unaltered from that in EN-3 and would be mitigated in a similar manner.

Headline SD themes	EN-3	Alternative (a)
The Built Environment		**0**

2.2.6. The Natural Environment

It is considered that at the strategic level the adverse impact on the natural environment of implementing this alternative would be less than that of EN-3. The impacts on ecology, water quality and soils and geology are related to the number of wind farms developed and specific details of the location. Consequently, if fewer wind farms are proposed under this alternative when compared to the number under EN-3, the effect is

reduced. Moreover, the alternative proposes application of more stringent visual impact criteria. At the local or regional scale this may reduce the visual impact of wind farms on particular locations.

Headline SD themes	EN-3	Alternative (a)
The Natural Environment		**+?**

2.2.7. Summary of Alternatives Findings and Preferred Approach for the NPS

Headline SD themes	EN-3	Alternative (a)
Climate Change		**-?**
Security of Energy Supply		**-**
Health & Well-Being		**0**
The Economy		**-**
The Built Environment		**0**
The Natural Environment		**+?**

It is considered that implementing more stringent visual, noise and flicker criteria would have reduced effects when compared to those associated with the implementation of EN-3, principally because this alternative is considered likely to reduce the numbers of wind farms developed compared to EN-3. Impacts of noise on sensitive individuals may be slightly reduced, but the numbers of people affected in rural locations are low, therefore this would have limited effect. This would apply to flicker disturbance effects as well. Visual effects of specific wind farms may be reduced in specific locations, but the overall impact is likely to be largely unaffected, depending on the extent of the reduction in wind farm proposals.

However, a reduction in the amount of new wind farm development would be likely to result either in a significant impact on security of supply or in the reduction of the positive impacts which wind farm development brings from a climate change point of view and/or increases in the negative impacts associated with some of the other technologies which may be deployed to plug the gap that would be left if there was less wind farm development (for example, offshore wind farms are significantly more expensive, increased fossil fuel plant development would increase the risks of high carbon lock-in). For these reasons, the policy set out in the NPSs is preferred.

Alternative (b) - Adopting a policy that would mean consents set more stringent criteria for the fuel for biomass/waste combustion facilities based on sustainability considerations.

Sustainability criteria similar to those against which operators of larger biomass plants are currently obliged to report under the Renewables Obligation Order (2009) (RO) could be applied on a mandatory basis to biomass and the degradable fraction of waste to implement the proposed alternative. But the NPS sustainability of fuel criteria would be set out in EN-3 and would then be a requirement for development consent purposes, regardless of whether sustainability criteria are included in revisions of the RO. The potential, therefore, would exist for overlaps or variances between the two systems.

This is a relevant consideration for the purposes of deciding whether or not to prefer this alternative to the policy in EN-3, but for the purposes of considering the alternative's impact in terms of the sustainable development theme, it has been considered on its own, without making any assumptions about what new rules may apply under the RO (which would not in any event come into effect until some time after the likely designation date of EN-3). Since EN-3 currently specifies no sustainability criteria, any that were introduced would be more stringent. This would be likely to result in biomass fuel becoming more expensive, and fewer facilities being considered economically viable and worth developing, at least in the short term. Potential impacts relating to this proposed alternative are discussed below. The impacts of individual facilities would remain largely unchanged, but impacts associated with a reduction of facilities proposed relative to the adoption of EN-3 are outlined.

2.2.8. Climate Change

During the growth of biomass, carbon is sequestrated by the plants. This carbon is released as carbon dioxide during combustion. The technology is considered as a 'zero carbon' (or close to carbon neutral) technology since the amount of carbon released is almost equivalent to that sequestrated. Application of sustainability criteria for biomass fuel is therefore considered unlikely to have any impact on climate change. If the number of biomass facilities were reduced through this alternative, the carbon dioxide and other emissions would be reduced, but the amount of carbon sequestrated in organic matter grown specifically for the fuel supply chain would be reduced accordingly.

Headline SD themes	EN-3	Alternative (b)
Climate Change		**0**

2.2.9. Security of Energy Supply

A reduction in the number of facilities developed compared to EN-3 may result in a reduction in the security of supply, especially in the short term until the supply chain meeting these criteria developed sufficiently.

Headline SD themes	EN-3	Alternative (b)
Security of Energy Supply		**-**

2.2.10. Health and Well-Being

The adoption of more stringent sustainability criteria would not result in changes to the impacts associated with individual facilities. However, the impact at the strategic level would be that fewer facilities would be developed. This would reduce potential adverse impacts on health and well-being associated with demands water resources, air emissions, noise and traffic and visual impacts.

A reduction in the number of facilities constructed is considered to lead to a reduction in employment opportunities in the short term (construction) and in the longer term (during operation), with associated consequences on health and well-being and equality.

Headline SD themes	EN-3	Alternative (b)
Health & Well-Being		**+/-**

2.2.11. The Economy

Implementation of more stringent sustainability criteria could result in a decrease in the number of jobs, relative to the potential employment created through the implementation of EN-3.

Headline SD themes	EN-3	Alternative (b)
The Economy		**-**

2.2.12. The Built Environment

If the number of facilities were reduced compared to EN-3, traffic and transport impacts of moving fuel to facilities and removing combustion residues would be reduced (although unchanged to individual facilities).

Since the facilities would need to be located near water sources, or near ports (for biomass facilities) any flood defences to protect the facilities from flooding may have impacts elsewhere in the catchment or along the coast. Reduced numbers of facilities may therefore result in reduced impacts on flood risk.

Headline SD themes	EN-3	Alternative (b)
The Built Environment		**+?**

2.2.13. The Natural Environment

Reductions in the number of facilities developed is considered to result in reduced deposition and changes in air quality. This would be of benefit to ecology, but these effects are mitigated with current dispersion criteria, therefore this effect would be limited. If a long-term supply chain of biomass were developed, the sustainability criteria are of relevance. If the number of facilities were reduced compared to adoption of EN-3, the overall visual effect may be reduced.

Headline SD themes	EN-3	Alternative (b)
The Natural Environment		**0?**

2.2.14. Summary of Alternatives Findings and Preferred Approach for the NPS

Headline SD themes	EN-3	Alternative (b)
Climate Change		**0**
Security of Energy Supply		**-**
Health & Well-Being		**+/-**
The Economy		**-**
The Built Environment		**+?**
The Natural Environment		**+/-**

Adoption of a policy with stricter sustainability criteria for development consent may potentially result in a reduction in the number of facilities developed, compared to EN-3. If the criteria were similar to those proposed for the RO, the impacts may be negligible. If the criteria were more stringent than in the RO, the result could be a reduction in the number of facilities developed.

Impacts of individual facilities would be similar under the proposal in EN-3 and the alternative. Differences in impacts would be evident only through the difference in the overall number of developments.

A reduction in the number of biomass plants consented would be likely to have some adverse impact on security of supply, but the climate change impacts are considered to be neutral. Some reduction of adverse impacts relating to traffic and transport, noise, flood risk, coastal change, ecology and visual impacts may arise. However, there would also be a reduction in the employment opportunities and economy and associated benefits to health and well-being.

The imposition of sustainability criteria as a condition of development consent for biomass plant would be worth considering if it was decided not to require adherence to such criteria as a condition of receiving support under the RO – although this could lead to a reduction in the amount of new biomass plant developed and little or no benefit in climate change and biomass sustainability terms. However, if Government carries through its proposal to require adherence to sustainability criteria as a condition of receiving RO support, there is no reason to prefer the alternative, since it would only add duplication of reporting and/or potential confusion if the RO and consenting criteria diverge, and it is considered very unlikely that any biomass plant operator would choose not to obtain incentives under the RO. The proposed change to the RO will also ensure that existing, as well as new plants are covered, and give operators flexibility to switch between suppliers (provided they use sustainable methods) in a way which consent conditions might not (with adverse consequences for competition / free movement of goods).

2.2.15. Comparative Summary of Alternatives Findings ((a) and (b))

Headline SD themes	EN-3	Alternative (a)	Alternative (b)
Climate Change		**0**	**0**
Security of Energy Supply		**-**	**-**
Health & Well-Being		**0**	**+/-**
The Economy		**-**	**-**
The Built Environment		**0**	**+?**
The Natural Environment		**+?**	**+/-**

3. Appraisal Findings for revised draft NPS EN-3

Renewable energy infrastructure may have various impacts on communities and the environment depending upon the nature of the development and its location. Certain of these impacts are common to other energy infrastructure development and the findings of the appraisal for these generic effects are detailed in the Overarching AoS-1. The likely significant effects of the technology specific policies, requirements and guidance in EN-3 were appraised against the baseline conditions using the AoS framework of 14 topics with objectives for sustainability. The appraisal focused on the technology specific impacts with consideration of mitigation measures, such as the development control policies included in the Overarching AoS-1, in order to avoid duplication of assessment. It then considered the strategic effect of the implementation of EN-3 on the AoS objectives, giving consideration to the role of EN-3 in providing greater certainty to energy developers and facilitating renewable energy infrastructure more rapidly than would otherwise occur. A summary of the generic effects from AoS-1 is included for context at the beginning of each topic appraisal. The likely significant effects arising specifically from renewable energy infrastructure are discussed, including suggestions for mitigating significant negative effects, and a summary of the appraisal of EN-1, is provided for each topic as follows:

3.1. Climate Change

AoS Objective	Technology	Assessment (by timescale)		
		S	M	L
1. Climate Change: To minimise detrimental effects on the climate from greenhouse gases and ozone depleting substances and maximise resilience to climate change.	Onshore wind	**0**	**++**	**++**
	Offshore wind	**0**	**++**	**++**
	Biomass/ Energy from waste	**0**	**+**	**+**

AoS-1 describes the effects of energy infrastructure on climate change as including:

- minor positive effects for climate change through the accelerated consenting/construction of low carbon electricity projects with the potential for cumulative positive effects in the medium to long term; and

- minor positive effects in the medium and long term for climate change adaptation objectives through the requirements in EN1 (EN2-6) for adaptation and resilience measures in all new energy sector developments.

3.1.1. Onshore Wind

EN-3 does not identify any specific issues relating to climate change impacts of onshore wind facilities. It is anticipated that EN-3, in-combination with EN-1, will facilitate the consenting of onshore wind projects and, as such, should result in low carbon energy infrastructure becoming operational at a faster rate. This is likely to have a positive contribution towards the realisation of Government's low carbon energy targets and progress towards a low carbon economy. As onshore wind facilities generate low carbon energy, they would also make a significant contribution to the achievement of this objective.

A consequence of climate change is changing weather patterns, which can lead to an intensification of storms. Wind turbines have the potential to be negatively affected by high winds, shutting down when wind speeds exceed 25m/s. The revised EN-3 included a requirement in relation to climate change adaptation that proposals need to set out how wind farms would be resilient to extreme weather events.

Climate change could also lead to sea level rise, which could contribute to flood risk. This is discussed further in Section 3.5 of this AoS-3 report on Flood Risk & Coastal Change.

3.1.2. Summary

Through facilitating new development of onshore wind infrastructure, EN-3 is likely to make a positive contribution to meeting low carbon energy targets, with a positive effect on climate change over the medium to long term.

The AoS identified that wind farms may be at risk of damage due to increased storm intensities. This led to the inclusion of a requirement in EN-3 that proposals need to set out resilience of wind turbines to storms.

3.1.3. Offshore Wind

Impacts of offshore wind turbines on climate change and adaptation to climate change are the same as for onshore wind turbines, with the exception that they are not at risk of flooding. Refer to section 3.1.1 on onshore winds for the relevant assessment.

3.1.4. Summary

As for onshore wind, the implementation of EN-3 is likely to make a positive contribution to meeting the low carbon energy targets, through facilitating new development of offshore wind infrastructure. This is considered to have a positive effect on climate change over the medium to long term.

3.1.5. Biomass/Energy from Waste

EN-3 does not identify any specific issues relating to climate change impacts of biomass/waste combustion. Biomass combustion is considered to be a 'zero carbon' technology, because although the combustion process releases carbon dioxide, these emissions are compensated for by (temporary) carbon sequestration during biomass growth. It is assumed that biomass for facilities proposed under EN-3 would be imported, as the local biomass market is, as yet, insufficiently developed to provide the required quantities of biomass. The carbon dioxide would, therefore, be emitted in the UK, whilst sequestration would occur elsewhere. The location of the sequestration and subsequent release does not change the effect on global climate change, but has implication for reporting of greenhouse gas emissions against UK targets.

Waste combustion is also associated with carbon and other emissions considered to contribute to climate change. However, the amount of waste going to landfill is reduced and the degradable waste that would have produced methane in a landfill, contributes instead to emissions of the lesser greenhouse gas, carbon dioxide. The degradable fraction in waste is primarily paper, food and garden wastes (although varying proportions of these are removed from the waste stream prior to combustion). Further, during the growth phase of the materials that contribute to the degradable fraction of waste, such as growth of trees used for paper, carbon is sequestered.

There is a carbon capture readiness (CCR) requirement for facilities generating more than 300MW electricity. Climate change impacts of this technology are considered in more detail in AoS-1 and AoS-2. The requirement for CCR and retrofitting of CCS in the future is aimed at reducing CO2 emissions, thereby resulting in a positive impact on climate change. However, the efficacy of the technology is as yet uncertain and therefore the impact of implementing this requirement through EN-3 is uncertain. In practice applications for biomass facilities in excess of 300MW are considered unlikely due to the assumed poor economic case for retrofitting CCS to biomass facilities.

Facilities implementing CHP as encouraged by EN-3 use the energy produced from biomass/waste combustion more efficiently than those only generating electricity. Waste heat from the processes is used to heat water for district heating, industrial processes or facilities that have high heat demands. This has the potential for a positive effect on climate change since the emissions from CHP are lower than those of separate electricity and heat production.

EN-1 and EN-3 identify hotter, drier summers, drought and heat waves amongst the possible effects of climate change. This could affect the production of biomass for biomass facilities and, consequently, their ability to operate reliably at the design capacity. In addition, the hotter drier summers and drought could affect the availability of water resources for the biomass/waste combustion facilities. This would result in facilities not being able to run at the design capacity and, therefore, not meeting the required energy provision levels.

Biomass facilities are likely to be proposed for coastal or estuarine sites. At these locations they may be affected by rising sea levels and storm surges and flooding associated with to climate change.

Energy from waste combustion facilities require water for the electricity generating processes. Consequently, reductions in water availability through drought would cause the facility to reduce its operating capacity and thereby reduce electricity production. An indirect impact of this would be that waste would go to landfill during periods of reduced operation, resulting in methane emissions which contribute to climate change.

To mitigate these potential adverse impacts, EN-3 requires that applicants should consider how biomass/waste combustion facilities would be made resilient to these potential effects of climate change.

3.1.6. Summary

Through facilitating new development of biomass/energy from waste infrastructure, EN-3 is likely to make a positive contribution to meeting low carbon energy targets, with a positive effect on climate change over the medium to long term. If biomass is imported, the positive effects on climate change of carbon sequestration will not contribute to the UK’s targets.

As a result of the AoS process, EN-3 was amended to take account of the water demand of waste/biomass combustion facilities in relation to climate change adaptation.

3.2. Ecology (Flora and Fauna)

AoS Objective	Technology	Assessment (by timescale)		
		S	M	L
2. Ecology (Flora and Fauna): To protect and enhance protected habitats, species, valuable ecological networks and ecosystem functionality.	**Onshore wind**	**?**	**?**	**?**
	Offshore wind	**?**	**?**	**?**
	Biomass/ Energy from waste	**?**	**?**	**?**

AoS-1 describes the generic impacts of energy infrastructure and their potential effects on ecology as including:

- loss of habitat (and species) - direct loss from land take or the abstraction of water resources, and indirect or temporary, for example during construction phases;
- disturbance of habitats and species - through noise, light and visual and dust pollution arising from construction, operation and decommissioning activities;
- pollution impacts - from emissions to water, ground and air with impacts on water, soil and air quality;
- habitat fragmentation/ severance/ isolation - through development (in particular linear features);
- obstructions - from tall structures presenting obstacles to migration and flightpaths;
- changes to microclimates - alterations to wind patterns/ speeds, shading/ shadow effects; and
- habitat integrity and connectivity improvements from management, restoration and enhancements activities.

3.2.1. Onshore Wind

The sites for many proposed wind farms are in remote locations. In these rural locations the electricity network may be limited. As a consequence, construction of a wind farm will also potentially require access roads and additional transmission lines to be constructed. The ecological effect of transmission lines is considered in AoS-5.

EN-1 considers generic effects and considerations regarding biodiversity and designated sites. However, additional detail is provided in EN-3. Disturbance from noise is considered in section 3.8 in this AoS-3 report. Amongst the specific considerations relating to the effects of wind farm construction is the recognition that many wind farms are proposed on peat. These soils provide habitats for sensitive fauna and flora. Disturbance of the soils could lead to changes in the soil carbon storage and hydrological regime which in turn could affect the flora and fauna.

The potential for adverse impacts on bats and birds is identified in EN-3. This can be of particular concern if the wind farm is sited along bird migration routes. Information is available on the effect of wind farms on specific bird species, but less is known about the effect on bats. Data is, therefore, to be collected at the site for the purposes of collision risk modelling for birds and estimation of mortality rates for certain bat species prior to making an application.

EN-3 outlines mitigation measures to minimise effects on peat habitats. Proposed schemes are to be designed in such a manner that soil disturbances result in minimum disruption. Where relevant, it may also be required that the applicant provide geotechnical and hydrological data to show the location of peat and consider the risks associated with landslides.

To limit the number of bird strikes and adverse impacts on bats, EN-3 sets out mitigation measures such as locating turbines in such a manner that strikes are minimised. A potential mitigation, not possible at all sites, is to make the adjacent area less attractive to the species of concern.

3.2.2. Summary

Although disturbance to peat soils is limited to the construction period, the effect is considered to be permanent. Changes to the carbon storage of the soil and its hydrogeological properties are not reversible, and, therefore, the effect on fauna and flora would also be permanent.

Bird and bat mortality are of concern over the operational life of wind farms (typically 25 years). Monitoring is, therefore, required to validate collision risk modelling results and bat mortality estimates and inform other wind farm applications. The significance of the effect on ecology over the short, medium and long-term depends on the location of the development and the sensitivity of the receiving environment and is, therefore, uncertain at this strategic level. Any proposed developments will be subject to EIA and HRA.

3.2.3. Offshore Wind

EN-3 addresses potential effects of offshore wind on ecology that need to be considered in addition to those considered in EN-1. During construction and

decommissioning, there is the potential for activities such as drilling, piling and laying of cables to cause negative effects on fish communities, migration routes, spawning activities and nursery areas of particular species. Electromagnetic fields from transmission cables could impact on marine species. Acoustic disturbance is considered in section 3.8 in this AoS-3 report.

Effects on birds, which may include collisions with turbine blades, direct habitat loss, disturbance from construction or decommissioning activities, displacement during operation and effects on flight lines, are noted in EN-3. The extent of the risk of collision effects for certain species of birds can be determined through risk modelling using data from the pre-application EIA.

Intertidal zones may also be affected through the implementation of offshore wind energy schemes. The transmission cables from the wind farm to onshore distribution networks will pass through the intertidal zone. In some instances, the importance of habitats and species in intertidal zones may be recognised through statutory nature conservation designations. Potential negative effects relate to habitat loss and fragmentation, disturbance and increased sediment loads during construction and decommissioning.

There may also be negative effects on sub-tidal zones. Some of the effects relate to the geomorphology of the seabed and are assessed under section 3.12 of this AoS report. The key effects on sub-tidal areas from operation of wind farms relate to altered sedimentary processes. This may be reflected as a loss of habitat. Construction effects include increased suspended sediment load from construction of foundations, construction vessels and anchors and installation of cables. Extendable legs and anchors of construction vessels may also cause habitat disturbance. The duration of the effect is dependent on the habitats and species affected. For example, damage to reefs may result in long-term habitat disturbance.

However, EN-3 also notes potential positive impacts on fish stocks and marine biodiversity, particularly through reduction of fishing activity in the vicinity of wind farms and by the structure itself acting as an artificial reef.

EN-3 identifies mitigation that can reduce effects on fish. A possible measure to mitigate the electromagnetic fields is by the use of armoured export cables. If these are buried sufficiently deep (at least 1.5m below the sea bed) the electromagnetic field is reduced to levels considered unlikely to affect fish movement. It is considered that continuous construction would limit the duration of the effects on fish communities by reducing the construction period. Disturbance of fish and marine mammals could be reduced through 24 hour working practices and soft start procedures for pile driving activities. Monitoring prior to construction is recommended.

Mitigation measures to limit the negative effects of offshore wind turbines on birds are included in EN-3. Collision effects may be reduced by the layout of the turbines in the

wind farm. Minimising aviation and navigation lighting, within safety constraints, is considered, which would avoid attracting birds to the wind farm. Rafting seabirds should, where practicable, be avoided by construction vessels associated with offshore wind farms during sensitive periods. Shutting down turbines during estimated peak migration periods is potentially unlikely to provide mitigation, as the exact timing of peak migration events is uncertain.

Appropriate designs taking into consideration the potential effects of cable installation and decommissioning in the intertidal zone can mitigate the severity and duration of the effect. Cumulative effects resulting from multiple cable routes may be avoided through coordination between various schemes.

EN-3 identifies a number of mitigation measures to reduce the effect of offshore wind farms on the sub tidal zone. These include identifying sensitive habitats in order to determine suitable routes for cables, burying cables to allow seabed recovery and minimising the use of anti-fouling paint to encourage colonisation on seabed structures.

3.2.4. Summary

Through facilitating new offshore wind development, EN-3 could have positive and negative effects on ecology. Negative effects could result from disturbance to birds, fish and marine mammals, as well as effects on intertidal and sub-tidal habitats. A number of mitigation measures to reduce the impacts of these negative effects are included in EN3. These measures include identification of sensitive habitats to avoid during route alignments of cables, burying of cables and encouraging colonisation on seabed structures. However, changes to fishing practices in the vicinity of wind farms may have positive effects on certain shellfish and fish species. The significance of the effect on ecology over the short, medium and long-term depends on the location of the development and the sensitivity of the receiving environment and is, therefore, uncertain at this strategic stage. Any proposed developments will be subject to EIA and HRA.

3.2.5. Biomass/Energy from Waste

EN-3 does not identify any potential effects in addition to those set out in EN-1. However, there are potential effects specific to Biomass/Waste combustion to consider, that are not noted in EN-3. Facilities producing electricity at the 50MW electrical scale will have large footprints, potentially causing habitat loss and fragmentation. For facilities generating more than 300MW of electricity, the footprint is further increased by the requirement for carbon capture readiness. Air emissions, which are further considered in section 3.11 of this report, also have potential effects, by increasing concentrations of NOx, SOx, particulate matter and other pollutants[1]. These pollutants

[1] Although regulated by the Large Combustion Plant Directive (LCPD) (in the case of biomass combustion) and the Waste Incineration Directive (WID) (in the case of waste combustion), there may still be negative effects

interact with soils where they are deposited, with moisture in the air and soil and have the potential to result in changes to the habitat or have direct impacts on flora. For example, SOx compounds, when reacting with moisture, cause acidification of the moisture/precipitation and this can have direct impacts on plants that come into contact with it as well as changing the pH of the soils, which in turn changes the habitat. Some environments are sensitive to changes in NOx. There is potential for disturbance (noise, light and visual) of fauna, particularly during construction and decommissioning. Noise disturbance is considered further in section 3.8 below. Depending on the location of the facilities, air emissions and dust, which could impact sensitive flora, may also be increased through the high number of heavy goods vehicles transporting fuel and combustion residues.

Adoption of EN-3 would also result in the requirement for large volumes of water, depending on the combustion technology. This may require locations in coastal, estuarine and riverine locations. These locations potentially have marginal habitats, specialist species and valuable ecological environments. Reductions in water availability due to high abstraction rates may negatively affect these habitats.

Meeting the requirements of CCR for facilities greater than 300MW would increase the footprint relative to that if CCR was not a requirement. This has the potential in the short and medium term for habitat fragmentation. If CCS is retrofitted in future, there is the potential for long-term disturbance from the additional processes. However, these processes would result in positive impacts on climate change, therefore would have indirect benefits on ecology. The effects of CCS are considered in more detail in the AoS documents for EN-1 and EN-2.

Since the biomass market in the UK is not sufficiently developed to provide fuel for biomass facilities of the required scale, in the short and medium term, it is not anticipated that there would be any ecological effects in the UK from biomass production. It is possible that, in the long-term, if the international demand for biomass grows, energy crops will be grown in the UK, which would have potentially negative effects on biodiversity if indigenous vegetation is replaced with energy crops.

The policy set out in EN-3 in relation to developments on sites with national designation differs from that in EN-1. This is to reflect the wider environmental benefits and urgency of meeting renewable energy targets. As a consequence, there may be negative ecological impacts in these areas. Depending on the designations, these impacts may be significant, but would need to be assessed in a site-specific EIA and HRA.

Although no specific mitigation measures are set out in EN-3 in relation to ecology effects of biomass/waste combustion, there are a number of mitigation measures that should be considered. These would include measures such as the implementation of environmental construction management and decommissioning plans to manage risks associated with disruption during construction and decommissioning/demolition, and may include opportunities for habitat restoration and enhancement during the

operational phases and after decommissioning where appropriate. It is considered that site-specific effects would be addressed by the site-specific EIA.

3.2.6. Summary

Adoption of EN-3 to facilitate biomass/waste combustion at the large scale could lead to some negative effects on ecology, particularly habitat loss and fragmentation, disturbance to fauna and the ecological effects of emissions to air. The significance of the effect on ecology over the short, medium and long-term depends on the location of the development and the sensitivity of the receiving environment and is, therefore, uncertain at this strategic stage. Any proposed developments will be subject to EIA and HRA.

3.3. Resources and Raw Materials

AoS Objective	Technology	Assessment (by timescale)					
		S		M		L	
3. Resources and Raw Materials: To promote the sustainable use of resources and natural assets and to deliver secure, clean and affordable energy.	**Onshore wind**	0		0		0	
	Offshore wind	0		0		0	
	Biomass/ Energy from waste	+	-?	+	-?	+	-?

AoS-1 describes the effects of the NPSs for energy infrastructure on resources and raw materials as including:

- positive effects on resources in the long term through the delivery of secure, clean and affordable energy;
- short-term minor negative effects on resources and raw materials through the use of resources for construction materials and production of construction waste from infrastructure projects;
- medium- to long-term negative effects through production of nuclear waste and decommissioning redundant infrastructure; and
- negative effects on resources and raw materials in the short-medium term through continued reliance on fossil-fuels.

3.3.1. Onshore Wind

EN-3 does not identify specific effects on resources and raw materials relating to the implementation of onshore wind turbines. The installation of additional wind turbines is not considered to have an effect on raw materials and resources. The wind resource is not affected by installation of turbines. Wind turbines are currently imported and it is assumed that in the short and medium term this is likely to continue. However, given the anticipated level of demand from offshore developers in particular, it is possible, particularly in the medium to long term, that wind turbines may be manufactured in the UK. This would then require resources for manufacture, but it is not considered a significant effect.

No mitigation is required as no effects of wind turbines on resources and raw materials have been identified.

3.3.2. Summary

The overall effect of implementing EN-3 is considered to have no effect on resources and raw materials. This is because, in the short and medium term, the turbines will be manufactured outside the UK and imported. Although the effect of long-term development of a UK manufacturing industry is possible, the effect on raw materials is not considered to be significant.

3.3.3. Offshore Wind

The effects on resources and raw materials of adopting EN-3 are considered similar to those of onshore wind, except that the greater scale of anticipated development offshore may make it more likely that manufacturing will be established in the UK at some point.

3.3.4. Summary

Overall, EN-3 is not expected to have a significant effect on resources and raw materials. This is because, in the short and medium term, the turbines will be manufactured outside the UK and imported. Although the effect of long-term development of a UK manufacturing industry is possible, the materials requirements arising from any such development are likely to be limited.

3.3.5. Biomass/Energy from Waste

EN-3 considers the specific potential effects on local and regional waste management plans and management of combustion residue. There is the potential for inefficient use

of resources if waste with re-use or recycling potential is used as fuel in a waste combustion facility. However, combustion of waste that has limited potential for reuse or recycling can result in the reduction of the volume of waste to landfill, which would reduce land use, emissions of methane and pollutants in landfill leachate.

EN-3 discusses the effects of residue management relating to biomass and waste combustion. It is noted that some of the residues can be used for commercial purposes. This is considered to have a positive effect on raw materials and resources, as the ash residue is able to replace virgin material in certain processes, such as cement manufacture and concrete production.

Residual ash, that cannot be reused, such as designated hazardous flue gas ash, requires landfilling. However, the reduction in volume through the combustion process significantly reduces the total amount of material going to landfill and, therefore, this effect is considered to be neutral. The effect on transport and traffic are considered in section 3.7 of this report.

The NPS assumes that it is unlikely, in the short and medium term, that there will be an effect on biomass resources in the UK. This is based on the observation that the biomass market in the UK is not yet well developed and most biomass fuel would need to be imported. In the long-term, however, there is the possibility that a UK supply-chain may become established.

Although not identified in earlier version of EN-3, the revised document recognises that combustion of waste and biomass requires large quantities of water. Depending on the location, this could have negative effects on water resources. Demand, and therefore the magnitude and significance of the effect, are determined by the technology, but demand is generally higher for waste combustion than for biomass combustion. The magnitude and extent of the adverse impacts resulting from implementation of EN-3 are uncertain as water abstraction is subject to regulations such as the Water Framework Directive which would potentially limit the negative impacts.

It is identified that the proposed waste combustion facilities should consider local and regional waste management plans and strategies. The waste hierarchy is to be applied, as far as practicable, to minimise the combustion of waste with potential for reuse or recycling.

Facilities that introduce CHP have the potential to reduce demands on resources (fuel and water) relative to facilities that separately generate electricity or heat. These impacts on biomass resources are considered to be in the medium and long-term when a biomass supply chain potentially becomes established. The impacts on water resources would be for biomass/waste combustion facilities with CHP and these impacts are considered to be in the medium and long-term.

Mitigation measures to reduce the potentially negative effects of ash disposal are identified in EN-3. These include the consideration of potential recovery routes for bottom ash and fly ash. Even potentially hazardous fly ash can be used in cement production and stabilisation of industrial wastes. Further uses could include use of the bottom ash as fertiliser or road aggregate. These recovery measures would need to be considered in terms of the Environmental Permitting regime.

The revised version of EN-3 recognises the water demand of biomass/waste combustion facilities. Consideration of these demands is highlighted in relation to climate change adaptation measures (discussed in section 3.1 above). A possible mitigation measure to minimise effects on water resources would be to consider technologies that use the least amount of water practical.

3.3.6. Summary

The implementation of EN-3 could lead to both positive and negative effects on resources and raw materials in the short, medium and long term. However, it is unlikely to have significant effects on local and regional waste management plans and strategies if the measures set out in EN-3 are followed. The potential effects on biomass resources arising as a result of adoption of EN-3 are uncertain, as these are likely to be in the long-term and depend on other factors such as the international biomass market and supply-chain. Water demands for biomass/waste combustion facilities may have adverse effects on water resources, especially during drought periods. The significance and magnitude of the impacts that may occur as a result of implementing EN-3 are uncertain (although adverse), since water abstraction is subject to various regulations that would potentially limit the adverse impacts.

The effects of residue management through the implementation of EN-3 are likely to result in neutral or positive consequences. Combustion reduces the amount of waste to landfill and the recovery of ash products could result in positive consequences.

As a result of recommendations from the AoS process, EN-3 was amended to take account of the water demand of waste/biomass combustion facilities in relation to climate change adaption. EN-3 has also been amended to include a section on Water Resources and Water Quality using the equivalent section in EN-2 as a model.

3.4. Economy and Skills

AoS Objective	Technology	Assessment (by timescale)					
		S		M		L	
4. Economy and Skills: To promote a strong and stable economy with opportunities for all.	**Onshore wind**	+		+?		+?	
	Offshore wind	+	-	+	-	+	-
	Biomass/ Energy from waste	+		+		+	

The significant positive strategic effects identified in AoS-1 for the energy NPSs include:

- improved vitality and competitiveness of the UK energy industry through providing greater clarity, with benefits for investment certainty and inward investment;
- enhanced economy, employment and jobs across England and Wales through provision of a secure and affordable supply of energy; and
- benefits for employment in the short, medium and long-term through the planning, construction, operation and decommissioning of energy infrastructure; including for skilled workers and particularly in the low carbon energy industries (including in research and development).

Negative effects at the project level identified include:

- potential negative economic effects on existing and future land uses, especially during construction; including disruption, land sterilisation, decreases in property values, and cumulative effects on tourism objectives due to visual effects from clusters of infrastructure development.

3.4.1. Onshore Wind

EN-3 does not identify any additional specific requirements or impacts on the economy or skills related to onshore wind farms. Although wind turbines are currently imported, there is the potential for a large enough market to develop to encourage local production. Most job creation would be in the wind farm construction phase, and the effect would be a positive short term effect. However, given that more wind farms will be consented over the period during which EN-3 is expected to be current than would be

likely to receive consent without an NPS, the effect would be positive in the medium and long term.

3.4.2. Summary

Positive effects on the economy and skills from implementing EN-3 are likely to be greatest in the short-term (construction). Given that more wind farms will be consented over the period of the EN-3 than without an NPS, the effect would also be positive in the medium and long term.

3.4.3. Offshore Wind

EN-3 notes that there are positive and negative potential effects on fish and shellfish stocks. EU monitoring records of fishing vessel routes indicate that the greatest density of fishing activity and effort is within coastal waters for static (pots, traps or gillnets) and mobile (trawls and dredgers) fishing methods. Offshore wind farms may be a hindrance to commercial fishing activities, such as long-lining and trawling. Other fishing activities that may safely take place within a safety zone of a wind farm, such as potting, however, may be increased. Exclusion zones or safety zones may be requested around some offshore wind farms, but the effects of these on commercial fishing would be uncertain, with some types of fishing activity benefiting whilst others may be negatively affected.

Potential sites suitable for offshore wind around England and Wales are in areas important for shipping and offshore infrastructure, such as telecommunication cables and oil and gas pipelines. Offshore wind farms may also affect future technologies, such as tidal range energy production and carbon capture and storage infrastructure. The effects on these future technologies are, however, site-specific and uncertain at the strategic assessment stage.

Shipping for import and export of goods is important to the UK economy. Routes taken by shipping vessels are generally direct and obstructions, such as those presented by new offshore wind farms, could negatively affect shipping routes, causing deviations, increased travel time and fuel costs.

The mitigation proposed in EN-3 in response to potential effects on commercial fishing requires applicants to consult with relevant representatives of the fishing industry. Since the effects on the fishing industry are dependent on the nature of fishing method employed, EN-3 proposes to consider development that would have positive medium and long-term effects on the commercial fishing industry.

Siting of wind farms should be given careful consideration to mitigate potential effects on shipping routes. EN-3 requires that consent not be granted for wind farms that interfere with recognised sea lanes for international navigation. Liaison with the MMO is

required to consider consent under the Coast Protection Act 1949 and the Food and Environment Protection Act 1985 for marine operations.

3.4.4. Summary

There are potential effects relating to the economy and skills identified in EN-3, which are linked to the commercial fishing industry, which could be positive or negative depending on fishing method. These effects need to be considered at the site-level.

Implementation of EN-3 ensures that the importance of shipping routes for international navigation is given consideration and priority. The effects on shipping are therefore considered to be local. These effects will be over the lifetime of the wind farm (25 years).

3.4.5. Biomass/Energy from Waste

No specific effects on the economy or skills related to biomass/waste combustion are identified in EN-3. Employment created in the renewable energy sector is considered in EN-1. As the number of such plants increases in England and Wales, it is likely that a skilled work-force will develop. Although the highest number of staff is required on site during construction and decommissioning, staff are also required throughout the operational phase, to operate the facility and transport fuel and residual waste material. This is likely to have a positive effect on the local economy in the short term, during construction, and also in the medium and long term, during operation.

3.4.6. Summary

Although not specifically identified in EN-3, its implementation is likely to have positive effects on the economy and skills, as it enables the development of large-scale biomass/waste combustion facilities. This is considered to represent a positive effect in the short, medium and long terms.

3.5. Flood Risk and Coastal Change

AoS Objective	Technology	Assessment (by timescale)		
		S	M	L
5.Flood Risk and Coastal Change: To avoid, reduce and manage flood risk (including coastal flood risk) from all sources and coastal erosion risks by locating infrastructure in lower risk areas and ensuring it is resilient over its lifetime without increasing risks elsewhere.	**Onshore wind**	**0**	**0**	**0**
	Offshore wind	**0**	**0**	**0**
	Biomass/ Energy from waste	**-?**	**-**	**-**

AoS-1 describes the effects of energy infrastructure on flood risk as including:

- changes to hydrological flows (surface and ground water) from alterations to land use, including increases in impermeable surfaces (built structures, hard standing etc) may result in negative and more uncertain effects in the short, medium and long term; and

- Construction activities, the introduction of water management measures including sustainable drainage systems (positive effects for water management) and the development coastal/ river defences which may have negative effects in the short term with uncertain effects in the longer term.

3.5.1. Onshore wind

EN-1 summarises the generic effects relating to flood risk of onshore wind farms and other renewable energy infrastructure. There are no further specific effects identified in relation to flood risk impacts on wind turbines. Onshore wind farms do not significantly increase the risk of flooding due to the relatively small footprint of individual turbines. Since wind farms are often proposed for high-lying ground, wind farms are considered not to be at high risk of damage from flooding. If they are placed in the path of flood waters, there may be scour around the foundations or similar damage, but this is considered unlikely. Further, subsidence resulting from flooding may have adverse impacts on foundations, but these impacts are considered to have a low likelihood of occurrence and would be site-specific.

3.5.2. Summary

The effect of development of additional wind farms through the implementation of EN-3 is considered to have a neutral effect over the short, medium and long term on flood risk.

3.5.3. Offshore wind

Offshore wind farms are not affected by flood risks, although changes to water movement offshore and transmission of generated electricity to the onshore grid may affect flood defences. Changes in sea level may negatively affect the structural integrity of the wind turbines, but this would be considered as part of the climate change adaptation that should be set out in the proposal, in accordance with EN-3 requirements.

3.5.4. Summary

Implementation of EN-3 is not considered have any strategically significant effect on flood risk, as the effects are likely to be site-specific.

3.5.5. Biomass/Energy from Waste

The revised EN-3 identifies that biomass/waste combustion facilities may be at risk of increased flooding related to climate change. The facilities, however, also have the potential to contribute to increased flood risk. The most likely negative effects relate to the footprint of biomass/waste combustion facilities considered within EN-3. Runoff is likely to increase as a result of the roofing and surfacing of most of the facility. In addition, these facilities are likely to be located at or near rivers, coasts or estuaries due to the transport requirements for fuel and water demands. These locations are more flood-prone and, therefore, increased runoff could increase flood risk in the area. Flood defences built to protect any coastal facilities may impact on flooding elsewhere. Flooding also has the potential to lead to earth movement and subsidence, which could affect biomass/waste combustion facilities.

Although no mitigation measures for flood risk are identified in EN-3 in relation to biomass/waste combustion facilities, the potential exists to harvest rainwater during high intensity events and, thereby, reduce the flood peak in receiving surface waters as identified in EN-1.

3.5.6. Summary

Flood risk & coastal change is not specifically considered in EN-3 in relation to biomass/waste combustion facilities, as the issues would not differ from those set out in

EN-1. The effect of implementing EN-3 would result in potentially increased flood risk, due to the likely location of these facilities at or near rivers, coasts and estuaries. These effects are considered to be greatest in the medium and long term.

3.6. Water Quality

AoS Objective	Technology	Assessment (by timescale)		
		S	M	L
6. Water Quality: To protect and enhance surface (including costal) and groundwater quality (including distribution and flow).	**Onshore wind**	**0**	**0**	**0**
	Offshore wind	**-**	**-**	**-?**
	Biomass/ Energy from waste	**-**	**-**	**-**

AoS-1 describes the effects of energy infrastructure on the water environment as including:

- increased water discharges and atmospheric pollution (eutrophication) can lead to reduced water quality;
- construction, operation and decommissioning activities can increase risk of pollution spills and leaks, which can result in reduced water quality;
- increased abstractions can reduce water levels and therefore modify surface and groundwater flow; and
- construction activities and associated land take can result in modified surface and groundwater flow.

3.6.1. Onshore Wind

EN-3 does not identify additional specific effects on water quality relating to onshore wind. Wind farms do not require water for operation and, therefore, the effects would be limited to minor mobilisation/disruption of sediments during earthworks for construction or decommissioning. Depending on the site hydrogeology, ground water quality or hydrology may also be temporarily affected if excavation intrudes into an aquifer or confining layer. However, this would be site-specific and not an effect that would be expected for all wind turbines.

No specific mitigation measures are set out in EN-3 relating to water quality, as no specific effects of wind turbines are identified.

3.6.2. Summary

The negative effects of wind farms on water quality are minor and limited to some sediment mobilisation or breakthrough into an aquifer or confining layer during construction and earthworks. The overall effect is therefore considered neutral in the short, medium and long term.

3.6.3. Offshore Wind

Effects on water quality identified in EN-3 include the disturbance of seabed sediments and possible release of contaminants. These effects are most likely during construction and decommissioning of the wind farms. The effects on water quality will, in part, be determined by dispersion and dilution of contaminants or sediments and the receiving waters or coastline. Indirect effects of sediment movement on shipping and fishing industries are considered in section 3.4 above.

Measures to minimise these effects have been proposed in EN-3. These include undertaking a geotechnical assessment to determine suitable construction methods and minimise the negative effects.

3.6.4. Summary

Sediment disturbance is identified as the key effect on water quality that would result through construction of wind farms if EN-3 were implemented. This is considered to be a short to medium term effect, as they relate primarily to construction. In mitigation, EN-3 requires applicants to undertake geotechnical investigations and choose construction methods based on these results. The effects on water quality are likely to be negative, but regional in extent and dependent on where facilities are constructed.

3.6.5. Biomass/Energy from Waste

EN-3 does not identify any specific effects of biomass/waste combustion on water quality. As discussed in section 3.3 above, these combustion facilities have large water demands. Reduction in river flow volumes would have potentially negative consequences on water quality. In addition, there is the risk of runoff being contaminated by fuel or ash falling off trucks. Depending on the combustion technology, there could be the production of wastewater, some of which can be disposed of in the combustion process, whilst some may need to be removed from the site as wastewater.

No effects on water quality from biomass/waste combustion are recognised in EN-3, since they are no different to those set out in EN-1. There are, therefore, no specific mitigation measures outlined.

3.6.6. Summary

Adopting EN-3 may result in negative effects on water quality, EN-3 suggests some mitigation measures for the impacts of biomass/waste combustion on water quality. The effects could in some measure be limited by good design principles, but the high water demands could still result in negative water quality effects.

As a result of recommendations from the AoS process, EN-3 was amended to take account of the water demand of waste/biomass combustion facilities in relation to climate change adaption. EN-3 has also to been amended to include a section on Water Resources and Water Quality using the equivalent section in EN-2 as a model.

3.7. Traffic and Transport

AoS Objective	Technology	Assessment (by timescale)		
		S	M	L
7. Traffic and Transport: To minimise the detrimental effects of travel and transport on communities and the environment, whilst maximising positive effects.	**Onshore wind**	-	0	0
	Offshore wind	-	-	0
	Biomass/ Energy from waste	-	-	-

As detailed in AoS-1, through the transport of materials, goods and personnel, energy infrastructure projects can have significant effects on traffic and transport networks, with the effects more pronounced during the construction stage. Identified effects include:

- Disruption to road and public transport services; cycleways and footpaths, especially during construction;
- Increased traffic leading to congestion and increased journey times;
- Increased noise and atmospheric emissions from road transport;
- impacts on aviation through interfering with the operation of radars and radio signals; and

- potential positive effects through new road facilities and transport links, upgrading of existing roads, enhanced public transport.

3.7.1. Onshore Wind

EN-3 highlights the fact that most wind farms are proposed in relatively remote locations. The roads to these areas are predominantly minor roads. The components of wind turbines, such as the rotors, are delivered to site as one piece, which may weigh in excess of 100 tonnes and be up to or exceeding 45m in length. EN-3, therefore, requires the IPC to be satisfied that the abnormal loads can be safely transported with the least inconvenience to other road users. The views of other agencies, such as the highways authorities, should be taken into consideration in the decision. Transporting turbine components can result in significant localised disruption to nationally significant volumes of traffic. Transportation can also lead to environmental impacts, including negative impacts on climate change and air quality. The duration of the disruption is limited predominantly to construction and decommissioning (if removed in large units). During the operational phase of the facility, the transport effects are considered negligible as only occasional visits for inspection and maintenance will be required.

EN-3 notes that, in some instances, applicants may be required to make modifications to highways to facilitate the movement of turbine components and check whether strengthening of bridges is required. In addition, trial runs may be considered appropriate to determine whether the largest components can safely be delivered. Additional mitigation may be requested to limit the number of vehicle movements to and from the wind farm during construction, which may include specific routing of construction-related traffic.

3.7.2. Summary

The overall effect of wind turbines in relation to traffic is considered negative in the short term. During construction the disruption may be high due to large vehicles on minor roads and there are potential negative environmental effects, including on climate change and air quality, of increased transportation. In the event that a number of wind farms are located close together, the effect on traffic and other road users will be compounded and therefore would be a severe negative effect in the short term. In the medium and long term, effects are considered neutral as the number of vehicle movements associated with the operation of the wind farms is minor.

3.7.3. Offshore Wind

It is highlighted in EN-3 that shipping and navigation routes may be affected by construction or operation of wind farms. If these facilities were installed where they

affected recognised sea lanes, the effect would be a significant negative effect with international consequences. This is considered further in section 3.4 above.

EN-3 states that consent cannot be given for wind farms that cause interference with recognised sea routes essential for international navigation. It is a further requirement that a risk assessment be undertaken. If there are potential conflicts between the applicant and the shipping industry, the Maritime and Coastguard Agency should also be consulted. It is anticipated that in the long term any disruption to local navigation will be minimised as new routes become accepted.

3.7.4. Summary

The potential consequences of development of wind farms that affect recognised international navigation routes would be a significant negative effect at an international level. However, the safeguard and mitigations set out in EN-3 would enable the development of wind farms with potentially low negative effects. The effects could be regional in the short and medium term. In the long term, it is assumed that new local navigation routes would become accepted.

3.7.5. Biomass/Energy from Waste

EN-3 does not identify any traffic and transport effects relating to biomass/waste combustion. However, given the high fuel loads required for the operation of facilities of the scale stated in EN-3, the facilities will need to be located at or near good transport links. In the case of biomass combustion facilities, this could include ports. Some fuel can be delivered by rail links, and through ports, but for most facilities, there will be a very high number of heavy vehicle movements to deliver and remove materials. These effects could cause significant disruption if smaller roads and routes were used, and some traffic delays even if larger routes were used, with impacts greatest near the facilities. Some of the component parts of the combustion facilities can be very large and will require transport to the facility. There are potential negative environmental effects, including on climate change and air quality, of increased transportation throughout the lifetime of the facility.

EN-3 does not propose additional mitigation measures specific to biomass/waste effects on traffic and transport. However, EN-1 does require applicants to include a transport assessment, using the current NATA/Web TAG methodology or any successor approach, in the Environmental Statement. EN-1 identifies the use of water or rail transport as being preferable to road transport, as far as possible.

3.7.6. Summary

The overall effect of implementation on traffic and transport of biomass/waste combustion through the implementation of EN-3 is considered o be negative in the short, medium and long term. These effects are primarily from the movement of fuel and residue during the operational phase of the facility, although some significant, short term, local negative effects may result from the movement of component parts to the facility during construction.

As part of the AoS process, it was recommended that impacts on traffic and transport from biomass/energy from waste facilities be considered in EN-3, including associated mitigation measures. However, the DECC position was that this topic was adequately addressed in EN-1 and that EN-3 would not need to be revised since no further technology specific effects were identified.

3.8. Noise

AoS Objective	Technology	Assessment (by timescale)		
		S	M	L
8. Noise: To protect both human and ecological receptors from disturbing levels of noise.	**Onshore wind**	**-?**	**-?**	**0**
	Offshore wind	**-?**	**-?**	**0**
	Biomass/ Energy from waste	**-?**	**-?**	**-?**

AoS-1 identifies the potential for the following generic impacts on noise from energy infrastructure projects:

- Noise generated as a result of construction activities (for example, from large construction equipment/machinery);
- operational noise (for example, from the operation of turbines);
- noise generated as a result of decommissioning (for example, from demolition of structures); and
- noise generated as a result of supporting or ancillary services (for example, from increased traffic movements).

3.8.1. Onshore Wind

EN-3 notes the potential for disturbance from noise for nearby residents arising from onshore wind generation. However, applicants are required to demonstrate compliance with recommended noise limits set out in ETSU-R-97 and maintain noise levels within 'acceptable limits'. Noise generated during the operation of wind farms, may, however still impact on nearby properties. It is anticipated that wind farms of the scale governed by EN-3 would be primarily in rural locations, away from wind disturbances created by buildings and other structures. As a result, the noise impacts are likely to be limited to close proximity to the wind farms. If clusters of wind farms are developed, there is the potential for regional noise disturbance.

EN-3 states that "there is no evidence that ground transmitted low frequency noise from wind turbines is at a sufficient level to be harmful to human health". However, perception of increased noise levels can have a negative effect on well-being and disturbance arising from noise cannot be ruled out entirely. Humans vary in their sensitivity to noise and perceived noise levels can vary with existing background noise and wind direction. A study commissioned by the then Department of Trade & Industry[2] found that of the 126 operational wind farms in the UK, 5 had received complaints relating to low frequency noise.

EN-3 does not note any potential effects on ecological receptors arising from noise produced by onshore wind farms. However, disturbance from noise could impact sensitive species, particularly during construction and decommissioning.

Mitigation measures referred to in EN-3 include the design of wind farms to keep increases in ambient noise levels to acceptable levels and the imposition of conditions to development consent to ensure noise levels remain within acceptable limits. EN-3 notes that distance to residential dwellings from wind farms should be guided by 'The Assessment and Rating of Noise from Wind Farms' (ETSU-R-97),[3] which recommends limits to noise levels.

EN-3 does not note any potential mitigation measures for effects on ecological receptors. However, measures could include siting wind farms away from sensitive fauna and limiting construction/decommissioning during sensitive periods, such as breeding, for certain species.

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2 http://www.decc.gov.uk/assets/decc/what%20we%20do/uk%20energy%20supply/energy%20mix/renewable%20energy/planning/on_off_wind/noise/file40570.pdf

3 http://webarchive.nationalarchives.gov.uk/+/http://www.berr.gov.uk/energy/sources/renewables/explained/wind/onshore-offshore/page21743.html

3.8.2. Summary

EN-3 states that the design of onshore wind farms and their siting relative to residential areas should be such that noise levels are within 'acceptable limits'. However, humans vary in sensitivity to noise, so disturbance cannot be ruled out entirely. EN-3 does not propose mitigation measures for the impacts of noise on ecological receptors, so disturbance effects could be significant for sensitive fauna. Noise effects are likely to be experienced in close proximity to the wind farm, but could be significant at the regional level if energy generation is located in clusters or if species of conservation importance are disturbed. Any effects experienced would be short to medium-term, throughout the lifetime of the development (typically 25 years).

3.8.3. Offshore Wind

Offshore wind farms are assumed to be greater than 1.5 miles offshore, based on the Round 3 Crown Estates concession areas. EN-3, therefore, does not identify any effects on human receptors in addition to those addressed in EN-1. However, EN-3 notes that the high noise levels during offshore piling can have a significant impact on marine species. These noise levels may be high enough to cause injury or death. Applicants therefore need to consider the species in the area as effects on certain species could lead to an offence. Marine mammals were identified as having the greatest sensitivity to acoustic disturbance from offshore wind farms, even during the operational phase of the facilities.

EN-3 suggests ecological monitoring during construction and operation and careful design and construction techniques to mitigate for impacts on marine life.

3.8.4. Summary

The implementation of EN-3 is not considered to have any additional effects on human receptors with regard to noise from offshore wind. However, it is considered that there are potentially strategically significant negative effects, depending on the site location, on ecological receptors in the short to medium term.

3.8.5. Biomass/Energy from Waste

EN-3 does not set out any specific noise effects in relation to biomass/waste combustion. However, it must be noted that there are potential sources of noise similar to those at coal-fired power stations, which may include:

- crushing and shredding of biomass/waste for use in the combustion process;
- delivery and movement of fuel and residue materials at the combustion facilities;

- steam turbines that operate continuously during normal operation; and
- air-cooled condensers situated outside the building envelope that operate continuously during normal operation.

Depending on the nature of the fuel delivered, there may be varying levels of noise associated with fuel preparation operations. In addition to impacts on human receptors, noise disturbance of fauna is also possible, especially during construction and decommissioning.

No specific mitigation measures in relation to noise effects from biomass/waste combustion are set out in EN-3.

3.8.6. Summary

The impact of noise from facilities constructed as a result of EN-3 is considered to have potential negative effects on human and ecological receptors, although this is dependent on site location. Although industrial noise regulations would apply, the continuous operation would result in continual noise at the permitted levels. Depending on the choice of transport for fuel and residues, there may also be noise levels associated with fuel and residue transport and movement. Facilities are designed to operate 25-35 years and, therefore, these effects are considered long term.

As part of the AoS process it was recommended that noise from biomass/waste combustion facilities and potential mitigation measures are included in EN-3, using the equivalent section in EN-2 as a model. DECC has indicated that NPS is to be revised to address noise impacts of fuel preparation in relation to biomass/waste combustion facilities.

3.9. Landscape, Townscape and Visual

AoS Objective	Technology	Assessment (by timescale)		
		S	M	L
9. Landscape, Townscape and Visual: To protect and enhance landscape quality, townscape quality and to enhance visual amenity.	**Onshore wind**	**-?**	**-?**	**0**
	Offshore wind	**-?**	**-?**	**0**
	Biomass/ Energy from waste	**0**	**-?**	**-?**

AoS-1 notes that the landscape and visual effects of energy projects vary in accordance with the type of development, its location and the landscape setting of the proposed development:

- Negative effects can occur through construction and operation and can be temporary or permanent. Effects can occur in designated landscape areas (of local or national importance) and in non-designated areas, including towns and can include negative effects on views, visual amenity and on local amenity (for example, from light pollution).

3.9.1. Onshore Wind

In order to derive maximum energy from the wind resource, the general siting requirements are that there are no obstructions that could reduce wind speeds. This leads to turbines being sited on top of hills, on large areas with low relief and other exposed (generally rural) locations. Wind turbines for the facilities considered under this planning regime are large structures and EN-3 identifies that these will have significant visual and landscape effects. As a result of the location and size of the wind turbines, they are visible from a wide area. Although most wind power facilities are sited at some distance from cities or towns to avoid the turbulence caused by tall buildings, smaller settlements or the edges of towns may have wind turbines located close by. Wind energy resources are not uniform across the country and, as a consequence, some areas may have a high number of onshore wind facilities, with associated cumulative visual and landscape effects. Depending on site location, landscape impacts could include effects on designated or important landscapes.

EN-3 states that consent given to wind farms is typically time-limited, with a typical limit of 25 years. The visual effects from the construction and operation will, therefore, be reversed after decommissioning. However, if the site is already in use for wind power generation, it is possible that new consent may be sought by the same or other applicants at the end of this time limit. However, it is not possible to predict whether the granting of previous consent would make future consent more likely.

As stated in EN-3, mitigation is unlikely since the number and scale of turbines cannot be reduced without loss in electricity generating output. However, onshore wind should be sited away from areas of landscape importance where possible.

3.9.2. Summary

The visual effects of wind turbines resulting from the implementation of EN-3 are considered to be reversible and in the order of 25 years. The resulting negative effect is therefore considered negative but uncertain in the short and medium term, as the effect may be significant, depending on the location, but would be reversed when the facility is decommissioned. In the long term, the effects are, therefore, considered neutral.

3.9.3. Offshore Wind

Coastal landscapes may be recognised through statutory designations and seascapes are identified as an important resource in EN-3. In addition to the visual effect considerations outlined in EN-1, EN-3 identifies potential effects on seascapes. However, this effect only occurs if the wind farms are visible from the shore.

For those likely to be visible from the shore, EN-3 sets out a number of mitigation measures, including seascape and visual effect assessment and considerations relating to the layout of the facility. It is highlighted that the reduction in the number of turbines to reduce the visual effect is unlikely to be feasible.

3.9.4. Summary

The result of developing wind farms in line with measures set out in EN-3 is uncertain. Since EN-3 states that visual effects should not be the primary reason for refusing to grant consent, there may be circumstances where the effect has the potential to be significant on a regional or even international scale if the sites are located in areas with international designations. The effects would be for the duration of construction through to decommissioning and would be reversible. Implementation of EN-3 is, therefore, considered to have an uncertain visual and seascape effects, with any effects likely to be in the short and medium term.

3.9.5. Biomass/Energy from Waste

EN-3 identifies that buildings and abatement units that may make up a biomass/waste combustion facility are large (in the order of 25m high). Additional visual effects of the condensers and chimney stack (generally in the range of 60 – 90m high, although some may be taller, depending on site-specific conditions for emission dispersion) are considered in the revised EN-1. The significance and scale of the effect will be largely dependent on the location of the facility. Facilities of this scale would need to be located near large transport routes and, potentially, for facilities implementing CHP, in or near industrial areas where waste heat could be used. This would minimise the visual intrusion effect of the facility. Facilities generating more than 300MW of electricity also have a requirement for CCR. To meet this requirement, land at or near the facility would be required to retrofit carbon capture infrastructure. Consequently, the footprint would be larger than if there was no requirement for CCR.

Biomass/waste combustion facilities are designed for an operational life of 15 – 35 years. Associated visual effects are, therefore, considered to be medium- to long-term impacts.

Mitigation measures suggested in EN-3 to reduce the intrusive effect relate to architectural treatment of the building envelope design, and physical screening measures, such as earth bunds or mounds and trees.

3.9.6. Summary

Visual and landscape effects resulting from the implementation of EN-3 in relation to biomass/waste combustion facilities are considered negative in the medium to long term. Although some attempt can be made to make the facility visually less intrusive through the proposed mitigation measures, these facilities will remain large features on the landscape, with a high chimney. However, the significance of the effect is dependent on the location.

It is recommended that the visual impact of the chimney stack of biomass/waste combustion facilities and potential mitigation measures are again included in EN-3. These were removed from the revised EN-3 and included in a revision of EN-1. The DECC position, after consideration of the aspects of exhaust stack design in landscape and visual impacts, is that there are insufficient differences between fossil fuel generating stations, energy from waste and biomass stacks – since the height and appearance will be largely dictated by operational emissions requirements, which are regulated by EA. As these are common to all thermal combustion power stations, it is considered that the best place for description of this impact is EN-1.

3.10. Archaeology and Cultural Heritage

AoS Objective	Technology	Assessment (by timescale)		
		S	M	L
10. Archaeology and Cultural Heritage: Protect and where appropriate enhance the historic environment including heritage resources, historic buildings and archaeological features.	**Onshore wind**	**0?**	**0?**	**0?**
	Offshore wind	**0?**	**0?**	**0?**
	Biomass/ Energy from waste	**0?**	**0?**	**0?**

AoS-1 describes the effects of the NPSs for energy infrastructure on Archaeology and Cultural Heritage as including:

- disturbance or loss of heritage assets[4] as a result of ground works or excavation; and
- impacts on the setting of nearby heritage assets.

3.10.1. Onshore Wind

Where wind farms may have an effect on the historic environment, EN-3 suggests that visualisation may be required for features above ground. This would demonstrate the potential effects on the heritage features and could enable the visual effect of wind turbines to be minimised. Where consent is limited to 25 years, the effect would be largely reversible, although some features, such as foundations, may be left in-situ.

For sub-surface features, there is the potential for non-reversible damage to archaeological features during the construction of foundations for turbines and transformers or trenching for installation of cables. This effect is limited to a relatively shallow depth.

Mitigation measures proposed in EN-3 include trial trenching and/or a watching brief. The watching brief would ensure that the extent of damage is limited and no further damage occurs. However, any damage that did occur would be permanent. Micro-siting of elements of the permitted infrastructure within a specified tolerance is suggested, which enables the amendment of precise locations in order to avoid locations of archaeology identified through trial trenching or implementing a watching brief during construction.

Since the potential impacts are site-specific and measures are set out in EN-3 to mitigate potentially negative impacts, the impact of adopting EN-3 is considered neutral but uncertain in the short, medium and long term. The uncertainty arises because the potential negative effects on archaeology and cultural heritage are site specific. Proposed wind farms may be located where they have no impact, whilst others may have adverse effects.

3.10.2. Summary

Effects on archaeology and cultural heritage relating to onshore wind resulting from adopting EN-3 are considered neutral but uncertain. Impacts are dependent on the location and design of new facilities assisted by the implementation of EN-3. Further studies would be necessary at the site-specific level.

[4] Those elements of the historic environment – buildings, monuments, sites or landscapes – that have significance due to their historic, archaeological, architectural or artistic interests are known as ‘heritage assets’.

3.10.3. Offshore Wind

In addition to the generic effects outlined in EN-1, EN-3 recognises further potential effects on archaeology. EN-3 identifies possible negative effects on seabed archaeology (such as submerged settlements and wreck sites) and maritime archaeology in the intertidal zone.

In order to minimise the effects identified in EN-3 on archaeology, the applicants are required to consult relevant bodies, undertake designs to minimise or avoid damage and facilitate micro-siting of elements of the wind farms and connecting infrastructure.

3.10.4. Summary

Effects on archaeology and cultural heritage relating to offshore wind are uncertain at this strategic level and dependent on the location and design of new facilities assisted by the implementation of EN-3. Further studies would be necessary at the site-specific level.

3.10.5. Biomass/Energy from Waste

No effects specific to biomass/waste combustion in relation to archaeology or cultural heritage are noted in EN-3. Given the large footprint of these facilities, there are, however, potential impacts on buried archaeology and on above ground cultural heritage assets, which may be of strategic significance depending on the proposed location of the development.

No mitigation measures specific to this technology are set out in EN-3.

3.10.6. Summary

Effects on archaeology and cultural heritage relating to biomass/waste combustion are uncertain at this strategic stage and dependent on the location and design of new biomass or energy from waste facilities assisted by the implementation of EN-3. Further studies would be necessary at the site-specific level.

It was recommended as part of the AoS process that a trenching/watching brief should be included for the biomass/waste combustion facilities, as for onshore wind, since the footprint of the facilities is large and text relating to this topic was included for onshore and offshore wind facilities. DECC considered these aspects and the historic environment section in EN-1 has been significantly revised; the detailed requirements for archaeology in EN-3 are generic, so this reference has been removed from EN-3 as repetitious.

3.11. Air Quality

AoS Objective	Technology	Assessment (by timescale)		
		S	M	L
11. Air Quality: To protect and enhance air quality on local, regional, national and international scale.	**Onshore wind**	**0?**	**0?**	**0?**
	Offshore wind	**0**	**0**	**0**
	Biomass/ Energy from waste	**0?**	**-?**	**0?**

3.11.1. Generic Effects

As detailed in AoS-1, energy infrastructure projects can have significant negative effects on air quality during construction, operation and decommissioning. These include:

- emissions generated as a result of construction activities (transport emissions from the transport of materials, resources and personnel; dust and fumes from machinery operation, excavation and drilling);
- emissions from project operation (operation of plant, transport of materials, resources and personnel); and
- emission from plant, machinery and vehicles during the decommissioning of projects (including transport to and from site).

3.11.2. Onshore Wind

The effects on air quality would be limited to dust releases during construction of foundations or trenches. The effect would be of a short duration. During the operational phase there are no emissions from the turbines and vehicle movements related to the activity are low (for maintenance and inspection only). Limited emissions of dust may occur during decommissioning if foundations or other infrastructure is excavated. The geographic extent of the effect would be localised and dependant on prevailing winds.

EN-3 highlights the fact that many proposed wind farms are sited on peat. Disturbance of the peat may result in release of carbon stored in the soils. This would affect local air quality and would contribute to greenhouse gas emissions. The emissions would be

limited in temporal and spatial extent since the area of disturbance for foundations is relatively small and there is a finite amount of stored carbon that would be released.

There are no specific mitigation measures identified in EN-3.

3.11.3. Summary

The overall negative effect on air quality of onshore wind turbines is considered to be small and localised. Dust emissions are limited to the construction period, and possibly the decommissioning period if there is excavation of foundations. Some carbon dioxide release can be expected if turbines are sited on peat, since disturbance of the soil will allow release of the stored carbon. There are no specific mitigation measures proposed or required. The effect of implementation of EN-3 in relation to onshore wind farms is considered to be uncertain, in the short, medium and long term.

3.11.4. Offshore Wind

EN-3 does not identify any specific effects on air quality that are not addressed in EN-1.

There are no further mitigation measures set out in EN-3 in relation to offshore wind farm effects on air quality.

3.11.5. Summary

Implementation of EN-3 is considered to have a neutral effect on air quality in relation to offshore wind farms.

3.11.6. Biomass/Energy from Waste

EN-3 identifies air emissions that are specifically associated with combustion of biomass/waste. These include particulates, NOx, SOx, dioxins, furans and heavy metals. The emissions are limited by regulations set out in the Waste Incineration Directive for waste combustion facilities and the Large Combustion Plant Directive for biomass combustion technologies. Although these emissions are subject to legal limits (which are likely to be tightened following the introduction of the Industrial Emissions Directive (IED) in 2016) and the stack heights designed to disperse emissions, air quality will be locally affected even if local air quality standards are not exceeded.

Operation of biomass/waste combustion facilities is also associated with an increase in the release of particulates into the atmosphere, including PM10 and trace elements found in waste. These potentially have negative impacts on air quality, as well as public health, but as mentioned previously, are limited by the air quality regulations.

There are also additional effects on air quality associated with the operation of biomass/waste combustion facilities from activities such as the receipt and preparation of fuel, furnace maintenance and residue removal. All of these are associated with plant operation, and are therefore medium term and ongoing in duration, although only likely to be localised in extent, the geography of which will be determined by prevailing winds..

The developer needs to ensure that the Environment Agency has been consulted in all releases to the atmosphere. This will help to ensure that the IPC can receive timely advice and reassurance that the applications are taking into account all the necessary permitting and licensing requirements (including emissions performance standards) and that these are being considered in parallel to the planning process. This will be given additional scrutiny if the development is within or adjacent to an Air Quality Management Area (AQMA).

EN-3 identifies emissions standards and stack height dispersion modelling as mitigation measures. There are a range of mitigation measures available to manage the emissions from biomass/waste combustion facilities. In-line process technologies are available to ensure the emissions meet the required emissions standards.

3.11.7. Summary

The implementation of EN-3 is considered to have local air quality effects related to large scale biomass/waste combustion facilities.

The significance of the effects varies between different fuel sources (waste or biomass) and technologies, between different releases to atmosphere, and also whether there is an AQMA within proximity to the development. For example, the release of SOx and NOx could be strategic in nature where these releases cross international borders on prevailing winds, or more regional and local in terms of impact on receptors from particulate and dust releases from power stations.

These effects are therefore considered to be potentially significant in nature and strategic in magnitude during the operational phase of the combustion facilities. These remain and depend on the technology adopted. For construction and decommissioning, negative effects are likely to be local in extent through these periods, and following decommissioning air quality impacts from the development will be neutral. However, technology does exist to mitigate the magnitude of these negative effects, in order to comply with air quality permitting, licensing requirements and emissions performance standards under the existing LCPD and upcoming IED. These measures are therefore likely to reduce the negative impact on air quality, but some uncertainty remains associated with location and technology.

3.12. Soil and Geology

AoS Objective	Technology	Assessment (by timescale)		
		S	M	L
12. Soil and Geology: To promote the use of brownfield land and where this is not possible to prioritise the protection of geologically important sites and agriculturally important land.	**Onshore wind**	**0?**	**0?**	**0?**
	Offshore wind	**0?**	**0?**	**0?**
	Biomass/ Energy from waste	**0?**	**0?**	**0?**

AoS-1 identifies the potential for a number of generic effects on soil and geology which are applicable across the different types of energy infrastructure development. They include:

- disturbance or loss of soils and geologically important sites; and
- increased risk of pollution and potential contamination of soils.

3.12.1. Onshore Wind

Many wind farms in England and Wales are proposed on peat, as identified in EN-3. Disturbance will potentially result in the release of carbon and changes to the local hydrological regime. The effects on other forms of geology are considered site-specific.

There are no specific mitigation measures identified within EN-3.

3.12.2. Summary

The effects on soil and geology resulting from onshore wind development in terms of the implementation of EN-3 are considered uncertain in the short, medium and long term. Effects are site-specific and depend, in part, on the geology, the magnitude of the disturbance created and the local hydrology.

3.12.3. Offshore Wind

It is recognised in EN-3 that, although foundations of offshore wind turbines are relatively compact, there is the potential for seabed disturbance. This could be direct disturbance resulting from construction activities in the sub-tidal and intertidal range, as well as indirect effects from changes in water movements that could result in scour.

These effects are considered to be potentially significant in the vicinity of the footprint of the development, but could impact sediment movements along the coast. Impacts on habitats from seabed disturbance are considered in section 3.2 of this AoS.

By way of mitigation, in addition to considerations outlined in EN-1, EN-3 identifies that geotechnical investigations can contribute to the design of appropriate construction methods.

3.12.4. Summary

The effect of implementing EN-3 is likely to result in neutral, but uncertain, effects in the short, medium and long term. Depending on geology, there may be negative effects from seabed disturbance, but the spatial extent of these effects would be local to the development and not strategically significant.

3.12.5. Biomass/Energy from Waste

EN-3 does not identify any specific effects on soil and geology relating to biomass/waste combustion. However, depending on the site geology, there may be impacts.

There are no specific mitigation measures set out in EN-3 relating to effects on soil and geology.

3.12.6. Summary

EN-1 considers the potential generic effects on soils and geology and associated mitigation measures. EN-3 does not identify additional specific technology-related effects or mitigation measures in relation to soil and geology. Implementation of EN-3 is therefore considered to have a neutral, but uncertain, effect on soil and geology in the short, medium and long term.

3.13. Health and Well-Being

AoS Objective	Technology	Assessment (by timescale)		
		S	M	L
13. Health and Well-Being: To protect and enhance the physical and mental health of the population	**Onshore wind**	**0**	**0**	**0**
	Offshore wind	**0**	**0**	**0**
	Biomass/ Energy from waste	**0?**	**0?**	**0?**

AoS-1 identifies the potential for the following positive effects on health and wellbeing from energy infrastructure projects:

- significant positive effects from an increase in employment opportunities and enhanced economy; and
- significant positive effects from enhanced energy security and affordability, particularly a reduction in fuel poverty.

However, potential significant negative effects on human health and wellbeing were also identified, with these effects more significant during the construction period:

- disruption and annoyance effects due to noise and vibration;
- effects on health from odour, dust and air pollution;
- effects on health and wellbeing from artificial light, smoke, steam or insect infestation; and
- effects from loss of amenity, open space, access and recreational areas.

3.13.1. Onshore Wind

Shadow flicker from wind turbines, although essentially a visual effect, may have an effect on the health and well-being of some individuals. Modelling indicates that there is not much disturbance or nuisance beyond ten rotor diameters of the turbines. At greater than 2.5Hz there is the potential for sufferers of epilepsy to be affected, but the maximum frequency is less than 1Hz. Noise impacts on human health are discussed in section 3.8 of this AoS.

The potential duration of the shadow flicker effect can be estimated and mitigated through controls on the operation of the turbines at the period when the effect is expected. EN-3 proposes that rotating blades should be, as far as practical, non-reflective and that the potential duration of this effect be determined for occupied buildings. Where the potential for shadow flicker has been identified, mechanisms to inhibit the effect can be fitted.

In the impacts of onshore wind facilities on the economy and skills resulting from the adoption of EN-3, it was identified that there is a potential for employment creation in the short term (during construction) and possibly in the long term, if manufacturing of wind turbines were to occur in the UK. These are considered to have positive impacts on health and well-being. These effects are, however, not considered significant at the strategic level of the assessment.

3.13.2. Summary

It is considered that the impact of the implementation of EN-3 with regard to onshore wind on human health and well-being is neutral over the short to long term, as impacts from shadow flicker would be limited to a small geographical area in and around the site.

3.13.3. Offshore Wind

EN-3 does not identify additional health and well-being effects in addition to those outlined in EN-1. However, it was identified that implementation of EN-3 would potentially lead to increased numbers of offshore wind farms. These would have associated employment creation during construction and there is a possibility that further employment opportunities would be created if a manufacturing industry for wind turbines were to develop in England and Wales. This would have associated positive impacts on health and well-being. Impacts on the fishing industry were identified as having the potential to be either positive or negative, depending on the type of fishing employed. Consequently, the impacts on health and well-being would, therefore, also be positive or negative.

EN-3 does not set out mitigation measures specific to effects of offshore wind farms on health and well-being.

Although some short-term positive impacts on health and well-being may result from the implementation of EN-3 through the creation of employment opportunities during the construction phase of wind turbines, these effects are not considered significant at the strategic level of the assessment. Impacts resulting from effects on fishing are considered neutral but uncertain.

3.13.4. Summary

It is considered that the effects on human health and well-being through offshore wind turbines developed as a result of the implementation of EN-3 would be neutral in the short, medium and long-term.

3.13.5. Biomass/Energy from Waste

EN-3 does not identify additional effects on health and well being resulting from the development of biomass/waste combustion facilities.

EN-3 points out that the IPC should not consider facilities meeting the required emission standards to have any associated health and well-being effects. However, biomass combustion could still have air quality impacts, which may have associated health impacts[5]. The effects are likely to be greatest for sensitive individuals and those with pre-existing lung illnesses and are likely to last for the duration of the operational phase of the facility. Potential health impacts also exist for emissions from waste combustion facilities. Emissions criteria were developed to minimise these adverse impacts. Successor emissions criteria set even more stringent emissions standards, which will further reduce these residual health impacts.

Potential for employment creation resulting from the implementation of EN-3 throughout the lifetime of biomass/waste combustion facilities was identified earlier in section 3.4. These employment opportunities created during construction and the operational phases of the facilities are considered to have positive effects on health and well-being.

Effects resulting from increased traffic, noise (operational and traffic noise) and landscape and visual effects are described under each of these topics elsewhere in this AoS. The effects are generally considered as resulting in adverse impacts on health and well-being. Potential pressures on water resources and water quality resulting from the high water demands of waste/biomass facilities could result in adverse health and well-being impacts.

There are no mitigation measures set out for this topic in EN-3.

3.13.6. Summary

It is considered that the development of biomass/waste combustion facilities developed as a result of the implementation of EN-3 are unlikely to have significant effects on health and well-being in the short, medium and long term, despite some minor local

[5] Markandya, A. and Wilkinson, P. (2007) Energy and Health 2: Electricity generation and health, The Lancet, Vol 370 September 15, 2007, pp979 – 990.

adverse effects. It is recommended that monitoring is undertaken to assess these conclusions.

3.14. Equality

AoS Objective	Technology	Assessment (by timescale)		
		S	M	L
14. Equality: To encourage equality and sustainable communities.	**Onshore wind**	0?	0?	0?
	Offshore wind	0?	0?	0?
	Biomass/ Energy from waste	0?	0?	0?

AoS -1 notes that the Energy NPSs will have the following effects on equality:

- positive effects through ensuring energy security and affordability, with benefits for all socio-economic groups, but particularly for those on low incomes and hence susceptible to fuel poverty; and
- indirect positive effects due to the enhanced economic benefits and increased employment and skills opportunities likely to be created as a result of the energy NPSs.

3.14.1. Onshore Wind

EN-3 identifies no specific effects with regard to equality. However, EN-3 may contribute to the potential within EN-1 for positive effects on equality and sustainable communities through security of supply; the provision of low carbon, affordable energy; and access to associated services, employment opportunities, transport, education and training and other potential community benefits.

There are also potential negative effects on equality from onshore wind, although these would be likely to be most significant at the local level. These could be significant at a regional level if energy clusters were to form in certain areas. An increase in inequality may result from negative effects on health and well being, particularly through increased disturbance, of those living in close proximity to the wind farm. Local residents may also experience property blight, without benefitting economically from the development. Wind farms are frequently sited in rural locations, with rural communities most likely to be affected. Lower income groups may be disproportionately affected, with limited

economic resources to move from geographically affected areas to those areas with reduced adverse impacts.

There are no mitigation measures proposed in EN-3 for impacts on equality. However, measures to reduce disturbance effects on local communities such as outlined elsewhere in EN-3 in relation to health and well-being and noise, may reduce the effects outlined above.

3.14.2. Summary

It is considered that the development of new onshore wind facilities as facilitated by EN-3 has potentially positive effects on equality and sustainable communities, particularly through access to affordable, low carbon energy. However, disturbance effects on local communities could potentially be regionally significant if generation was to become concentrated in certain areas or if particular groups, such as rural communities, were more affected than others and inequalities increased. Overall effects were considered neutral, but uncertain. Any effects experienced would be short to medium-term, throughout the lifetime of the development (typically 25 years).

3.14.3. Offshore Wind

EN-3 identifies no specific effects with regard to equality. However, EN-3 may contribute to the potential within EN-1 for positive effects on equality and sustainable communities through security of supply, access to low carbon, affordable energy and access to associated services, employment opportunities, transport, education and training and other potential community benefits.

There are also potential negative effects on equality from offshore wind. If visible from the coast, offshore wind developments have the potential to affect coastal communities through visual/seascape effects. This is considered further in section 3.9 on Landscape, Townscape and Visual in this AoS. These could be significant at a regional level if energy clusters were to form in certain areas. Lower income groups may be disproportionately affected, with limited economic resources to move from geographically affected areas to those areas with reduced negative effects.

Effects from offshore wind on marine life could disrupt certain types of fishing and have a negative economic effect on fisheries and fishing communities. However, positive effects on fish and shellfish availability have also been noted at some existing offshore wind farms, which could bring economic benefits to fishing communities. This is considered further in section 3.4 on Economy and Skills of this AoS.

There are no mitigation measures proposed in EN-3 for impacts on equality. However, measures such as changes in the type of fishing may reduce economic effects on fishing communities.

3.14.4. Summary

It is considered that the development of new offshore wind facilities as facilitated by EN-3 has potentially positive effects on equality and sustainable communities, particularly through access to affordable, low carbon energy. However, disturbance effects on local communities could potentially be regionally significant if generation was to become concentrated in certain areas or if particular groups, such as coastal or fishing communities, were more affected than others and inequalities increased. Overall effects of implementing EN-3 are, therefore, considered neutral, but uncertain. Any effects experienced would be short to medium-term, throughout the lifetime of the development (typically 25 years).

3.14.5. Biomass/Energy from Waste

EN-3 identifies no specific effects with regard to equality. However, EN-3 may contribute to the potential within EN-1 for positive effects on equality and sustainable communities through security of supply, access to low carbon, affordable energy and access to associated services, employment opportunities, transport, education and training and other potential community benefits.

Biomass/waste combustion facilities tend to be sited in industrial areas and in wards with low income. Given the scale of these developments, the likely locations are near ports (for biomass combustion facilities) and at locations with good transport routes. The negative consequences listed elsewhere (emissions, noise, traffic and visual effects) are, therefore, disproportionately in lower income communities, thereby further increasing inequalities. An additional effect could be property blight that results when a facility of this nature is sited nearby.

EN-3 does not identify specific mitigation measures in relation to this topic. However, if the mitigation measures proposed in sections 3.11 on Air Quality; 3.9 on Landscape, Townscape and Visual; 3.7 on Transport and Traffic; and 3.8 on Noise are adopted, the effects could be reduced.

3.14.6. Summary

It is considered that the development of new biomass/waste combustion facilities as facilitated by EN-3 has potentially positive effects on equality and sustainable communities, particularly through access to affordable, low carbon energy and employment opportunities. EN-3 does not identify any effects on equality resulting from development of biomass/combustion facilities. However, there are potential negative effects associated with the likely locations of these facilities and these burdens are mostly on low income areas. The effects of implementing EN-3 are considered neutral, but uncertain in the short, medium and long term.

3.15. Cumulative Effects

EN-1 notes that the renewable energy targets will primarily be met by onshore and offshore wind. It is therefore likely that a number of wind farms could be proposed in areas with good wind resources. This clustering of facilities has the potential to lead to cumulative effects during construction and operation. Potential cumulative short term effects (during construction) in relation to the development of onshore wind turbines, as facilitated by EN-3, are likely to relate to landscape and visual effects, noise, traffic and transport, ecology, economy and skills, soils and geology and health and well being. In the medium term, there is the potential for cumulative operational impacts related to landscape and visual effects, noise, ecology and health and well-being. A positive cumulative impact may result if a manufacturing industry develops as a result of numerous onshore wind developments through the implementation of EN-3. This in turn may have positive impacts on skills and the economy and health and well-being. Adverse cumulative impacts may be difficult to mitigate since the facilities need to be located where there is sufficient wind resource.

Multiple offshore wind facilities could also, potentially, result in cumulative effects. As a result of the system of obtaining concessions from the Crown Estates for offshore wind farms, there is the potential for offshore wind farms to be clustered. EN-3 identifies that there are potential cumulative effects on the subtidal and intertidal habitats and species if a number of offshore facilities are located along the same stretch of coastline. EN-3 also proposes that effects of multiple cable routes could be mitigated by cooperation between developers of these facilities. Cumulative impacts on flood defences may result in increased risk of flooding along the coast. Further cumulative impacts are likely to relate to visual and seascape effects, skills and economy (through fishing impacts), shipping and navigation, and health and well-being effects resulting from visual impacts and impacts on employment (potentially positive or negative). As for onshore wind, a positive cumulative impact may result in the medium to long term if a manufacturing industry for wind turbines develops as a result of the adoption of EN-3. The overall cumulative impacts are potentially positive and negative impacts, but are uncertain. The uncertainty arises because the number and location of potential proposals cannot be ascertained at this strategic stage.

It is possible that biomass facilities may be located in clusters near ports, since it is likely that in the short to medium term biomass fuel will need to be imported, in the absence of an established supply chain. Since these facilities would need to comply with the LCPD (and its successor the Industrial Emissions Directive) and local Air Quality limits, it is unlikely that there will be cumulative air quality emissions that would impact on human health in the medium to long term (during the operational phase). However, dust from construction activities may impact on local communities. Cumulative air emissions may also adversely impact ecology. Further cumulative impacts in the short, medium and long term (up to 35 years, depending on the design life of the facilities) may include:

- adverse noise and vibration impacts;
- adverse traffic and transport impacts, especially if residues are not transported by rail or water;
- adverse water resource and water quality impacts relating to the large water demands, especially during low flow or drought periods;
- positive impacts on skills and economy if numerous skilled employment opportunities develop to support these facilities;
- adverse impacts on visual effects;
- adverse impacts on health and well-being from the noise and vibration effects;
- positive health and well-being effects as a consequence of increased employment and possible development of supporting skills for the facilities;
- adverse effects on equality since property blight may result, with poorer communities less able to move away from the affected areas; and
- for facilities with CHP, the health and well-being impacts may be increased since these facilities would be located close to communities.

It is not considered likely that there will be clustering of waste combustion facilities. Since the facilities will be located where sufficient fuel is available or can be readily transported to the facility, these are not likely to be located in close proximity. It is anticipated that each facility would have a fuel 'catchment' area. However, in the event that facilities are clustered, the effects are considered to be similar to those outlined for biomass combustion above. Since these facilities would not necessarily be located at or near ports, the potential impact on traffic and transport from additional HGV movements would be increased, unless rail transport is used.

Cumulative effects are likely to be experienced as a result of development of any of the technologies discussed in EN-3 (onshore wind, offshore wind and biomass/energy from waste) with the related transmission lines addressed in EN-5. Adverse cumulative effects are, therefore, likely to be experienced in the short term in relation to air quality, dust, noise, landscape and visual effect, traffic and transport and noise. Visual impact of the renewable energy facilities and transmission lines are also cumulative. There are potential benefits from development of renewable energy facilities and transmission lines to these facilities. These are in relation to employment with potentially linked impacts on health and well-being and equality.

3.16. Summary of Key Findings of Appraisal

Generally, renewable energy infrastructure development would have similar effects to other types of energy infrastructure. Onshore wind facilities have a smaller footprint in land use terms than biomass or energy from waste facilities. Offshore wind will, conversely, have impacts on marine and coastal environments. For the majority of AoS objectives, the strategic effects of EN-3 were considered to be neutral for onshore and offshore wind, whilst biomass and energy from waste were associated with a greater number of negative effects.

However, through facilitating and enabling the new renewable energy infrastructure necessary to support the transition to a low carbon economy and ensure security of supply, the three technologies covered by EN-3 are considered likely to have significant positive effects on the AoS climate change objective in the medium and long term and both positive and negative effects on equality through provision of affordable energy. There are positive effects on economy and skills from EN-3's facilitation of development of onshore wind and biomass/energy from waste, and both positive and negative effects from offshore wind. Biomass/energy from waste is associated with positive and negative effects on raw materials and resources.

Effects on ecology are uncertain at this level of appraisal, as they are dependent on the sensitivity of the environment and the location and design of infrastructure, however it is noted that EN-1 and EN-3 include extensive mitigations to ensure these effects are considered by applicants and the IPC when preparing and determining applications.

Significant negative effects were identified for onshore wind for traffic and transport; noise; landscape, townscape and visual; and soil and geology. For offshore wind, negative effects are identified for landscape, townscape and visual; water quality; traffic and transport; and noise. Biomass/energy from waste is associated with negative effects under the AoS objectives of landscape, townscape and visual; flood risk; water quality; traffic and transport; and noise.

EN-3 contains a range of mitigation measures for significant effects identified.

A summary of the likely significant effects arising specifically from renewable energy infrastructure development is set out in the Tables 2.1-2.3.

Effects of the current AoS process were summarised under preceding headings, and are listed below. As a result of the AoS process:

- EN-3 was amended to take account of the water demand of waste/biomass combustion facilities in relation to climate change adaption.EN-3 has also been further to include a section on Water Resources and Water Quality using the equivalent section in EN-2 as a model;

- it was recommended that impacts on traffic and transport from biomass/energy from waste facilities be considered in EN-3, including associated mitigation measures. However, the DECC position was that this topic was adequately addressed in EN-1 and that EN-3 would not need to be revised since no further technology specific effects were identified;

- it was recommended that noise from biomass/waste combustion facilities and potential mitigation measures are included in EN-3, using the equivalent section in EN-2 as a model. EN-3 has been amended to include noise impacts of fuel preparation that are specific to biomass/waste combustion facilities;

- it was recommended that the visual impact of the chimney stack of biomass/waste combustion facilities and potential mitigation measures are again included in EN-3. These were removed from the revised EN-3 and included in a revision of EN-1. The DECC position, after consideration of the aspects of exhaust stack design in landscape and visual impacts, is that there are insufficient differences between fossil fuel generating stations, EfW and biomass stacks – since the height and appearance will be largely dictated by operational emissions requirements, which are regulated by EA. As these are common to all thermal combustion power stations, it is considered that the best place for description of this impact is EN-1;

- it was recommended that a trenching/watching brief is included for the biomass/waste combustion facilities, as for onshore wind, since the footprint of the facilities is large and text relating to this topic was included for onshore and offshore wind facilities. DECC considered these aspects and the historic environment section in EN-1 has been significantly revised; the detailed requirements for archaeology in EN-3 are generic, so this reference will be removed from EN-3 as repetitious. The archaeology section of EN-3 in respect of wind farms will be revised as it is largely a generic description applicable to other types of energy infrastructure.

Table 2.1: Summary of Key AoS Findings Specific to Renewable Energy Infrastructure - Onshore Wind

AoS Objective	Assessment of non-generic effects (by timescale)		
	S	M	L
1. Climate Change	0	++	++
2. Ecology (Flora and Fauna)	?	?	?
3. Resources and Raw Materials	0	0	0
4. Economy and Skills	+	+?	+?
5. Flood Risk & Coastal Change	0	0	0
6. Water Quality	0	0	0
7. Traffic and Transport:	-	0	0
8. Noise	-?	-?	0
9. Landscape, Townscape and Visual	-?	-?	0
10. Archaeology and Cultural Heritage	0?	0?	0?
11. Air Quality	0?	0?	0?
12. Soil and Geology	0?	0?	0?
13. Health and Well-Being	0	0	0
14. Equality	0?	0?	0?

Table 2.2: Summary of Key AoS Findings Specific to Renewable Energy Infrastructure - Offshore Wind

AoS Objective	Assessment of non-generic effects (by timescale)		
	S	M	L
1. Climate Change	0	++	++
2. Ecology (Flora and Fauna)	?	?	?
3. Resources and Raw Materials	0	0	0
4. Economy and Skills	+ -	+ -	+ -
5. Flood Risk & Coastal Change	0	0	0
6. Water Quality	-	-	-?
7. Traffic and Transport:	-	-	0
8. Noise	-?	-?	0
9. Landscape, Townscape and Visual	-?	-?	0
10. Archaeology and Cultural Heritage	0?	0?	0?
11. Air Quality	0	0	0
12. Soil and Geology	0?	0?	0?
13. Health and Well-Being	0?	0?	0?
14. Equality	0?	0?	0

Table 2.3: Summary of Key AoS Findings Specific to Renewable Energy Infrastructure - Biomass and Energy from Waste

AoS Objective	Assessment of non-generic effects (by timescale)		
	S	M	L
1. Climate Change	0	+	+
2. Ecology (Flora and Fauna)	?	?	?
3. Resources and Raw Materials	+ / - / ?	+ / - / ?	+ / - / ?
4. Economy and Skills	+	+	+
5. Flood Risk & Coastal Change	-?	-	-
6. Water Quality	-	-	-
7. Traffic and Transport	-	-	-
8. Noise	-?	-?	-?
9. Landscape, Townscape and Visual	0	-?	-?
10. Archaeology and Cultural Heritage	0?	0?	0?
11. Air Quality	0?	-?	0?
12. Soil and Geology	0?	0?	0?
13. Health and Well-Being	0	0	0
14. Equality	0?	0?	0?

4. Monitoring and Next Steps

4.1. Monitoring

Monitoring should be focussed upon likely significant effects that may give rise to irreversible damage, with a view to identifying trends before such damage is caused and likely significant effects where there was uncertainty in the AoS such that monitoring would enable preventative or mitigation measures to be undertaken.

A draft Monitoring Strategy for the Energy NPSs and AoSs will be published alongside the main consultation documents. The Government will further develop the monitoring strategy during the re-consultation period to take into account responses received on the revised draft NPSs and AoSs. The Strategy sets out the proposed indicators for monitoring together with agreed responsibilities and frequencies of monitoring during the implementation of the NPSs. This will be summarised in the Post- Adoption Statement that will be published with the designated NPSs.

Although visual effects are potentially generic for major infrastructure projects, they are a particular characteristic of onshore wind farm and consideration should be given to monitoring the cumulative effects on landscape. Monitoring is required as part of EN-3 to validate collision risk modelling results and bat mortality estimates and inform other wind farm applications. EN-3 also recommends the imposition of conditions to development consent to ensure noise levels remain within acceptable limits. In order to ensure that the condition is complied with, monitoring is required.

EN-3 suggests ecological monitoring during construction and operation to mitigate for impacts of offshore wind farms on marine life.

It is further recommended that impact of waste and biomass combustion facilities on health and well-being be monitored.

4.2. Quality Assurance Checklist

The Government's guidance on SEA contains a quality assurance checklist to help ensure that the requirements of the SEA Directive are met. This has been completed and is presented in Annex A.

4.3. Next Steps

The revised draft energy NPSs and AoS Reports will be available for re-consultation for a period of 14 weeks from 18th October 2010. The documents are available at www.energynpsconsultation.decc.gov.uk and details of how to comment are set out in the Consultation Document.

5. Annex A: Quality Assurance Checklist

The Government's Guidance on SEA[6] contains a quality assurance checklist to help ensure that the requirements of the SEA Directive are met. Those relevant to this stage have been highlighted below.

Quality Assurance Checklist	
Objectives and Context	
The plan's purpose and objectives are made clear.	**Section 1** of this AoS Report and **Section 2** of the AoS Report for EN-1.
Sustainability issues, including international and EC objectives, are considered in developing objectives and targets.	International and European objectives and targets are identified in **Annex B** and **Annex F**.
SEA objectives are clearly set out and linked to indicators and targets where appropriate.	**Section 2.4** of the AoS Report for EN-1 presents the AoS objectives and Guide Questions.
Links to other related plans, programmes and policies are identified and explained.	**Annex F** identifies a number of relevant plans and programmes.
Scoping	
The environmental consultation bodies are consulted in appropriate ways and at appropriate times on the content and scope of the Scoping Report.	The consultation on the Scoping Report ran for 5 weeks from the 13th February 2009 to 23rd March 2009. Two scoping workshops were also held during the scoping stage in March 2009 (one in Cardiff and one in London), to which all the consultation bodies were invited.
The SEA focuses on significant issues.	Significant issues were identified in the Scoping Report and were reiterated in **Annex F.**
Technical, procedural and other difficulties encountered are discussed;	These were stated throughout the **Scoping Report** where appropriate, and

[6] ODPM, Scottish Executive, Welsh Assembly Government, DoENI (2005) A Practical Guide to the Strategic Environmental Assessment Directive, ODPM, London.

assumptions and uncertainties are made explicit.	are presented in **Section 2.5** and **Section 2.6** of the AoS Report for EN-1.
Reasons are given for eliminating issues from further consideration.	These are stated in the **Scoping Report** as appropriate.
Alternatives	
Realistic alternatives are considered for key issues, and the reasons for choosing them are documented.	Alternatives were identified in **Section 3** of the AoS Report for EN-1. Technology-specific alternatives are presented in **Section 1.3** and are assessed in **Section 2.2** of this AoS Report.
Alternatives include 'do minimum' and/or 'business as usual' scenarios wherever relevant.	These were considered in **Section 3** of the AoS Report for EN-1.
The environmental effects (both adverse and beneficial) of each alternative are identified and compared.	Refer to **Section 3** in EN-1 for generic alternatives and to **Section 2.2** of this report for technology-specific alternatives.
Inconsistencies between the alternatives and other relevant plans, programmes or policies are identified and explained.	Refer to **Section 2.2** of this report, **Section 3** of the AoS for EN-1 and the review of policies, plans and programmes in **Annex F**.
Reasons are given for selection or elimination of alternatives.	These are presented in **Section 3** of the AoS for EN-1.
Baseline Information	
Relevant aspects of the current state of the environment and their likely evolution without the plan are described.	This is set out in **Annex F**.
Characteristics of areas likely to be significantly affected are described, including areas wider than the physical boundary of the plan area where it is likely to be affected by the plan where practical.	Refer to **Annex F**.
Difficulties such as deficiencies in information or methods are explained.	These are stated throughout the report where appropriate.
Prediction and Evaluation of Significant Environmental Effects	
Effects identified include the types	These are set out in **Annex F** and **Section**

listed in the Directive (biodiversity, population, human health, fauna, flora, soil, water, air, climatic factors, material assets, cultural heritage and landscape) as relevant; other likely environmental effects are also covered as appropriate.	**3** of this AoS Report.
Both positive and negative effects are considered, and the duration of effects (short, medium, or long tem) is addressed.	This is covered in the appraisal in **Section 3** of this AoS Report and in **Annex F.**
Likely secondary, cumulative and synergistic effects are identified where practicable.	Refer to **Section 3.15** of this AoS Report and **Section 4.16** of the AoS report for EN-1.
Inter-relationships between effects are considered where practicable.	Refer to **Section 3** of this AoS Report.
The prediction and evaluation of effects makes use of relevant accepted standards, regulations and thresholds.	These are considered in the appraisal in **Annex F.**
Methods used to evaluate the effects are described.	These are described in **Section 4** of the AoS Report of EN-1.
Mitigation Measures	
Measures envisaged to prevent, reduce and offset any significant adverse effects of implementing the plan or programme are indicated.	This is presented in **Section 3** of this report and **Section 4** of the AoS of EN-1.
Issues to be taken into account in project consents are identified.	These are considered in **Section 3**.
Environmental Report	
Is clear and concise in its layout and presentation.	The layout of the AoS Report is set out in **Section 1**.
Uses simple, clear language and avoids or explains technical terms.	Abbreviations are presented in **Annex A** and technical terms are explained throughout where necessary.
Uses maps and other illustrations where appropriate.	Figures and tables have been used throughout to where appropriate.

Explains the methodology used. Explains who was consulted and what methods of consultation were used.	This is presented in **Section 4** of the AoS Report of EN-1. This is covered in **Section 1.4** of the AoS Report of EN-1.
Identifies sources of information, including expert judgement and matters of opinion.	This is covered in **Section 4**, and **Annex F** of the AoS Report of EN-1.
Contains a non-technical summary covering the overall approach to the SEA, the objectives of the plan, the main options considered, and any changes to the plan resulting from the SEA.	An NTS is provided at the front of the AoS Report.
Consultation	
The SEA is consulted on as an integral part of the plan-making process.	Consultation has already taken place on the Scoping Report in February and March 2009. The AoS Report will be published alongside the draft NPS for consultation.
Consultation Bodies and the public likely to be affected by, or having an interest in, the plan or programme are consulted in ways and at times which give them an early and effective opportunity within appropriate timeframes to express their opinions on the draft plan and Environmental Report.	Stakeholders have been kept engaged throughout the report's preparation and comments have been sought during designated consultation periods and workshops.
Decision-making and Information on the Decision	
The AoS Report (Environmental Report) and the opinions of those consulted are taken into account in finalising and adopting the plan or programme.	This will be included in the Post Adoption Statement (to be issued following consultation).
An explanation is given of how they have been taken into account.	This will be included in the Post Adoption Statement (to be issued following consultation).
Reasons are given for choosing the plan or programme as adopted, in the	This will be included in the Post Adoption Statement (to be issued following

light of other reasonable alternatives considered.	consultation).
Monitoring Measures	
Measures proposed for monitoring are clear, practicable and linked to the indicators and objectives used in the SEA.	These are presented in **Section 5** of the AoS Report of EN-1 and in **Section 3.1**.
Monitoring is used, where appropriate, during implementation of the plan or programme to make good deficiencies in baseline information in the SEA.	These are presented in **Section 5** of the AoS Report of EN-1 and in **Section 3.1**.
Monitoring enables unforeseen adverse effects to be identified at an early stage (these effects may include predictions which prove to be incorrect).	These are presented in **Section 5** of the AoS Report of EN-1 and in **Section 3.1**.
Proposals are made for action in response to significant adverse effects.	This will be set out in the Post Adoption Statement (to be published following consultation).

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Department of Energy and Climate Change
3 Whitehall Place
London
SW1A 2AW
www.decc.gov.uk