National Policy Statements for Energy

Appraisal of Sustainability - Main Report

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Non-Technical Summary

Introduction

Under the Planning Act 2008, there is a requirement for the development of certain types and size of energy infrastructure to be considered under a particular planning process known as a Development Consent Order.

The types of energy infrastructure include electricity generating stations, both onshore and offshore, large gas reception and liquified natural gas facilities, underground gas storage facilities, cross-country gas and oil pipelines and gas transporter pipelines, as well as above ground electricity transmission lines. When above the required size thresholds, these energy infrastructure developments are considered to be Nationally Significant Infrastructure Projects.

National Policy Statements form the basis for all examination of and decision making on applications for development of these Nationally Significant energy Infrastructure Projects.

A series of National Policy Statements (NPS) were previously developed in respect of energy infrastructure as follows:

- Overarching NPS for Energy (EN-1);
- NPS for Fossil Fuel Electricity Generating Infrastructure (EN-2);
- NPS for Renewable Energy Infrastructure (EN-3);
- NPS for Gas Supply Infrastructure and Gas and Oil Pipelines (EN-4);
- NPS for Electricity Networks Infrastructure (EN-5); and
- NPS for Nuclear Power Generation (EN-6).

In 2021, the Department for Business, Energy and Industrial Strategy is revising the above NPSs, except EN-6 as the decision has been taken not to update that NPS at present. EN-6 currently sets out the planning and consents regime for nuclear projects deployable before 2025 and a new NPS for nuclear electrical generation deployable after 2025 will be developed.

It is the purpose of the Overarching NPS for Energy (EN-1) to set the policy context for the development of nationally significant energy infrastructure, show the need for new energy infrastructure, highlight relevant issues and demonstrate how consideration should be given to various kinds of environmental and other impacts which all types (or at least more than one type) of energy infrastructure have (such as noise, or landscape and visual impacts). EN-1 also sets out the circumstances in which it is appropriate for actions to be taken to mitigate the impact of development of this energy infrastructure.

The “technology-specific NPSs” (EN-2 to EN-5) focus on additional impacts related to the specific technologies with which they are concerned and should be considered alongside EN-1.

As part of the process of updating the NPS, it is important to understand what the effect on sustainability could be due to the implementation of any energy infrastructure development that could be examined by the NPS. The process of understanding these effects is known as an Appraisal of Sustainability (AoS).

Appraisal of Sustainability

The key purpose of the AoS is to ensure that before a plan which establishes the framework for development consent is adopted (the NPS in this instance), it should be subject to consultation alongside a sustainability report which identifies, describes and evaluates the significant effects which its implementation is likely to have on the sustainability aspects such as the environment the economy and society. It is hoped that this process means that the NPS has been informed by the principles of sustainable development (most commonly summarised as ensuring that development meets the needs of the present without compromising the ability of future generations to meet their own needs).

AoS is an iterative process which means that as the NPS is being reviewed and updated, it is examined by sustainability professionals, who provide input to help ensure that the full range of sustainability issues are considered and addressed as appropriate.

This AoS report sets out the process that was undertaken and ultimately the consideration of what implementation of the NPS will mean in sustainability terms.

Developing the Appraisal of Sustainability

The legislation which requires AoS to be undertaken is based on a process known as Strategic Environmental Assessment (SEA). This legislation sets out a list of topics to be examined and includes biodiversity, population, human health, fauna, flora, soil, water, air, climatic factors, material assets, cultural heritage including architectural and archaeological heritage, landscape and also requires consideration of how these interact. As SEA is largely concerned with environmental matters, AoS looks at these issues, but also examines the economy as well as further issues relating to people and society.

In order to fully understand how the energy NPSs will interact with the AoS issues, it is necessary to consider the geographical area in which the NPSs will apply, as well as the timeframe over which it will apply. In this instance, the NPSs will apply to England and Wales, though in some instances it will also apply to Scotland. The NPSs do not apply to Northern Ireland. In terms of timeframe, the NPS is ‘open ended’ and will remain in force until such time as a further review is considered to be appropriate.

Having considered the geography of the area, the environmental and sustainability issues within this area, as well as reviewing relevant plans and policies across a wide range of topics, it is possible to devise a framework containing a series of fifteen sustainability Objectives against which the Overarching NPS (EN-1), the technology NPS (EN-2 to EN-5) and their alternatives have been appraised. The identified Objectives used within this AoS are as follows:

No. 1: Consistent with the national target of reducing carbon emissions to Net Zero by 2050

No. 2: Maximise adaptation and resilience to climate change

No. 3: Enhance biodiversity, promoting net gain, and supporting ecosystem resilience and functionality

No. 4: Protect and enhance sites designated for their international importance for nature conservation purposes

No. 5: Protect and enhance cultural heritage assets and their settings, and the wider historic environment

No. 6: Protect and enhance the character and quality of the landscapes and townscapes, protect and enhance visual amenity

No. 7: Protect and enhance the water environment

No. 8: Protect and enhance air quality

No. 9: Protect soil resources and avoid land contamination

No. 10: Protect, enhance and promote geodiversity

No. 11: Improve health and well-being and safety for all citizens and reduce inequalities in health

No. 12: Promote sustainable transport and minimise detrimental impacts on strategic transport network and disruption to basic services and infrastructure

No. 13: Promote a strong economy with opportunities for local communities

No. 14: Promote sustainable use of resources and natural assets

Findings of the Appraisal of Sustainability

The following sets out some key findings from the AoS for EN-1.

- The energy NPSs will be transformational in enabling England and Wales to transition to a low carbon economy and thus help to realise UK climate change commitments sooner than continuation under the current planning system. However, there is also some uncertainty as it is difficult to predict the mix of technology that will be delivered by the market against the framework set by the Government.
- It is important to recognise that EN-1 will still generate residual carbon emissions which will need to be addressed if the Government target of Net Zero by 2050 is to be met. It should also be recognised that some climate change is inevitable and as such, there is a need for energy infrastructure to be resilient to climate change – the NPS sets out a clear and robust approach for ensuring this is done.
- The energy NPSs are likely to contribute positively towards improving the vitality and competitiveness of the UK energy market by providing greater clarity for developers. This should improve the UK's security of supply and, less directly through increased economic opportunities for local communities, have positive effects for health and well-being in the medium to longer term through helping to secure affordable supplies of energy and minimising fuel poverty. However, it is to be recognised that in health terms there is the potential for effects to be distributed disproportionally, with vulnerable groups potentially particularly susceptible to effects. However, the NPS sets out a clear approach for dealing with such issues.
- The development of new energy infrastructure, at the scale and speed required to meet the current and future need, is likely to have some minor negative effects on cultural heritage, the water environment, air quality, soils and potentially geodiversity. This is an inevitable reflection of the nature of this largescale infrastructure, the 'footprint', material and resource requirements as well as the construction activities involved to develop these assets. However, the significance of these effects and the effectiveness of mitigation possibilities is largely uncertain at the strategic and non-locationally specific level at which EN-1 to EN-5 are pitched.
- Short-term construction impacts are likely through an increased use of raw materials and resources and negative effects on the economy due to impacts on existing land and sea uses. In general, it should be possible to mitigate satisfactorily the most

significant potential negative effects of new energy infrastructure consented in accordance with the energy NPSs, and they explain ways in which this can be done.

- Due to the nature and size of potential schemes (as well as likely potential locations in areas such as coastal areas), opportunities for landscape mitigation will be limited and while EN-1 sets out a robust approach to addressing impacts on landscape, townscape and seascape across the short, medium and long timeframes, significant adverse effects are likely to remain.
- There is potential from construction and operation activities for significant negative effects on biodiversity as a result of EN-1 implementation in the short, medium and long term. However, due to the possibility of enhancement of the natural environment and biodiversity net gains, there is also potential for minor positive effects in the medium to long term.
- The AoS process has provided a series of recommendations which update the approaches outlined in the NPS to ensure that the NPS remains in line with current considerations of sustainability. These recommendations have been addressed where appropriate and incorporated to the NPS.

There may also be cumulative negative effects on biodiversity, landscape, water and air quality, water resources, flood risk, coastal change and health at the regional or sub-regional levels depending upon location and the extent of clustering of new energy and other infrastructure. Proposed energy developments will still be subject to project level assessments, including Environmental Impact Assessment, and this will address locationally specific effects. The energy NPSs set out mitigation for cumulative negative effects by requiring the Secretary of State to consider accumulation of effects as a whole in their decision-making on individual applications for development consent.

In relation to EN-2, key AoS findings are:

- Natural gas generating infrastructure development has similar effects to other types of energy infrastructure, resulting from impacts associated with large facilities at single sites; as well as those associated with linear features linked with potential development of CCS infrastructure. Therefore, for the majority AoS objectives, the strategic effects of EN-2 are considered to match those identified in AoS-1.
- However, associated with additional detail provided about the Technologies in EN-2, non-generic effects were considered for four AoS objectives (Carbon Emissions, Biodiversity, Water Environment and Air Quality). The non-generic effects have been found to be negative across short, medium and long terms for all four AoS Objectives linked to construction and operation activities of natural gas generating infrastructure.
- Consistency with the national target of reducing carbon emissions to net zero by 2050 is also considered negative in the long term, reflecting the residual emissions from unabated natural gas plants, unless balanced by negative emissions.
- In the long term, following decommissioning, as discharges and emissions to the air and water would cease, the effect would be neutral for Water Environment and Air Quality.
- It is important to note there is uncertainty over actual effects as this would be dependent upon location and sensitivity of the receiving environment

EN-1 (informed by AoS-1) includes extensive mitigations to ensure these effects are considered by applicants and the Planning Inspectorate when preparing and determining applications. EN-2 (informed by AoS-2) contains a range of technology specific mitigation measures, along with those proposed in EN-1, which seek to address the range of negative effects identified.

Key points from the AoS for EN-3 (AoS-3) are:

- Renewable energy infrastructure development has similar effects to other types of energy infrastructure. Solar, biomass or energy from waste facilities will occupy land and as such potentially result in a whole range of terrestrial impacts. Offshore wind will, conversely, have impacts on marine and coastal environments.
- For the majority AoS objectives, the strategic effects of EN-3 are considered to match those identified in AoS-1.
- However, associated with additional detail provided about the Technologies in EN-3, non-generic effects were considered for eight AoS objectives (Carbon Emissions, Biodiversity, Water Environment, Landscape / Seascape, Air Quality, Health, Economy and Resources). The non-generic effects have been found to be generally negative across short, medium and long terms, though there are some elements of positivity in respect of the need to promote sustainable use of resources and natural assets.
- Consistency with the national target of reducing carbon emissions to Net Zero by 2050 is considered significantly negative over the short, medium and long terms reflecting residual emissions from unabated waste combustion plants, in particular if negative emissions technologies are not used.
- Significant effects from renewable technologies can potentially affect biodiversity, landscape/ seascape, noise, commercial fishing, and commercial navigation routes. However, the effects are uncertain at this level of appraisal, as the actual effects are dependent on the sensitivity of the environment and the location and design of infrastructure.
- There are, however, a few positive specific effects associated with the technologies. Positive effects may occur on the fishing industry from offshore wind farms; on biodiversity from solar farms, where land is no longer managed intensively; on biodiversity from pumped hydro storage schemes, as a result of habitat creation and fish re-stocking; and on resources where residues from biomass or energy from plants can be recovered and re-used rather than being sent to landfill.
- Uncertainty is associated with this assessment, as at this level of appraisal, actual effects are dependent on the sensitivity of the environment and the location and design of infrastructure.
- EN-1 (informed by AoS-1) includes extensive mitigations to ensure these effects are considered by applicants and the Planning Inspectorate when preparing and determining applications. EN-3 (informed by AoS-3) contains a range of technology specific mitigation measures, along with those proposed in EN-1, which seek to address the range of negative effects identified.

Key points from the AoS for EN-4 (AoS-4) are:

- Generally, the development of oil and gas supply infrastructure and gas and oil pipelines has similar effects to other types of energy infrastructure, although due to the linear nature of cross-country, long distance pipelines, effects are often more dispersed and spread across a wider area. For the majority of the AoS objectives, the strategic effects of EN-4 are considered to match those identified in AoS-1 as above.
- However, associated with additional detail provided about the technologies in EN-4, non-generic effects were further considered for six AoS objectives (Carbon Emissions, Biodiversity, Water Environment, Landscape and Townscape, Soil and Air Quality). The non-generic effects have been found to be generally negative across short, medium and long terms.
- With regards to carbon emissions minor negative effects are predicted in the short, medium and long term reflecting the residual emissions from underground natural gas storage and natural gas facilities. Biodiversity non-generic negative effects due to disposal of brine from Underground Gas Storage, dredging from LNG Import Facilities and construction of Gas and Oil Pipelines. Large scale structures for LNG Import Facilities may give rise to non-generic negative impacts on Landscape/Townscape. Dredging and disposal of spoils for LNG Import Facilities in coastal and estuarine locations may negatively affect water quality in such locations and Oil and Gas Pipeline construction may negatively affect watercourses, aquifers etc. Air quality may be negatively affected by venting of gas from Gas Reception Facilities and sterilisation of mineral resources or soil pollution may occur as a result of Gas Pipelines construction and operation.
- However, the effects are uncertain at this level of appraisal, as the actual effects are dependent on the sensitivity of the environment and the location and design of infrastructure.
- EN-1 (informed by AoS-1) includes extensive mitigations to ensure these effects are considered by applicants and the Planning Inspectorate when preparing and examining applications. EN-4 (informed by AoS-4) contains a range of technology specific mitigation measures, along with those proposed in EN-1, which seek to address the range of negative effects identified. Nevertheless, it is considered that residual negative, but uncertain, effects will remain in most cases for the six AoS objectives considered.

Key points from the AoS for EN-5 are:

- Electricity networks infrastructure development has similar effects to other types of energy infrastructure, although due to the linear nature of cross-country, long electricity lines, effects are often more dispersed and spread across a wider area. Therefore, for the majority of AoS objectives, the strategic effects of EN-5 are considered to match those identified in AoS-1.
- However, associated with additional detail provided about the Technologies in EN-5, non-generic effects were considered for four AoS objectives (Carbon Emissions, Biodiversity, Landscape and Townscape, as well as Health and Wellbeing). The non-generic effects have been found to be generally negative across short, medium and long terms for all four AoS Objectives.
- In relation to the Net Zero by 2050 national target, technology specific effects were considered to be negative across the short medium and long term, due to the potentially unavoidable use of SF6 in switchgear.

- Significant and ongoing negative effects across the short, medium and long term are expected in terms of landscape and townscape / visual amenity dur to overhead lines.
- Regarding health and well-being, negative technology specific effects expected to arise across short, medium of long term, due to potential EMF exposure.
- Uncertainty is associated with this assessment, as at this level of appraisal, actual effects are dependent on the sensitivity of the environment and the location and design of infrastructure.
- EN-1 (informed by AoS-1) includes extensive mitigations to ensure these effects are considered by applicants and the Planning Inspectorate when preparing and determining applications. EN-5 (informed by AoS-5) contains a range of technology specific mitigation measures, along with those proposed in EN-1, which seek to address the range of negative effects identified.

Examination of Alternatives to the NPSs

As required by the SEA Regulations, an assessment of reasonable alternatives has also been carried out in respect of EN-1 to EN-5. The analysis of reasonable alternatives provides a strategic context for the detailed assessment of the likely significant effects of EN-1, as well as a means of evaluating it by comparing it 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.

It is important to maintain the appraisal at the appropriate level of plan making and AoS. For this reason, the strategic alternatives for implementing the aims of the NPS were assessed at a higher level by using six sustainable development themes, identified through bringing together the AoS objectives into topics that better reflected the strategic characteristics of the options. The sustainable development themes identified were:

- Climate Change
- Security of Energy Supply
- Health and Well-being
- The Economy
- The Built Environment
- The Natural Environment

Consideration of Alternatives to EN-1

EN-1 combines a range of infrastructure types and these are set out in Chapter 3 of the NPS. In summary, these include: Renewables (including Biomass and Energy from Waste with or without CCS), Natural Gas-fired electricity generation with or without CCS, Hydrogen-fired electricity generation, Pumped Hydro Storage, Nuclear, associated electricity network infrastructure, and natural gas, oil, hydrogen and CCS infrastructure.

The Alternatives which were assessed against EN-1 were:

Alternative 1 (A1) As EN-1 without Nuclear and Unabated Natural Gas.

Alternative 2 (A2) As EN-1 without Unabated Natural Gas.

Alternative 3 (A3) As EN-1 without Nuclear.

Alternative 4 (A4) As EN-1 but with an even stricter protection of the marine environment.

In comparison with EN-1, the alternatives are assessed as being beneficial in respect of climate change for Alternative 1 and 2, but negative for Alternative 3 and 4. All Alternatives are considered negative in terms of Security of Supply due to the reduction in generation options. In terms of Health and Wellbeing and Economy, no differences have been identified between any of the Alternatives and EN-1. In respect of the other sustainability development themes of the Built and Natural Environment there is a more mixed picture of having adverse effects under some Alternatives and beneficial effects under others. The key differences between the different alternatives and the plan (EN-1) are highlighted below.

Alternative A1 As EN-1 without Nuclear and Unabated Natural Gas would:

- be materially beneficial for the achievement of Net Zero due to no emissions from unabated gas, although reliant on smaller group of low carbon technologies for delivery;
- be materially adverse on security of supply as reliant on technologies still under development such as Hydrogen and Energy Storage at scale to ensure peak supply and maintain the stability and security of the electricity system;
- have no differential effects on the economy or human health (compared to EN-1) because of providing for a range of low energy sources to meet future energy needs, as well as economic stimulus and improved employment opportunities, though note some negative effects may arise due to disruption to existing industries / communities; and
- have a mix of beneficial and adverse effects on the built and natural environment due to positive environment effects through for example mitigation of climate change, and negative due to larger areas of land and sea required for renewables and natural gas with CCUS to meet the same energy output as EN-1

Alternative A2 As EN-1 without Unabated Natural Gas would:

- be materially beneficial for the achievement Net Zero due to no emissions from unabated gas;
- have adverse effects on Security of Supply, as although it would be less reliant (than alternative A1) on yet to be fully proven technologies, such as Hydrogen and Energy Storage at scale, there would still be a need for them to ensure peak supply and maintain the stability and security of the electricity system;
- be neutral (compared to EN-1) in relation to benefits to the Health and Well-being and Economy SD themes by providing for a range of low energy sources to meet future energy needs, as well as economic stimulus and improved employment opportunities though there may also be economic and community costs at the local scale; and
- have a negative effect for the Built and Natural Environment as greater use of Natural Gas with CCS (compared to EN-1) may require more land take due to the associated need for CCS infrastructure.

Alternative A3 As EN-1 without Nuclear would:

- have adverse effects on the achievement of Net Zero due to greater ongoing emissions from unabated gas;
- have adverse effects on Security of Supply as reliant on a smaller range of electricity generating technologies;
- be neutral in terms of Health and Well-being and the Economy by providing for a range of low energy sources to meet future energy needs, as well as economic stimulus and improved employment opportunities though there may also be economic and community costs at the local scale;
- have adverse effects for the Built Environment due to additional land take by wind and solar Renewables and location near to coasts, estuaries or rivers by Natural Gas with or without CCS, affecting flood risk; and
- have adverse effects for the Natural Environment as emphasis on Renewables and Natural Gas with CCS would require larger areas to meet the same energy output as EN-1.

Alternative A4 is the same as EN-1, but with even stricter protection of the marine environment would (compared to EN-1):

- be materially adverse for the achievement of Net Zero as reliant on a smaller range of low carbon technologies compared to EN-1;
- have adverse effects on Security of Supply as reliant on a smaller range of electricity generating technologies;
- be neutral on Health and Well-being and the Economy due to providing for a range of low energy sources to meet future energy needs, as well as economic stimulus and improved employment opportunities though there may also be economic and community costs at the local scale; and
- be adverse on the Built Environment and aspects of the Natural Environment due to increased pressure on land for energy generation. However, the natural environment could benefit in marine areas due to less disturbance.

None of these alternatives are as good as, or better than, the proposals set out in EN-1 and therefore the government's preferred option is to take forward the Energy NPS EN-1 (and the technology-specific NPSs EN-2 to EN-5).

Consideration of Alternatives to EN-2

In respect of EN-2, the alternatives assessed against EN-2 were: (a) only consent low carbon gas plant (i.e. natural gas with CCS or hydrogen fired; or (b) only consent natural gas generation plants which can demonstrate that they are capable of converting to low carbon alternatives in future.

The key differences between alternative (a) and EN-2 are:

- materially beneficial for the achievement of Net Zero due to no emissions from unabated gas; and
- materially adverse on Security of Supply as reliant on technologies still under development such as Hydrogen and Energy Storage at scale to ensure peak supply and maintain the stability and security of the electricity system.

The key differences between alternative (b) and EN-2 are:

- beneficial for the achievement of Net Zero due by ensuring that no new unabated gas plant is ‘locked-in’ without the capability to convert to low carbon alternatives when ready; and
- adverse on Security of Supply, as although it would be less likely to be reliant (than alternative (a)) on yet to be fully proven technologies such as Hydrogen and Energy Storage at scale, there may still be a need for them to ensure peak supply and maintain the stability and security of the electricity system.

It is recognised that alternative (b) could present a more sustainable alternative than the policies set out in EN-1 and EN-2, if implemented in a way which minimises the potential impact on security of supply. As set out in the Energy White Paper, published in December 2020, the government is committed to consult on proposals to update the Carbon Capture Readiness requirements to reflect technological advances, such as conversion to low carbon hydrogen and apply them more broadly, by removing the 300MW threshold and including all combustion technologies within scope. If that consultation leads to changes in the relevant legal or policy framework then those new requirements will apply and this NPS will be updated to reflect any revised requirements ahead of designation.

Consideration of Alternatives to EN-3

The alternative assessed against EN-3 was: only consent biomass/ waste combustion plant with Combined Capture and Storage (CCS).

The key difference between this alternative and EN-3 would seem to be a beneficial for the achievement of net zero due to reduction of emissions from energy from waste and negative emissions through BECCS. This assessment is highly uncertain and would depend on what happens to the waste if not used within the power sector (as energy recovery from residual waste has a lower greenhouse gas impact than landfill) and the extent to which biomass may be more cost effective in decarbonising other sectors (such as heat and transport) over the long-term.

However, the use of carbon capture and storage with biomass and energy from waste could present a more sustainable alternative than the policies set out in EN-1 and EN-3, if implemented in a way which minimises unintended consequences. As set out in the Energy White Paper, published in December 2020, the government is committed to consult on proposals to update the Carbon Capture Readiness requirements to reflect technological advances, such as conversion to low carbon hydrogen and apply them more broadly, by removing the 300MW threshold and including all combustion technologies within scope. If that consultation leads to changes in the relevant legal or policy framework then those new requirements will apply and this NPS will be updated to reflect any revised requirements ahead of designation.

Consideration of Alternatives to EN-4

The alternative assessed against EN-4 was: only consent new gas infrastructure (gas pipelines and underground gas storage) which can demonstrate that it can convert to a low carbon alternative in future.

The key differences between this alternative and EN-4 are that EN-4 is more likely to give confidence to developers to come forward with planning applications which if approved will contribute to security of supply and affordability, whereas the alternative may compromise security of supply and affordability and lead to adverse economic effects. Accordingly, the policies set out in the revised draft EN-4 are preferred.

Consideration of Alternatives to EN-5

In respect of EN-5, one alternative was identified and assessed: adopt a blanket presumption that all electricity lines should be put underground.

The key differences between this alternative and EN-5 are:

- adverse for the achievement of Net Zero due to the additional emissions associated with energy intensive tunnelling technologies; and
- adverse for the Security of Energy Supply and the Economy due to higher costs and increased disruption for maintenance and repair.

Although undergrounding for all electricity lines will have significant positive effects for landscape receptors in the medium to long term by removing long term visual impacts associated with overhead lines the short-term effects from undergrounding on the landscape may be more significant due to the larger construction footprint and disruption of soil.

Given that underground lines are not without a range of adverse impacts of their own, and that they are significantly more expensive, it is considered better to adopt the policies set out in EN-1 and EN-5. This is because the range of factors to be taken into account means that any decision to underground is best taken within a more flexible policy framework that follows a case by case evaluation of all of the impacts of a particular project and supports the use of both undergrounding and overhead lines as appropriate, in line with the appraisal findings.

Cumulative and Transboundary Effects

Cumulative Effects

It is a requirement as part of the AoS to consider cumulative effects of implementation of the energy NPSs. These are effects where several proposals or elements of the NPSs, individually may or may not have significant effect but when brought together in a location or within the same timeframe, have a significant effect.

A key element to the NPSs is the recognition of the need to reduce carbon emissions in order to help combat climate change. As such, there is a key focus within the NPSs for low or net zero carbon energy generation and transmission. In addition to reducing emissions at source, the NPSs provide for new technologies that will remove carbon emissions and store these (Carbon Capture and Storage). However, given the likely costs associated with the development of such infrastructure and the offshore location for the storage of the captured CO2, there is likely to be a clustering of installations around strategically important locations. This effect can have beneficial or negative effects, on the environment, as well as local communities and the NPS recognises this.

Technological drivers are a key consideration in respect of the potential for cumulative effects and the NPSs do place careful emphasis on the need to analyse all such aspects, as well as ensuring that decision makers balance all competing issues as they arise.

The NPS also places a strong emphasis on the need for further consideration of all issues and effects (including cumulative effects) through applicable assessment types such as EIA, or through socio-economic assessment.

The NPSs also ensure consideration needs to be made of cumulative effects across the full timescale of the energy infrastructure, through to decommissioning and beyond. It is to be recognised that this could be many decades in respect of some technologies.

In short therefore, while the lack of clarity relating to location of infrastructure means it is not possible to be precise as to cumulative, synergistic and indirect effects, it is possible to

conclude that the significance and nature of cumulative effects may vary with the mix of technology projects proposed and the sensitivity of the receiving communities and environment. The NPSs set out a series of approaches that will address and manage these issues.

Cumulative effects can also arise due to effects from the NPSs combining with effects from other plans and policies. However, due to the strategic and high level nature of the NPSs and the lack of any specific detail on any infrastructure developments that are likely to arise due to implementation of the NPSs (including where infrastructure would be located), as well as that inevitably there is going to be a delay between the adoption of the NPSs and any subsequent energy infrastructure development, it is not possible to predict what other plans and policies will be relevant to future project assessments.

Transboundary Effects

The AoS identified that there is a potential for significant Transboundary effects of implementation of the NPS on other countries, particularly through the development of Offshore wind farms. Where the potential for significant effects is identified, the SEA Regulations require that notification is made to those countries within the European Union, where it is considered likely to have significant effect on the environment. Therefore, it is considered that Ireland, France, Belgium, Germany, Denmark, Sweden and the Netherlands should be informed of the potential for significant environmental effect from implementation of the NPS. For the same reason there would also be potential effects on Norway and the Crown Dependencies of the Isle of Man and the Channel Islands.

It is also the case that the transboundary effects (if any) of individual proposals for both new nuclear and offshore wind farms will be considered at project-level as part of the development consent process. Legislation relating to Environmental Impact Assessment sets out that countries within the European Economic Area (EEA) must be notified as part of the procedural duties necessary where the Secretary of State (SoS) is of the view that a Nationally Significant Infrastructure Project (NSIP) is likely to have significant effects on the environment in an EEA State. As such, identification of the relevant State will be made in light of the technology being developed and the location within which the development is to take place.

Monitoring

Monitoring helps to examine the effects predicted through the AoS process against the actual effects of the NPSs when they are implemented. The AoS therefore sets out a range of measures against which the NPS can be monitored. This monitoring will be undertaken by BEIS and a range of partner bodies.

1: Introduction

This document is the Appraisal of Sustainability (AoS) report for the revised draft energy National Policy Statements (NPS) published for consultation by the Secretary of State for Business, Energy and Industrial Strategy as follows:

- EN-1: Overarching National Policy Statement for Energy
- EN-2: National Policy Statement for Natural Gas Generating Infrastructure
- EN-3: National Policy Statement for Renewable Electricity Generation
- EN-4: National Policy Statement for Gas Supply Infrastructure and Gas and Oil Pipelines
- EN-5: National Policy Statement for Electricity Networks Infrastructure

The National Policy Statement for Nuclear Power Generation (EN-6) is not being updated. EN-6 currently sets out the planning and consents regime for nuclear projects deployable before 2025 and a new NPS for nuclear electrical generation deployable after 2025 will be developed.

The suite of Energy National Policy Statements was first designated in 2011. In the 2020 Energy White Paper a review of the NPSs was announced under section 6 of the Planning Act and has resulted in the reviewed and updated NPSs that are appraised in this report.

The main function of this report is to set out the likely significant effects on the environment of developing new energy infrastructure of the types envisaged by the reviewed and updated energy NPSs as a whole and for each technology, as well as indicating how the NPSs are consistent with the principles of sustainable development more generally.

The AoS report is designed to inform consultation on the revised and updated drafts of the five NPSs with which it is being published.

This AoS report has been developed by Atkins Limited, with the support of Land Use Consultants (LUC), between March and June 2021 and provides an AoS of the Overarching NPS for Energy (henceforth AoS-1) as well as an AoS of the four technology NPSs (henceforth AoS-2, AoS-3, AoS-4 and AoS-5) and their contribution towards achieving a range of environmental, social and economic objectives. The approach adopted in the AoS is consistent with the requirements of SEA and has been expanded to include a wider range of issues, such as socio-economic issues, normally found within an AoS.

Sections 2-4 of this report include a description of the methodology, baseline and issues which are common across all of the AoSs. The technology-specific AoSs (AoS-2 to AoS-5) focus on alternatives and issues which are additional to those already covered in the assessment of EN-1 set out in AoS-1. It is important to note that EN-1 to EN-5 are not site-specific and provide a framework for assessing applications for developments of the relevant type in any location.

This AoS report should be read in conjunction with the relevant National Policy Statements, and in particular the Overarching NPS for Energy (EN-1), which sets out the background on the planning regime and government policy on energy and energy infrastructure. AoS-1 in Section 5 must also be read in conjunction with the AoSs for the relevant technology-specific NPSs which are set out in Section 6 to 9 of this report, and vice versa.

Habitats Regulations Assessment (HRA) has been undertaken in parallel to the AoS and its results incorporated into the AoS as appropriate, though it has been reported separately to this AoS report, in order to meet the requirements of the Habitats Regulations.

1.1: Purpose of this AoS report

This AoS report has two primary functions:

- The Environmental Assessment of Plans and Programmes Regulations 2004 (as amended), known as the Strategic Environmental Assessment (SEA) Regulations (and which are derived from the Strategic Environmental Assessment Directive - 2001/42/EC), require that before a plan or programme which establishes the framework for development consent is adopted, it should be subject to consultation alongside an environmental report which identifies, describes and evaluates the significant effects which its implementation is likely to have on the environment. Amongst other things, the NPSs are a plan or programme for the purposes of the Regulations, and so this AoS report fulfils the function of an environmental report under the Regulations.
- The Planning Act requires that NPSs must be the subject of an AoS before they are designated. The scope of such an appraisal is similar to that of an environmental report under the SEA Regulations, but with more emphasis on social and economic impacts, and informed overall with the principles of sustainable development (often summarised as ensuring that development meets the needs of the present without compromising the ability of future generations to meet their own needs).

By requiring the AoS to be produced alongside the NPSs while they are still in draft form, the SEA Regulations and Planning Act aim to ensure that consultees are able to review and comment on the NPSs with a sense of what it would mean in environmental and wider sustainability terms for a new generation of large-scale energy infrastructure to be built in accordance with decisions made on Planning Act applications for development consent which will be decided on the basis of the energy NPSs.

1.1.1 Report Structure

The remainder of this report is structured as follows:

Section 2: Overview of AoS process: This section covers the approach taken to the appraisal process, including description of the methodology that has been applied.

Section 3: Scope of the AoS: covers geographical and temporal scope of the AoS and how this document fulfils the requirements of the SEA Regulations.

Section 4: Policy context, baseline, issues and framework: presents the scoping information that supports the AoS.

Section 5: Assessment for Overarching NPS for Energy (EN-1): presents the findings of the AoS of EN-1, including possibilities for mitigation and cumulative effects. This section also includes an assessment of NPS Alternatives for EN-1 and identifies and assesses strategic alternatives to Overarching NPS for Energy (EN-1); it also provides a comparison of the significant sustainability effects of the strategic alternatives and why the draft NPS is the preferred option.

Section 6: Assessment for Natural Gas Generation Infrastructure (EN-2): presents the findings of the AoS of EN-2 including possibilities for mitigation and cumulative effects. This section also includes an assessment of alternatives for EN-2.

Section 7: Assessment for Renewable Energy Infrastructure (EN-3): presents the findings of the AoS of EN-3 including possibilities for mitigation and cumulative effects. This section also includes an assessment of alternatives for EN-3.

Section 8: Assessment for Gas Supply Infrastructure and Gas and Oil Pipelines (EN-4): presents the findings of the AoS of EN-4 including possibilities for mitigation and cumulative effects. This section also includes an assessment of alternatives for EN-4.

Section 9: Assessment for Electricity Networks Infrastructure (EN-5): presents the findings of the AoS of EN-5 including possibilities for mitigation and cumulative effects. This section also includes an assessment of alternatives for EN-5.

Section 10: Appraisal of Sustainability – Summary for EN-1 to EN-5

Section 11: Cumulative Effects: presents an overview of anticipated cumulative, synergistic and indirect effects, as well as consideration of cumulative effects in-combination with other plans and policies

Section 12: Monitoring: This section sets out monitoring proposals for the implementation of the NPSs.

The Appendices to this report are published separately and are as follows:

- Appendix A - Glossary & List of Abbreviations
- Appendix B - Response to Scoping Consultation
- Appendix C - Review of Policies, Plans and Programmes
- Appendix D - Baseline Data and contextual information
- Appendix E - Recommendations made through the AoS process
- Appendix F - Baseline Maps (provided in a separate Volume)

2: Overview of AoS process

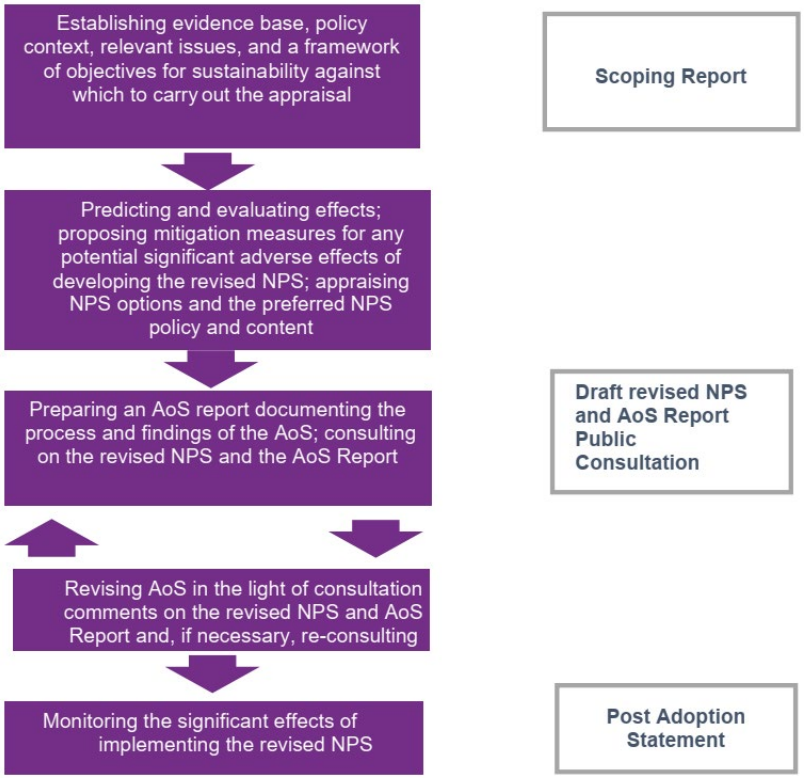
2.1: Assessment Methodology

The AoS process and methods that have been applied are broadly based on a number of published guidance documents (note that there is no specific guidance on preparing an AoS):

- Sustainability Appraisal (SA) of Regional Spatial Strategies and Local Development Documents - Guidance for Regional Planning Bodies and Local Planning Authorities, by the ODPM, the Scottish Executive, the Welsh Assembly Government and the Northern Ireland Department of the Environment November 2005;
- A Practical Guide to the Strategic Environmental Assessment Directive, by the ODPM, the Scottish Executive, the Welsh Assembly Government and the Northern Ireland Department of the Environment, September 2005; and
- Revised National Planning Policy Framework, 2019 and associated Planning Practice Guidance, July 2018.

It is to be noted that the processes of SEA and Habitats Regulation Assessment (HRA) are based on European Union (EU) Directives. While the United Kingdom has left the EU, the relevant SEA and HRA Regulations implementing these processes still apply as of July 2021, however, future changes cannot be ruled out.

Figure 2-1 - Government's guidance for preparing SEAs and Sustainability Appraisals



Source: Based on ODPM (2005) A practical guide to the Strategic Environmental Assessment Directive and ODPM (2005) Sustainability Appraisal of Regional Spatial Strategies and Local Development Documents

The AoS of the revised NPS has been carried out in a staged approach, with this AoS report representing the 3rd stage in the above Figure 2-1 which demonstrates the various preparation stages of the AoS.

The methodology that has been adopted is described below.

2.2: Setting the Context and Establishing the Baseline

The NPSs will both influence and be influenced by other plans, policies and programmes (PPPs) produced by local and combined authorities, by statutory agencies and other bodies with plan making responsibilities. Legislation is a further driver that sets the framework for the NPSs, both directly and indirectly. Relevant legislation, plans and programmes have been identified and considered to inform the preparation of this AoS report.

To predict accurately how NPSs policies will affect the current baseline, it is first important to understand its current state and then examine the likely evolution without the implementation of the plan. Baseline information provides the basis for understanding existing local environmental, economic and social issues, in particular in respect of health, and alternative ways of dealing with them; formulating objectives to address these issues and predicting and monitoring sustainability effects.

Key sustainability issues have been identified through analysis of the baseline data and review of other plans and programmes. The identification of these issues helped focus the AoS processes on the aspects that really matter. Implications to NPSs development and opportunities for how the NPSs could assist in addressing these issues were also identified.

A set of AoS Objectives has been developed, against which the policies in the NPSs could be assessed. For each objective, guide questions were set out to form the AoS framework. The assessment aid questions provided a clarification of the intended interpretation of each objective to support direction of change sought through the implementation of the NPSs.

The scoping information was refined through prior consultation on the AoS Scoping Report with the statutory consultees identified under the SEA Regulations (including those of England, Northern Ireland, Scotland and Wales)1. This consultation took place from 1 April 2021 to 6 May 2021. The consultation comments were taken on board in preparing this AoS Report (see Appendix B) and updates made are reflected in this report as appropriate.

Government has decided that an appraisal of sustainability against a separate equality objective is unnecessarily duplicative and difficult to apply at the strategic level of the energy National Policy Statements. Not all Appraisals of Sustainability have included a specific equality objective. Issues relating to equality are also addressed through other objectives in the framework, e.g. the objective to improve health and well-being for all citizens and reduce inequalities in health. In reviewing the National Policy Statement, the Secretary of State will be subject to the Public Sector Equality Duty. When considering individual development consent applications, interested parties may make representations on the effect of the proposed development on individuals (including those with protected characteristics), and relevant material considerations should be integrated into the wider assessment of the merits and demerits of the application.

[1] The Environment Agency, English Heritage, Natural England, Department of Agriculture, Environment and Rural Affairs (Northern Ireland), Historic Scotland, Scottish Natural Heritage, Scottish Environment Protection Agency, Cadw (Welsh Historic Monuments), Countryside Council for Wales, and the Environment Agency Wales.

2.3: Appraisal of NPSs Policies

The appraisal of the NPSs policies has been undertaken in a topic by topic manner, with the draft overarching NPS for energy (EN-1) tested against each of the 14 AoS objectives (see Section 4). The findings of AoS-1 are presented in Section 5 by AoS Objective. Where relevant, the interactions between topics have been considered and the commentary is reported against each of the AoS Objectives.

The appraisal of the policies in the draft technology NPSs was undertaken against relevant AoS objectives to reflect non-generic effects associated with the technologies (see Sections 6 to 9).

The appraisal seeks to predict the significant environmental effects of the plan[2]. This is done in accordance with the criteria set out in Annex II of the ODPM guidelines. In predicting effects, changes to the baseline which would occur as a result of implementing the NPS are identified. These changes are then described (where possible) in terms of their geographic scale, the timescale over which they could occur, whether the effects would be temporary or permanent, positive or negative, likely or unlikely, frequent or rare and whether or not they are secondary, cumulative or synergistic.

Quantitative information is not available to help inform the development of predictions in most cases. In such cases, the effects have been predicted based on professional judgement and by reference to relevant legislation and regulations and baseline data. Significance of likely effects was predicted according to the five categories set out in the following table:

Table 2-1 - Key to Appraising Significance of Predicted Effects

Likely Significance of Effects		
Significant positive effect likely	**++**	Policy is expected to address an existing sustainability problem or deliver sustainability enhancements, such as substantial environmental net gain above existing/emerging policy.
Minor positive effect likely	**+**	Policy is expected to lead to environmental net gain in line with existing or emerging Government policy OR result in protection and conservation of a sustainability asset (for example, a designated biodiversity site or designated heritage asset).
No effect likely or not applicable	**0**	No perceptible effects expected, or the objective is not relevant to the part of the NPS being assessed.
Minor negative effect likely	**-**	Policy is expected to result in adverse effects of a lower magnitude or smaller scale, which can be mitigated through standard measures and best practice.
Significant negative effect likely	**--**	Policy is expected to result in adverse effects of a greater magnitude or larger scale, which cannot be mitigated OR will require extensive and bespoke mitigation solutions (further studies may be required to identify appropriate solutions).

[2] ODPM (2005) A Practical Guide to the Strategic Environmental Assessment Directive. See Figure 5. Available online at: http://www.communities.gov.uk/publications/planningandbuilding/practicalguidesea

As noted above, it is important to note that EN-1 to EN-5 are not site-specific and provide a framework for assessing applications for developments of the relevant type in any location. This does mean though that all findings carry a degree of uncertainty as precise effects will ultimately be determined by the nature of the infrastructure and the specific location within which it is developed.

Where beneficial and adverse effects have both been noted, this is shown in relation to the relevant AoS Objective as applicable.

It is noted that an initial assessment was undertaken on a draft EN-1 document dated April 2021 and that this resulted in suggestions of additional mitigation (in the form of recommendations, see Appendix E) to be considered in the drafting of EN-1 for public consultation. Equally, initial assessments were also undertaken on draft technology EN-2 to EN-5 documents dated May 2021 and suggestions of additional mitigation made (see also Appendix E).

2.4: Relationships Between the Overarching AoS and the Technology Specific AoSs for Cumulative Effects Assessment

The Overarching AoS considers the likely significant effects of implementing the draft EN-1 NPS as a whole with the mix of technologies it includes, as well as the likely significant generic effects associated with all major energy infrastructure. Specific effects associated with specific energy technology are detailed in AoS-2 for Natural Gas Electricity Generating Infrastructure, AoS-3 for Renewable Energy Infrastructure, AoS-4 for Gas Supply Infrastructure and Gas and Oil Pipelines and AoS-5 for Electricity Networks Infrastructure. (see Section 6 to 9).

The SEA Regulations require consideration of cumulative effects (Schedule 2, Paragraph 6). Cumulative effects on communities and the environment can arise where the effects of several proposed pieces of new energy infrastructure interact. Such effects may be additive, neutralising or synergistic – where the effect of one or more effects acting together is more than the simple sum of the effects when acting alone. For example, a wildlife habitat can become progressively fragmented with limited effects on a particular species until the last fragmentation makes the habitat too small to support the species anymore. Conversely, progressive small additions of habitats may have limited effects individually until a threshold is reached at which the areas and linkages of habitat contribute positively to green infrastructure aims. Clustering of new energy developments can have positive synergistic effects on the local economy, upskilling and community vitality but conversely may have negative cumulative effects on landscape, air quality and local amenity. It may be considered that climate change is the ultimate cumulative effect.

The nature (positive or negative) and significance of any cumulative effects is likely to be associated with the number and types of technology specific infrastructure projects and the sensitivities of the receiving communities and environment. It is to be noted that the technology specific NPSs do not have any locational specificity and therefore it is difficult to predict any significant cumulative effects. Nonetheless, each energy technology is associated with certain characteristics and an understanding of the potential for cumulative effects was used to identify any key effects and mitigation possibilities.

The significance of cumulative effects may vary with the mix of energy technology projects that are proposed. It is considered that the cumulative effects on certain topics, such as climate change and the economy, may be significant overall at the national level of the NPS,

whilst effects on other topics, such as water quality and resources, and biodiversity, are more likely at the regional or sub-regional and local levels. Consideration of interactions and cumulative effects was integral to the appraisal process and addressed in this AoS using professional judgement and evidence from the draft NPSs, the baseline and the plans/programmes review.

The cumulative effects assessment was undertaken both individually for each energy NPS and also considering the cumulative effects between all five NPSs in combination (see section 2.6 below).

2.5: Appraisal of Alternatives

The SEA Regulations also require the environmental assessment of reasonable alternatives to the NPS policies and these alternatives are analysed in Section 5 of this AoS Report for EN-1 and Sections 6 to 9 for the AoSs of EN-2, EN-3, EN-4 and EN-5.

It is important to maintain the appraisal at the appropriate level of plan making and AoS. For this reason, the strategic alternatives for implementing the aims of the NPS were assessed at a higher level by using six sustainable development themes, identified through aggregating the AoS objectives into topics that better reflected the strategic characteristics of the options as follows:

Table 2-2 - Sustainable Development Themes and AoS Objectives

Headline SD Themes	**AoS/SEA Objectives (numbers refer to AoS objectives)**
Climate Change	Net Zero (1)
Security of Energy Supply	Health (11), , Economy (13)
Health & Well- Being	Air Quality (8), Health (11)
The Economy	Health (11), Economy (13), Resources (14)
The Built Environment	Transport (12), Heritage (5), Adaptation and Resilience (2)
The Natural Environment	Adaptation and Resilience (2), Biodiversity (3 & 4), Landscapes and Townscapes (6), Water (7), Soils (9), Geodiversity (10)

Note that in consideration of Alternatives, the assessment is undertaken in comparison to EN-1 and as such, the findings of the AoS in respect of EN-1 in Section 5 broadly apply to all of the alternatives – the key differentiator being the inclusion or absence of specific technologies and the relative outcomes of such inclusion or absence. The same broad methodology was applied in relation to alternatives for EN-2 to EN-5 with the key differentiator being the inclusion or absence of particular aspects related to the particular technologies and the relative outcomes of such inclusion or absence.

In order to draw comparison between the Alternatives on a broad level, the following scale has been used:

Table 2-3: Differentiator scale for Alternatives

Scale	Description
Large Positive	A materially different positive outcome is anticipated compared to EN-1*
Positive	A more positive outcome is anticipated compared to EN-1*
Neutral	This alternative is anticipated to have the same outcome as EN-1*
Negative	A more adverse outcome is anticipated compared to EN-1*
Large Negative	A materially different adverse outcome is anticipated compared to EN-1*

* EN-2 to EN-5 for technology AoS

2.6: Cumulative and Transboundary Effects

Cumulative effects arise where several proposals or elements of the energy NPSs, individually may or may not have significant effect but in-combination have a significant effect due to spatial crowding or temporal overlap. Synergistic effects occur when two or more effects act together to create an effect greater than the simple sum of the effects when acting alone. Cumulative effects can also arise due to effects from the NPSs combining with effects from other plans and policies.

Transboundary effects extend to multiple countries rather than just the UK.

Both types of effects have been considered in relation to the energy NPSs.

2.7: Monitoring the Effects of the NPSs Implementation

Monitoring involves measuring indicators which will enable the establishment of a causal link between the implementation of the plan and the likely significant effect (positive or negative) being monitored. It thus helps to ensure that any adverse effects which arise during implementation, whether or not they were foreseen, can be identified and that action can be taken to deal with them. A monitoring programme has been prepared and is presented in this report.

2.7: Consultation on this AoS Report

The AoS Report is published for public consultation together with the revised draft NPSs. Please refer to the consultation document for details.

2.8: Next Steps

The revised draft NPSs will be subject to Parliamentary scrutiny. Government will consider comments received during the public consultation, and the NPSs will be subject to approval by Parliament before final designation. Upon designation of the NPSs, an AoS Post Adoption Statement will be published, and this will outline how the findings of the AoS and the responses to consultation have been taken into account. It will also provide further information on how monitoring of the significant effects of implementing the revised NPSs will be carried out.

2.9: Habitats Regulations Assessment

A Habitats Regulations Assessment (HRA) report has been prepared for the suite of draft NPSs in a parallel process to the AoS. The HRA report is subject to public consultation alongside the draft NPSs and this AoS report.

In England and Wales, under the Conservation of Habitats and Species Regulations 2017 (as amended), as well as the Conservation of Offshore Marine Habitats and Species Regulations 2017 (together known as the 'Habitats Regulations') an 'Appropriate Assessment' is required to be undertaken on proposed plans or projects which are not necessary for the management of the European Site but which are likely to have a significant effect on one or more European Sites either individually, or in combination with other plans or projects.

European Sites include Special Areas of Conservation (SACs), originally designated under European Council Directive 92/43/EEC (referred to as the Habitats Directive), and Special Protection Areas (SPAs), originally designated under the Conservation of Wild Birds Directive (Council Directive 2009/147/EC (which codifies Directive 79/409/EEC)) for rare, vulnerable and regularly occurring migratory bird species and internationally important wetlands. As a matter of Government policy listed or proposed Ramsar sites, potential SPAs (pSPA), candidate SACs (cSAC) and sites identified, or required, as compensatory measures for adverse effects on habitats sites, pSPAs, cSACs and listed or proposed Ramsar sites, are treated in the same way as European Sites. Hereafter, all the above sites are referred to as European Sites.

Therefore, a HRA report was prepared for the revised and updated NPSs (EN-1 to EN-5) and considers the potential effects of designating the draft NPSs on European sites.

It is important to note that the Habitats Regulations require assessment of the NPSs as a plan and as such the HRA has been undertaken on that basis – this does not remove the requirement for detailed project level HRA to be undertaken at development consent stage. At this point, there are no specific sites, allocations or any spatial component to the NPSs. Therefore, the HRA has purely focused on the policy content within each NPS and has been applied to drafts of EN-1 to EN-5 in a manner which is consistent with their non-spatial, strategic nature as these NPS do not identify locations to construct new nationally significant infrastructure.

The HRA of the draft National Policy Statements (EN-1 to EN-5) noted that while the lack of spatial information within the NPSs made it impossible to reach certainty on the effect of the plan on the integrity of any European Site, the potential for proposed energy infrastructure projects of the kind contemplated by EN-1 to EN-5 to have adverse effects on the integrity of such sites cannot be ruled out, based on following the precautionary principle. The HRA explains why the Government considers that EN-1 to EN-5 are, nevertheless, justified by imperative reasons of overriding public interest, while noting that its conclusions are only applicable at the NPS level and are without prejudice to any project-level HRA, which may result in the refusal of consent for a particular application.

3: Scope of the AoS

3.1: Thematic Scope

The SEA Regulations require the analysis of likely significant effects on the environment in an environmental report to include the effects on a specific list of factors or topics (known as 'SEA Topics'), which are: "biodiversity, population, human health, fauna, flora, soil, water, air, climatic factors, material assets, cultural heritage including architectural and archaeological heritage, landscape and the interrelationship between the above factors". This is what Sections 5 to 9 of this AoS report do for each of the five NPSs. There is also a requirement for the environmental report to include "measures envisaged to prevent, reduce and as fully as possible offset any significant adverse effects on the environment" of implementing the plan or programme. The scoping consultation confirmed that all of the SEA Topics were relevant to the development of energy infrastructure. Table 3-1 identifies the headings under which analysis of these issues is set out in this AoS report (particularly in Section 4).

Table 3-1 – How SEA Topics are covered by the AoS Objectives

SEA Topics	Headings used in this AoS
Biodiversity	3. Enhance biodiversity, promoting net gain, and supporting ecosystem resilience and functionality; and 4. Protect and enhance sites designated for their international importance for nature conservation purposes.
Population	6. Protect and enhance the character and quality of the landscapes and townscapes, protect and enhance visual amenity; 11. Improve health and well-being and safety for all citizens and reduce inequalities in health; 13. Promote a strong economy with opportunities for local communities; and 12. Promote sustainable transport and minimise detrimental impacts on strategic transport network and disruption to basic services and infrastructure.
Human Health	8. Protect and enhance air quality; 11. Improve health and well-being and safety for all citizens and reduce inequalities in health.
Fauna	3. Enhance biodiversity, promoting net gain, and supporting ecosystem resilience and functionality; 4. Protect and enhance sites designated for their international importance for nature conservation purposes; and 8. Protect and enhance air quality.
Flora	3. Enhance biodiversity, promoting net gain, and supporting ecosystem resilience and functionality; 4. Protect and enhance sites designated for their international importance for nature conservation purposes); and 8. Protect and enhance air quality.
Soil	9. Protect soil resources and avoid land contamination; and

	10. Protect, enhance and promote geodiversity.
Water	2. Maximise adaptation and resilience to climate change; and 6. Water Quality & Resources.
Air	8. Protect and enhance air quality
Climatic Factors	2. Maximise adaptation and resilience to climate change; and 6. Water Quality & Resources.
Material Assets	9. Protect soil resources and avoid land contamination; 10 Protect, enhance and promote geodiversity; and 14. Promote sustainable use of resources and natural assets.
Cultural Heritage	5. Protect and enhance cultural heritage assets and their settings, and the wider historic environment; and 6. Protect and enhance the character and quality of the landscapes and townscapes, protect and enhance visual amenity.
Landscape	6. Protect and enhance the character and quality of the landscapes and townscapes, protect and enhance visual amenity

3.2: Geographic Scope

The AoS applies to the same geographical area of the NPSs – namely England and Wales, though in certain circumstances elements will apply to Scotland. The Energy NPSs do not apply to Northern Ireland.

Potential effects have been considered across a range of geographic scales (including international, UK, regional and local). However, as the NPSs do not prescribe the location for new infrastructure projects, there are limitations in terms of appraising those effects that are site specific in nature. This is not to exclude the possibility that they could be significant but rather to indicate that such effects may only be effectively judged as significant at the project level (for example, increases in noise or vibration levels from a new access road affecting a local housing settlement). This explains why effects that may be quite intensely felt at local level do not always register as strategically significant in the scoring sections of the assessment.

The assessment of project level effects will be given full consideration at the application for development consent, as detailed in the NPSs, particularly through Environmental Impact Assessment (EIA), and, where relevant, Habitats Regulations Assessment (HRA).

3.3: Temporal Scope

The temporal scope of the AoS has been aligned with that for the NPSs, which remain in force until such time as a further review is considered to be appropriate. It should be noted though, that the AoS considers the full lifetime of any individual energy related development which might arise from the reviewed NPSs and that includes the construction, operation and decommissioning stages.

The effects of a policy, plan or programme sometimes change over time for a number of reasons. This has been reflected in the appraisal. In this context, for the purposes of the appraisal, the “short term” has been defined as the effects arising generally during the infrastructure construction period typically 2-7 years (different technologies have different

construction times); the “medium term” as typically between 5 and 30 years (operational lifetimes vary with the characteristics of different technologies); and the “long term” as beyond 30 years (and including decommissioning where relevant).

4: Policy context, baseline, issues and framework

4.1: Review of Policies, Plans and Programmes

The SEA Regulations requires a report containing:

'*an outline of the contents, main objectives of the plan or programme and relationship with other relevant plans and programmes'.* (Schedule 2, Paragraph 1)

'*The environmental protection objectives, established at international, (European) Community or Member State level, which are relevant to the plan or programme and the way those objectives and any environmental considerations have been taken into account during its preparation*'. (Schedule 2, Paragraph 5)

The review of international and national plans, policies and programmes (PPP) is a valuable element of the AoS process as it assists with the following:

- The identification of environmental, social and economic objectives of other relevant plans or programmes that should guide the identification of sustainability issues;
- The development of the AoS framework which should comprise sustainability objectives; and
- Determining whether there are any clear potential conflicts or challenges between the PPP and the emerging policy which is the subject of the AoS process. Note that there are a number of policy levers other than the planning regime which Government can and does use to try to achieve its overall objectives in relation to the Energy sector. In the energy NPSs and their AoSs, we are concerned only with those policies which relate to land use and help set the framework for development consent.

The international and national PPP that have been reviewed are listed in Table 4-1 and details of the review presented in Appendix C.

Table 4-1 - International and national PPP reviewed[3]

International
Aarhus Convention (Convention on Access to Information, Public Participation in Decision Making and Access to Justice in Environmental Matters) (2001)
Bern Convention on the Conservation of European Wildlife and Natural Habitats (1979)
Closing the Gap: Social Determinants of Health (World Health Organisation, 2008)
Convention on the Protection of the Archaeological Heritage (1992) – the 'Valetta Convention'
Convention on the Protection of Underwater Cultural Heritage (2001)
Espoo Convention on Environmental Impact Assessment in a Transboundary Context (1991)

[3] The review of Plans, Policy and Legislation is not to be considered an exhaustive list and elements may have been superseded. However, it is the purpose to illustrate the evolution of sustainability requirements and demonstrate the context of the NPS and associated AoS and to show how these are broadly influenced in setting Objectives for both.

European Landscape Convention (2000) – the 'Florence Convention'
Ramsar Convention on Wetlands of International Importance Especially as Waterfowl Habitat (1971)
Kyoto Protocol to the UN Framework Convention on Climate Change (agreed in 1997, ratified in 2005)
The OSPAR Convention
The Paris Agreement (2015)
UK-EU TAC Agreement, Articles: ENER.21 Renewable Energy and Energy Efficiency, ENER.22 Support for Renewable Energy, ENER.23 Cooperation in the Development of Offshore Renewable Energy, and ENER.26 Research, Development and Innovation.
UN Convention on Biological Diversity (2010)
UN Framework Convention on Climate Change (1994)
UNESCO Convention Concerning the Protection of the World Cultural and Natural Heritage (1972)
WHO Guidelines for Community Noise 1999
WHO Night Noise Guidelines for Europe 2009
National (United Kingdom)
A Children's Environment and Health Strategy for the United Kingdom (2009)
A connected society – A strategy for tackling loneliness, 2018
A Green Future: Our 25 Year Plan to Improve the Environment (HM Government 2018)
Air Pollution: Action in a Changing Climate (Defra, 2010)
Air Quality Standards Regulation 2010 as amended by The Air Quality (Amendment of Domestic Regulations) (EU Exit) Regulations 2019
Air Quality Plan for Nitrogen Dioxide in the UK, 2017
Ancient Monuments and Archaeological Areas Act 1979
Ancient Woodland Inventory
BIS Climate Change Adaptation Plan 2011
Building a Low-Carbon Economy – The UK's Contribution to Tackling Climate Change (Committee on Climate Change, 2008) and the Fourth Carbon Budget: Reducing Emissions Through the 2020s (CCC, 2010)
Carbon Plan (DECC, 2011)
Children's Environment and Health Action Plan – Summary of current activities which address children's environment and health issues in the UK (2007)
Clean Air Strategy, 2019
Climate Change Act 2008 and its 2050 Target Amendment Order, 2019
Climate Change Risk Assessment 2017
Conservation of Habitats and Species Regulations 2010 as amended by The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019
Countryside and Rights of Way Act 2000

Cutting Carbon, Creating Growth: Making Sustainable Local Transport Happen White Paper 2011
Decarbonising Transport: Setting the Challenge 2020
DfT Single Departmental Plan 2019
Eels (England and Wales) Regulations 2009
Enabling the Transition to a Green Economy: Government and business working together (HM Government, 2011)
Enterprise and Regulatory Reform Act 2013
Environment Act 1995 (as amended)
Environment Bill Policy Statement 2020
Environmental Permitting (England and Wales) Regulations 2016
Environmental Protection Act (1990)
Fisheries Act 2020
Flood and Water Management Act 2010
Flood Risk Management Plans
Government Heritage Statement 2017
Guidance for Local Authorities on Implementing the Biodiversity Duty (2007)
Health Impact Assessment in Strategic Environmental Assessment (2001)
Heritage Protection for the 21st Century 2007
Historic Buildings and Ancient Monuments Act 1953
Inclusive Transport Strategy 2018
Industrial Decarbonisation Strategy (2021)
Infrastructure Planning (Environmental Impact Assessment) Regulations 2018
Local Transport Act 2008
Localism Act 2011
Low Carbon Transition Plan 2009
Marine and Coastal Access Act 2009
National Forest Inventory
National Heritage Act 1983 (as amended 2002)
National Infrastructure Plan (HM Treasury, 2014)
National Infrastructure Strategy
National Infrastructure Assessment 2018
National Parks and Access to Countryside Act 2006
National Pollinator Strategy 2014-2024
Natural Environment and Rural Communities Act 2006
Natural Environment White Paper (Defra, 2011)
Network Rail Delivery Plan 2019-2024

Planning Practice Guidance – Climate Change 2015
Protection of Military Remains Act 1986
Resource Security Action Plan 2012
River Basin Management Plans (RBMP)
Salmon and Freshwater Fisheries Act 1975
Shoreline Management Plans
Stern Review of the Economics of Climate Change (Stern, 2007)
The Agriculture Act 2020
The Air Quality Strategy for England, Scotland, Wales and Northern Ireland (Defra, 2007)
The Energy White Paper (2020)
The Flood Risk Regulations 2009
The Floods and Water (Amendment etc.) (EU Exit) Regulations 2019
The Planning Act 2008
The Planning (Listed Buildings and Conservation Areas) Act 1990
The Protection of Wrecks Act 1973
The Road to Zero, 2018
The Ten Point Plan for a Green Industrial Revolution (2020)
The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017
The Water Act 2014
The Wildlife and Countryside Act (1981)
Towards Social Investment for Growth and Cohesion 2014 - 2020
Transport Act 2000
UK Biodiversity Plan (1994)
UK Clean Growth Strategy 2017
UK Climate Change Risk Assessment 2017 Synthesis report: priorities for the next five years
UK Climate Projections 18
UK Government Sustainable Development Strategy: Securing the Future (HM Government, 2005)
UK Marine Policy Statement 2011
UK Marine Strategy 2019
UK Post-2010 Biodiversity Framework (July 2012)
UK Renewable Energy Road Map 2013
UK Shared Framework for Sustainable Development; One Future – Different Paths 2005
Water Resources Act 1991 (which applies in England and Wales)
England

A Strategy for England's Trees, Woods and Forests (2007)
Biodiversity 2020: a Strategy for England's Wildlife and Ecosystem Services (Defra, 2011)
Climate Change: Second national adaptation programme (2018-2023)
English National Parks and Broads UK Government Vision and Circular 2010 (DEFRA 2010)
Environmental Damage (Prevention and Remediation) (England) Regulations 2015 as amended by The Environmental Damage (Prevention and Remediation) (England) (Amendment) Regulations 2019
Environmental Noise (England) Regulations 2006 SI 2238 as amended by Environmental Noise (England) (Amendment) Regulations 2009 and 2010
Future Water, the Government's Water Strategy for England (Defra, 2008)
Government Policy Statement on Flood and Coastal Erosion Risk Management Strategy
Government Review of Waste Policy in England 2011
Government Forestry and Woodlands Policy Statement (2013)
Healthy Lives, Healthy People: Our strategy for public health in England (2010)
Highways England Growth and Housing Fund
Landscape Character Framework
Marine Plans for England
National Flood and Coastal Erosion Risk Management Strategy for England 2020
National Planning Policy for Waste (2014)
Noise Policy Statement for England (DEFRA, 2010)
Planning for the Future: A guide to working with Highways England on planning matters
Project Speed
Roads Investment Strategy 2020 - 2025
Safeguarding our Soils: a strategy for England 2009
The Contaminated Land (England) Regulations 2006 (HMSO, 2006) as amended by the Contaminated Land (England) (Amendment) Regulations 2012
The Environment Bill
The Planning White Paper
The National Adaptation Programme – Making the country resilient to a changing climate (2013)
The National Flood and Coastal Erosion Risk Management Strategy for England (FCERM) (Environment Agency, 2011)
The National Planning Policy Framework (2012; revised 2019)
The Smoke Control Areas (Authorised Fuels) England (No. 2) Regulations 2014
The Town and Country Planning (Trees Preservation) (England) Regulations 2012
Waste (England and Wales) Regulations 2011 as amended by The Waste (England and Wales) (Amendment) Regulations 2014

Waste Management Plan for England (2013)
Waste Prevention Programme for England 2013
Wales
Adapting to Climate Change: Guidance for Flood and Coastal Erosions Risk Management Authorities in Wales 2021
Environment (Wales) Act 2016
Environmental Damage (Prevention and Remediation) (Wales) Regulations 2009
Future Wales Collection of Evidence
Future Wales Habitats Regulation Assessment
Future Wales Integrated Sustainability Appraisal
Future Wales – The National Plan 2040
Guidance for flood consequence assessments: climate change allowances 2021
Historic Environment Act (Wales) 2016
National Strategy for Flood and Coastal Erosion Risk Management in Wales (2020)
Natural Resource Policy (Welsh Government) (2017)
Natural Wales Resources Technical Guidance (Series - Natural Resource Wales)
Llwybr Newydd The Wales Transport Strategy (2021)
One Wales: One Planet – the Sustainable Development Scheme for Wales (2009)
Planning Policy Wales (Edition 11, 2021)
Planning (Wales) Act 2015, including consideration of Development of National Significance (DNS)
Policy Statement on Local Ownership of Energy Developments
Prosperity for All: A Climate Conscious Wales
Rural Development Plan 2007-2013
Shoreline Management Plans applicable in Wales
State of Natural Resources Report (Natural Resources Wales 2020)
Technical Advice Notes (TANs) TAN 5: Nature Conservation and Planning (2009) TAN 6: Planning for Sustainable Rural Communities (2010) TAN 8: Renewable Energy (2005) TAN 11: Noise (1997) TAN 13: Tourism (1997) TAN 14: Coastal Planning (1998) (to be combined with TAN 15 in September 2021) TAN 15: Development and Flood Risk (2004) TAN 16: Sport, Recreation and Open Space (2009) TAN 18: Transport (2007) TAN 21: Waste (2014)
The Climate Change Strategy for Wales (2010)

The Contaminated Land (Wales) Regulations 2006 as amended by the Contaminated Land (Wales) (Amendment) Regulations 2012
The Town and Country Planning (Development Management Procedure) (Wales) Order 2012 as amended by The Town and Country Planning (Development Management Procedure) (Wales) (Amendment) Order 2017
The Town and Country Planning (Trees) (Amendment) (Wales) Regulations 2017
The Smoke Control Areas (Authorised Fuels) (Wales) Regulations 2019
The Waste (Miscellaneous Provisions) (Wales) Regulations 2012
The Welsh Historic Environment Strategic Statement: Action Plan (2010)
Towards Zero Waste - One Wales: One Planet - The Overarching Waste Strategy Document for Wales (2010)
Water Strategy for Wales (2015)
Wellbeing and Future Generations (Wales) Act 2015
Welsh Government Rural Communities - Rural Development Programme (2014-2020)
Welsh National Marine Plan (Welsh Government (2019)
Woodlands for Wales (2011)
Scotland
2020 Challenge for Scotland's Biodiversity - A Strategy for the conservation and enhancement of biodiversity in Scotland
Cleaner Air for Scotland – the Road to a healthier future (the Scottish Government 2015)
Climate Change (Emissions Reduction Targets) (Scotland) Act 2019
Climate Change (Scotland) Act 2009
Climate Ready Scotland Scottish Climate Change Adaptation Programme (2014)
Climate Ready Scotland Scottish Climate Change Adaptation Programme (2019-2024)
Contaminated Land (Scotland) Regulations (2000 and 2005)
Control of Woodland Removal 2012
Environmental Noise (Scotland) Regulations (2006) as amended by The Environmental Noise (Scotland) Amendment Regulations 2018
Flood Risk Management Act (Scotland) (2009)
Forestry and Land Management (Scotland) Act 2018
Forestry (Felling) (Scotland) Regulations 2019
Planning Advice Note (PAN) 3/2010 Community Engagement
PAN 33 Development of Contaminated Land (Revised Oct 2000)
PAN 51 Planning, Environmental Protection and Regulation (Revised 2006)
PAN 2/2011 Planning and Archaeology
PAN 71 Conservation Area Management
PAN 60 Planning for Natural Heritage
PAN 1/2011 Planning and Noise

PAN 61 Waste Management Planning
Scotland’s Biodiversity Strategy (consists of two documents - 2020 Challenge for Scotland's Biodiversity - A Strategy for the conservation and enhancement of biodiversity in Scotland and Scotland’s Biodiversity: It’s in Your Hands (2003))
Scotland’s Forestry Strategy 2019-2029
Scotland's Third National Planning Framework (2014)
Scotland’s Zero Waste Plan (2010)
Scottish Energy Strategy: The Future of Energy in Scotland (2017)
Scottish Planning Policy (2014)
Securing a green recovery on a path to net zero: climate change plan 2018–2032 - update
The Air Quality (Scotland) Amendments Regulations 2016
The Air Quality Standards (Scotland) Regulations (2010)
The Nature Conservation (Scotland) Act 2004 (Authorised Operations) Order 2011
The Scottish Forestry Strategy (2006)
The Smoke Control Areas (Authorised Fuels) Scotland Regulations 2014
The Town and Country Planning (Development Management Procedure) (Scotland) Regulations 2013
The Town and Country Planning (Tree Preservation Order and Trees in Conservation Areas) (Scotland) Regulations 2010
The Waste (Scotland) Regulations 2012
The Water Environment (Controlled Activities) (Scotland) Regulations 2011
Tourism Development Framework for Scotland (2013)
Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2011 and amendments
Wildlife and Natural Environment (Scotland) Act 2011 (as amended)

A series of tables contained in Appendix C present the review of PPP and document the following:

- The primary objectives of the documents including their environmental protection objectives where appropriate;
- Key indicators and targets of relevance in the documents; and
- How the objectives within the plans and programmes have been taken into consideration in the AoS and NPS processes.

The review of PPPs revealed a large number of common themes in terms of their objectives relating to sustainability within the context of strategic development planning, including:

Biodiversity and the Natural Environment

- Protection of sites designated for nature conservation purposes
- Protect and enhance endangered or important species and habitats, including those considered irreplaceable such as Ancient Woodland and Veteran trees

- Contribute to the delivery of biodiversity strategies and plans
- Support ecosystem resilience
- Increase important habitat
- Protect, maintain and where possible enhance natural habitat networks and green infrastructure, to avoid fragmentation and isolation of networks
- Contribute to the achievement of Biodiversity Net Gain
- Contribute to delivering multi-functional Green Infrastructure – note this will also have implications in addition to biodiversity across a range of themes such as climate change, air quality, water quality and so on
- Contribute to the achievement of Environment Net Gain

Geodiversity

- Protection of sites designated for geodiversity importance

Greenhouse gas (GHG) Emissions

- Reduce GHG emissions, particularly CO_2
- Maximise the use of low carbon (or renewable and low carbon) energy
- Increase energy efficiency and make use of new technology and use of waste heat
- Minimise use of fossil fuels
- Contribute to the achievement of Net Zero Carbon target

Adaptation to a Changing Climate and Flooding

- Prepare for extreme weather events including drought and sea level rise and coastal erosion
- Minimise the risk and impact of flooding from all sources for life of development
- Avoid development in flood risk areas when possible
- Help meet objectives and support actions of Flood Risk Management Plans and Shoreline Management Plans allowing for climate change
- Utilise Natural Flood Management, river restoration and SuDS

Air Quality

- Do not cause additional AQMA to be designated
- Reduce emissions of NO_2
- Reduce emissions from transport (roads in particular)
- Increase use of low emission / zero emission at point of use vehicles
- Increase convenience and use of sustainable transport modes
- Reduce emissions of PM_{10} and $PM_{2.5}$

Water Resources

- Protect and improve the quality of ground and surface water (including sea)
- Help to meet objectives of the Water Framework Directive (WFD) and the relevant River Basin Management Plan
- Need to consider as appropriate water resource management and drought management

- Make use of Sustainable Drainage Systems (SuDS)

Land Use, Soil and Agriculture

- Prioritise development on brownfield sites
- Seek to reclaim derelict and contaminated land
- Protect farmland and soils – particularly those of the best value
- Change agricultural land use to forestry

Cultural Heritage

- Conserve and protect historic assets (designated and undesignated) and those of cultural note
- Improve access to historic assets, including buildings and landscapes of value where appropriate
- Sympathetic design and use of vernacular architecture when appropriate to enhance the local character and ‘sense of place’

Landscapes and Townscapes

- Protect those areas designated for landscape value
- Protect and enhance landscape and townscape character and local distinctiveness
- Protect tranquillity from noise and light pollution
- Foster good design quality for all new development
- Promote regeneration of previously developed land when appropriate

Natural Resources and Waste

- Ensure efficient resource use and minimise resource footprint
- Use secondary and recycled materials and sustainable construction techniques
- Consider opportunities to maximise on-site re-use of materials
- Employ waste reduction methods and waste hierarchy to minimise construction and maintenance waste
- Reduce the amount of waste disposed of at landfill
- Promote circular economy

Economic Themes

- Improve physical accessibility to jobs through the location of employment sites and transport links close to areas of high unemployment
- Improve accessibility to superfast / ultrafast broadband
- Widen the number and range of accessible employment opportunities and support growth in employment and labour productivity
- Improve attractiveness for inward investment
- Improve rail and road journey reliability for business users
- Support local businesses
- Support enhancement of local economy and overall prosperity
- Support development of the skills base

Social Themes

- Distinctive development that recognises, reflects and enhances the ‘sense of place’ and ‘sense of community’
- Self-sufficient, resilient and adaptable communities
- Communities that will develop roots and connections between people
- Access to a mix of affordable housing to meet the needs of all sections of society, at different phases of life
- Access to social facilities – community, cultural, health and leisure / recreational
- Access to transport with an emphasis on active, low carbon and sustainable modes
- Access to and provision of modern and robust infrastructure, including digital, to allow connected communities
- Access to Open Space and Green Infrastructure
- Access to educational, training and employment opportunities

Health & Community Themes

- Tackle poor health by improving the health of everyone, and of the worst off in particular
- Tackle, where possible, specific issues that can affect health e.g. poor air quality
- Reduce health inequalities among different groups in the community (e.g. young children, pregnant women, black and minority ethnic people; older people, people with disabilities; low income households)
- Support the public to make healthier and more informed choices with regard to their health and adopt physically active lifestyles
- Address pockets of deprivation
- Provide physical access for people with disabilities
- Provide or improve access to local health and social care services
- Provide opportunities for increased exercise, thus reducing obesity, particularly in children, and illnesses such as coronary heart disease
- Provide for an ageing population
- Promote healthy lifestyles through exercise, physically active travel and access to good quality and affordable food, which can assist in reducing both physical and mental illnesses

4.2: Baseline Information and Key Issues

The SEA Regulations require identification and characterisation of:

'*the relevant aspects of the current state of the environment and the likely evolution thereof without implementation of the plan or programme'*. (Schedule 2, Paragraph 2)

'*the environmental characteristics of areas likely to be significantly affected*'. (Schedule 2, paragraph 3)

'*any existing environmental problems which are relevant to the plan or programme including, in particular, those relating to any areas of particular environmental importance, such as areas designated pursuant to Directive 79/409/EEC and 92/43/EEC*'. (Schedule 2, Paragraph 4)

This chapter sets out baseline information for the UK and baseline information required for the assessment of each NPS. The baseline information in this Chapter and Appendix C is an update of information used to inform the current NPSs.

4.2.1: Summary of national baseline data

The AoS is being undertaken to support reviewed NPSs which will have national implications and the approach to the baseline data collation process that has been adopted involved the collation of higher-level national data.

Appendix D sets out national baseline information that has been collated. The indicators that have been considered are listed below.

Table 4-2 - Summary of national baseline information

Topic	**Baseline Information (national)**
Climate change	Distribution of greenhouse gas emissions Contribution of sectors to greenhouse gas emissions Predicted changes to temperature and weather patterns
Biodiversity and the Natural Environment	Special Protection Areas Special Areas of Conservation Ramsar sites National Nature Reserves Sites of Special Scientific Interest (England, Scotland, Wales) and Areas of Special Scientific Interest (Northern Ireland) Marine Conservation Zones (England, Wales, Northern Ireland) Nature Conservation Marine Protected Areas (Scotland) Ancient Woodland Biosphere Reserves

	Biodiversity Targets
Communities – Population, Employment and Viability	Population Location of major settlements and areas of population Working age population Unemployment Economic Activity Rates
Communities – Supporting Infrastructure	Location of strategic rail links Location of strategic road network Location of airports Location of ports
Communities - Health and Well-Being	Radioactivity levels in the environment The Index of Multiple Deprivation (England) The Scottish Index of Multiple Deprivation The Welsh Index of Multiple Deprivation Northern Ireland Multiple Deprivation Measure The Measuring National Well-Being Programme National Trails (England and Wales), Scotland's Great Trails
Cultural Heritage	World Heritage Sites Scheduled Monuments Historic Battlefields Parks and Gardens Protected Wrecks Listed Buildings Conservation Areas
Landscape, Townscape, and Seascape	National Parks Areas of Outstanding Natural Beauty (England, Wales, Northern Ireland) and National Scenic Areas (Scotland) Heritage Coasts (England and Wales) National Character Areas (England)
Air Quality	Air Quality Management Areas
Land Use, Soils and agriculture	Sites of Special Scientific Interest (England, Scotland, Wales) and Areas of Special Scientific Interest (Northern Ireland) UNESCO Global Geoparks
Water Quality and Resources	Water Framework Directive (WFD) Bathing Water Quality Marine Strategy Framework Directive
Flood Risk and Coastal Change	Flood Zones (England, Scotland, Wales) and Flood Risk Areas (Northern Ireland)

Natural Resources and Waste	Sector waste statistics

Appendix D is supported by Figures 1 - 6 in Appendix F which show the geographical distribution of some of the key designations and land uses across the UK. Table 4-3 provides a summary of the data presented on these figures. An indication is provided in brackets of whether an information layer only applies to a specific part of the UK.

Table 4-3- Key designations and land use across the UK

Figure	**Key designations / land use considered**
Figure 1: Biodiversity and Ecosystems	Special Protection Areas Special Area of Conservation Ramsar sites Sites of Special Scientific Interest (England, Scotland, Wales) and Areas of Special Scientific Interest (Northern Ireland) National Nature Reserves Ancient Woodland Inventory (England and Scotland) Marine Conservation Zones (England, Wales, Northern Ireland) Nature Conservation Marine Protected Areas (Scotland) Biosphere Reserves
Figure 2: Infrastructure	Urban Areas Location of strategic rail links Location of strategic road network Location of airports Location of ports
Figure 3: Historic Environment	Protected Wrecks (England) World Heritage Sites Scheduled Monuments (England and Scotland) Historic Battlefields (England and Scotland) Parks and Gardens (England and Scotland)
Figure 4: Landscape / Health and Well-being	Areas of Outstanding Natural Beauty National Parks Heritage Coasts (England and Wales) National Trials (England)
Figure 5: Air Quality	Air Quality Management Areas
Figure 6: Flood Risk	Flood Risks Zones (England) Flood Risk Areas (Northern Ireland)

Note that while the above Figures depict a range of key designation and land use across the United Kingdom, the scale at which this mapping is presented does not allow for the full granularity of data of relevance. Underpinning many of the above noted aspects are a series of more 'local' designations and land uses which are also sustainability considerations and which have been considered where appropriate in this study. These include, for example, sites designated as Local Nature Reserves, Sites of Nature Conservation Importance, Noise Important Areas, non-designated heritage assets, listed buildings, Conservation Areas, Special Landscape Areas, Areas of Great Landscape Value, areas of contaminated land and so on.

4.2.2: Key Issues

The SEA Regulations require identification and characterisation of:

'*any existing environmental problems which are relevant to the plan or programme including, in particular, those relating to any areas of particular environmental importance, such as areas designated pursuant to Directive 79/409/EEC on the conservation of wild birds and the Habitats Directive.* (Schedule 2, paragraph 4)

The identification of key sustainability issues (or 'problems') has been based upon the collation of baseline data (Appendix D) and the review of relevant PPP (Appendix C). The summary of issues is presented below in Table 4-4. Note that due to the geographical scope of the NPS, this summary of key sustainability issues is focused on England and Wales, along with the United Kingdom as a whole as appropriate. Further detail on Scotland and Northern Ireland is provided in the baseline and contextual information contained within Appendix D.

It should be noted that some issues are cross-cutting and affect several topics. For example, climate change can affect biodiversity, water resources, flooding and landscapes. Table 4-4 shows the linkages to the AoS Objectives identified.

In addition, Table 4-4 below identifies the likely evolution of each key sustainability issue, if the revised NPSs were not to be designated. This addresses the SEA Regulations requirement to describe 'the relevant aspects of the current state of the environment and the likely evolution thereof without implementation of the plan or programme'. (Schedule 2, Paragraph 2).

Table 4-4 - Baseline evolution and implications and opportunities for the NPS

Key Issue and summary of baseline situation/information	Summary of likely evolution of the baseline without the Energy NPS (direction of condition trend)	Implications and Opportunities identified for the Energy National Policy Statement	AoS Objective
Biodiversity – new development and climate change put pressure on sites designated for nature conservation and wider green infrastructure but wider green infrastructure can benefit from opportunities to deliver Biodiversity Net Gain through new development Across England and Wales, there are sites internationally (SACs, SPAs, Ramsar sites) and nationally (SSSIs) designated for nature conservation. SACs, SPAs, Ramsar sites and SSSIs are afforded the highest level of protection through statutory designations. Within England there are a total of 82 SPAs, while Wales has a total of 17. There are also 242 SACs in England and 85 in Wales. A number of SPAs and SACs protect habitat and/or species associated with the marine environment. Currently, there are 46 SPAs with marine components designated partly or wholly within English waters and 10 within Welsh waters. A total of 3 SPAs with marine components are located within both English and Welsh waters. There are also currently 37 SACs with marine components designated partly or wholly within English waters and 12 designated partly or wholly within Welsh waters. A further 3 SACs with marine	**Declining** Although designated sites are afforded protection; this is unlikely to prevent some decline in condition due to the effects of climate change. Much of the green infrastructure network is not designated, however, the absence of the strategic guidance of the NPS could lead to further declines.	The NPS should aim to protect and enhance all sites of biodiversity importance and place a particular emphasis on protecting sites designated for nature conservation. This could be achieved by ensuring that planning / design of new Energy developments and their associated infrastructure avoid sensitive areas and through the adoption of best practice wildlife friendly designs that deliver multi-functional green infrastructure. Where this is not possible, there should be mitigation and compensation for losses. In parallel with the AoS of the NPS, HRA is being undertaken which will identify the internationally designated nature conservation areas, where possible establish the likelihood of impacts on the integrity of these sites and identify appropriate avoidance and mitigation measures early in the development of the NPS. The NPS should afford protection to priority species and their habitats. The NPS should explore opportunities for new habitat creation and enhancement associated with energy developments, e.g. through the use of appropriate locally native species in landscaping plans. The potential for biodiversity creation in brownfield sites should	Enhance biodiversity, promote ecosystem resilience and functionality and achieve Biodiversity Net Gain Protect and enhance sites designated for their international importance for nature conservation purposes (linked to separate HRA process for Energy NPS)

components are located within both English and Welsh waters. As of May 2018, there were 68 Ramsar sites in England, totalling an area of 320,648 ha, while Wales has 7 Ramsar sites, totalling 11,366ha. In addition to these internationally designated sites, there are over 4000 SSSIs within England and over 1000 in Wales. There are also 89 MCZs designated in England. There are substantial numbers of NNR and LNR recorded across England and Wales. There are also numerous areas of Ancient Woodland and priority habitats, together with Sites of Nature Conservation Interest (SNCIs) and locally designated wildlife corridor sites. Although these areas are not afforded the highest statutory protection, they contribute significantly towards nature conservation. All sites, from those designated with the very highest level of protection, to those areas at the local level, are threatened by a range of issues such as habitat loss, human encroachment, poor management practices and invasive species. Changes in air and water quality along with a changing climate can also change distribution of species and habitats within these sites. Increased accessibility or proximity of development to designated sites also has the potential to adversely affect them indirectly. The wider green infrastructure network across England and Wales incorporates not only sites designated for nature conservation purposes, but also many other multi-functional green spaces and the connections between such locations. This network is highly susceptible to impacts from development including:		be also taken into account. There should therefore be achievement of Biodiversity Net Gain in areas not formally designated, recognising that a target of 10% is anticipated as part of the forthcoming Environment Bill. Other opportunities for the NPS include the following: • avoid the fragmentation of green infrastructure, by seeking the integration and enhancement of the green infrastructure network to contribute to protecting natural habitats and delivering biodiversity net gain through all new developments; • the need for cohesive habitat networks to help habitats and species adapt to the consequences of climate change; • enhancement of the green infrastructure. Increased accessibility to appropriately designed multi-functional green infrastructure can play a significant role in diverting pressure away from more sensitive sites or areas. The NPS should incorporate measures designed to support the adaptation of biodiversity to the effects of climate change.	

• direct land take (which may contribute to fragmentation) • construction and operational disturbance (noise, vibration, light pollution, etc.) • emissions / contamination (air, water and soil). On the other hand, new development can provide opportunities for increased biodiversity, or to aid certain species. One such example is the National Pollinator Strategy 2014-2024 produced by DEFRA to support bees and other pollinators. In recognition of the continued threats and alarming levels of biodiversity decline, there are a range of commitments made through Strategies, Policy and Action Plans at the International, National and Local levels to halt biodiversity loss and reverse those losses made to date – this has resulted in the need for new development to deliver Biodiversity Net Gain.			
Geodiversity - new development puts pressure on designated geodiversity sites In addition to the three Geoparks designated within England and two in Wales, there are a number of areas designated as SSSI due to having geodiversity, or geodiversity combined with biodiversity importance. These areas are in a mix of conditions, with both favourable and unfavourable occurring. There are also some of the areas in decline, while others are recovering. There are also a range of Regionally Important Geology Sites (RIGS) across England and Wales. Geology across England and Wales is likely to face threats from development; human activities such as pollution, roads, disturbance, farming practices; loss of habitat; and a changing climate.	**Declining** While some of the geodiversity resource is in favourable condition, some is not and all aspects are experiencing threats from development, as well as the need to adapt to climate change. In the absence of the NPS, there is heightened potential for inappropriate greenfield development.	A co-ordinated strategic approach to development and infrastructure is required to limit the potential for inappropriate greenfield development to occur. This will help to manage pressures on SSSIs designated for their geological importance and on RIGS. The NPS presents an opportunity to develop strategic principles designed to control pollution, promote the re-use of previously developed land and tackle some of the causes of climate change, all of which should help to afford protection to the geodiversity resource.	Protect, enhance and promote geodiversity

Greenhouse gas emissions – there is an urgent need to further reduce emissions from the energy sector and reduce energy demand The release into the atmosphere of greenhouse gases (e.g. CO_2, CH_4, N_2O, O_3) resulting from fossil fuel usage, agriculture, land use change and other human activities has been linked with atmospheric warming and global climate change. The United Kingdom has achieved significant cuts to emissions in recent years. Total emissions of direct greenhouse gases have decreased by 44% between 1990 and 2019 and 3% between 2018 and 2019. This decline between 1990 and 2019 is driven predominantly by a decrease in emissions from the energy supply sector – particularly from power stations. CO_2 is the largest contributor to global warming in the UK. As of 2019, CO_2 emissions were 454.8 Mt CO_2 equivalent, 43.8% below the 1990 level. CH4 is the second most significant greenhouse gas in the UK after CO_2 and since 1990, emissions of CH_4 have decreased by 59.7%. As of 2015, methane emissions were 54 Mt CO_2 equivalent. As of 2019, emissions of N_2O were 22 Mt CO_2 equivalent. Emissions of N_2O have declined 55.1% since 1990. Emissions of the F-gases (HFCs, PFCs, SF6 and NF3) totalled 13 Mt CO_2 equivalent in 2019. Since 1990 the overall decrease in their emissions has been 22.6%. Efforts in relation to addressing climate change have been bolstered by a declaration of a Climate Emergency and this has resulted in commitments	**Declining** Interventions at the local and regional level have started to reduce the rate of greenhouse gas emissions; and actions outside the NPS are contributing to decarbonisation of energy networks. However, the underlying trend points towards a slowing of emissions rather than reversal of trends.	The NPS should ensure that reducing CO_2 emissions and achieving Net Zero carbon through promoting low carbon and renewable generation is a core component of development ambitions. There is also a need to seek to minimise energy demand from households, transport and businesses in anticipation of growing pressure on the future supply of electricity as decarbonisation continues across all sectors. The NPS should also ensure that opportunities are taken for maximising tree cover, where practical. Amongst other benefits, careful species selection can contribute to carbon sequestration by absorbing increased amounts of CO_2 from the atmosphere. There is an opportunity for the NPS to coordinate the proposed strategic energy development locations with sustainable infrastructure connections.	Contribute to the national target of reducing carbon emissions to Net Zero by 2050

(made in December 2020 under the UK's Nationally Determined Contribution communication to the UNFCCC[4]) to reducing economy-wide greenhouse gas emissions by at least 68% by 2030, compared to 1990 levels and to bring all greenhouse gas emissions to net zero by 2050. In addition, the Climate Change Committee has recommended a 78% reduction target by 2035 in the 6th Carbon Budget Report[5].			
Adaptation to a changing climate – England and Wales are already seeing the impact of climate change through increased severe weather events, leading to flooding, heat waves and hotter summers. There is a need for development to be climate change resilient The UK's Climate Projections show that the UK as a whole is likely to continue to experience hotter, drier summers, warmer, wetter winters and rising sea levels. This is likely to have a significant effect on a range of environmental conditions, including the water environment through lower and higher flows and heating of water bodies and there is an urgent need to develop climate resilience. Along with an increase in extreme weather events, it is anticipated that a changing climate will lead to an increase in risk to people and place. These increased risks include risks to health and well-being from increase in extremes of temperatures; risk to people, communities and buildings from flooding; risk to viability of coastal communities from sea level rise; risk to health and social care delivery from	**Declining** Climate change is recognised as a global concern with England and Wales, as with the rest of the UK, anticipated to experience hotter, drier summers; warmer, wetter winters; and rising sea levels. These trends are anticipated to continue irrespective of interventions from outside the NPS.	The NPS needs to be realistic and recognise that changes in temperature and rainfall patterns, along with more frequent extreme weather events (for example leading to drought or flood), creates the situation where a greater degree of resilience will have to be incorporated into plans and proposals. Recognition also needs to be made of health implications from a changing climate and the NPS can drive a strategic response to health stressors associated with climate change. There are multiple benefits associated with nature based solutions such as tree planting or peat restoration, including climate change adaptations. Strategic policies present the opportunity to promote this as a means of delivering urban cooling, wildlife benefits, contributing to flood reduction and supporting carbon sequestration. The NPS should recognise the challenges that a changing climate will bring and aim to reduce the impacts. More frequent and	Maximise adaptation and resilience to climate change Enhance biodiversity, promote ecosystem resilience and functionality and achieve Biodiversity Net Gain

[4] UNFCCC is the United Nations Framework Convention on Climate Change
[5] Sixth Carbon Budget - Climate Change Committee (theccc.org.uk)

extreme weather and risk to health from changes in air quality. A changing climate is likely to result in increased frequency and intensity of severe weather events. At present, significant proportions of the UK population are at risk from flooding, although the degree of risk varies, with a range of factors affecting potential risk. Increased flooding and increased flood risk are recognised as being some of the main potential threats from a changing climate due to potential direct risk to properties and infrastructure, as well as potential direct risk to human life and indirect risk to mental wellbeing. In addition, extreme weather events could include increased risk of higher summer temperatures, or severe cold spells. Across England and Wales, areas of potential flood risk from both rivers and coastal sources have been identified and are noted in a series of flood hazard maps and flood management plans. Flood Zones 2 and 3 are located across England and Wales. Very significant numbers of properties are currently at flood risk – for example, in England alone this is in excess of 5.2 million properties.		extreme weather events as well as issues such as sea level rise and coastal change should be considered in any design – this would also include potential risks posed by increased heat, or more intense cold. The NPS should seek to ensure that new development minimises any negative effects arising from flooding and avoids where possible areas of highest flood risk. Flood risk should be considered in any design and the implementation of multi functional green infrastructure including SuDS and other similar appropriate measures or new approaches should be considered and encouraged where feasible. This should include Natural Flood Management and other means of increasing flood storage capacity. The NPS should seek to explore the possibilities for creating blue infrastructure which can both help to manage localised flood risk and simultaneously create new habitats.	
Air Quality – the United Kingdom experiences pockets of poor air quality, principally derived from concentrations of urban and industrial activity, major road infrastructure and congestion Air pollution affects public health, the natural environment and the economy. Air quality has improved in the UK over the last sixty years as a result of the switch from coal to gas and electricity for heating of domestic and industrial premises, stricter controls on industrial emissions,	**Improving** At the national level air quality is generally improving as industrial practices, energy sources and tighter environmental legislation have contributed to reductions in pollutants. However, parts of England and Wales	The NPS should aim to protect and enhance air quality and should seek to ensure that reducing NO_2, $PM_{2.5}$ and PM_{10} emissions is a fundamental principle. The NPS should aim to ensure that no AQMA is worsened, or proposed development does not lead to changes, particularly increases, in traffic / transport that could lead to the declaration of further AQMA. The NPS should aim to exceed Government targets for air quality and be reflective of	Protect and enhance air quality Improve health and well-being and safety for all citizens and reduce

higher standards for the composition of fuel and tighter regulations on emissions from motor vehicles. However, poor air quality – particularly from motor vehicles – remains a significant issue for community health and for biodiversity, especially in/downwind of urban areas and major transport networks. It is also to be noted that the use of solid fuels (including for 'lifestyle' fuel such as wood burners in homes) are recognised as being a major contributor to poor air quality in towns, particularly during winter months. Nevertheless, poor air quality is generally associated with urban/industrial areas and major road infrastructure and this is reflected in the typical location for Air Quality Management Areas (AQMA), many of which have been designated due to high NO2 and PM10 levels. Across England, there are a total of 532 AQMA, while within Wales there were 44, all principally in those areas of greatest population, or areas of particular road congestion and these have impacts both on human health and biodiversity.	experience localised pockets of poor air quality – interventions outside the NPS will seek to address some of these issues, but opportunities exist for the NPS to influence this issue.	appropriate legislation, particularly seeking to deliver health benefits from improved air quality, as well as considering ecological receptors. Recognition should also be made of how new technologies can have air quality implications.	inequalities in health Enhance biodiversity, promote ecosystem resilience and functionality and achieve Biodiversity Net Gain
Water environment –pollutants from a range of sectors including energy pose considerable risks to the quality of water across England and Wales. Additional water demand from energy development would likely put further pressure on water resources. There are considerable pressures on water resources with resulting major impacts on many of the waterbodies across the UK. For the purposes of taking a holistic approach to management of water resources and to address the pressures on the water environment, under the Water Framework Directive	**Stable / Improving** Surface water quality is predicted to remain stable; however, ongoing pressures remain and climate change may compromise improvements.	The NPS should seek to prevent pollution of water bodies (including groundwater and bathing water) both during the construction and operation of any proposed energy development. This could be achieved via the appropriate use of SuDS, green infrastructure or other appropriate measures and new approaches in infrastructure drainage design to enhance water quality and reduce pollution and flood risk. Risk to all types of water bodies (not just main rivers) is to be considered during any development design.	Protect and enhance the water environment Enhance biodiversity, promote ecosystem resilience and functionality and achieve

(WFD), the UK has been divided into a series of River Basin Districts (RBD). As with most water bodies in England, there are a range of significant water management issues manifested across RBD, with pollution from infrastructure being of note. There are also a series of Drinking Water Safeguard Zone (DWSZ) across England and Wales, as well as bathing waters. The number of waterbodies assessed each year varies and has decreased from 10,761 in 2009 to 9,300 in 2018. There was a small decrease in the overall number of water bodies awarded high or good surface water status between 2009 and 2018. In 2018, 35% of surface water bodies assessed under the WFD in the UK were in high or good status. This reflects very little change from 36% of surface water bodies assessed in 2009 and 37% in 2013. It is anticipated that overall water quality will improve as the UK aims to ensure that the objectives of the WFD (all aquatic ecosystems and terrestrial ecosystems and wetlands to reach good chemical and ecological status by 2027). Climate change and a growing population will increase pressure on water resources.		Recognition of the objectives of the WFD should be made and all opportunities to help meet the objectives of the WFD should be taken when possible. Green-blue Infrastructure should be considered in the NPS in the context of the aims of the WFD and how this can realise these, as well as other wider benefits and objectives. Without a coordinated approach to energy development and infrastructure there is increased potential for water availability and pollution problems to result at water bodies, including contamination of drinking water.	Biodiversity Net Gain
Soil and Contaminated Land – soil is a non-renewable resource and is vulnerable to erosion, degradation and contamination. In addition, historic land uses have contributed to contamination across large areas. There is a need to address this in order to enable beneficial re-use of previously developed land and help	**Declining** It is likely that greenfield sites will experience increasing pressure for development in preference to the complexities of redeveloping previously	The NPS should seek to make best use of areas that are already urbanised (or subject to energy / industrial uses) and provide an opportunity for regeneration / improvements to land quality. Measures should be taken to avoid those areas of the highest quality agricultural soils and aim to protect soil and	Protect soil resources and avoid land contamination

protect soil resources from pressure for greenfield development Soil across England and Wales is graded, with those considered Best and Most Versatile (BMV) being noted as Grade 1, 2 and 3a. BMV soils are under pressure in many areas from development in order to support market led growth aspirations. Soil sealing (the covering of the soil surface with impervious material or the changing of its nature so that it becomes impermeable) is associated with development and is a primary cause of soil loss. The development of greenfield sites can lead to loss to valuable agricultural land which generally cannot be mitigated. Many areas of land in the UK have also been contaminated by past industrial and other human activities, including former factories, storage depots and landfills. Energy related infrastructure is also a frequent source of land contamination. Land at the full range of potentially contaminated sites could be contaminated by a wide range of harmful substances such as oils and tars, heavy metals, asbestos and chemicals. While many special sites of contamination have been identified, by its nature, it is often very difficult to know where land has been contaminated previously or is currently suffering ongoing contamination. As such the number of known sites of contamination is likely to be only a very small fraction of the overall number of potentially contaminated sites. Given the present and historic levels of industrial, commercial and transportation activity across England and Wales, in addition to the high levels of urbanisation, it is suggested that the	developed and potentially contaminated sites. This could reduce available high quality soil resources and fail to realise the potential of existing capacity within existing urban and previously developed areas.	agricultural holdings through avoidance of impacts such as contamination or severance. The NPS must protect soils as they are essential natural capital and perform a range of important ecosystem services and functions. Dealing with the past pollution / contamination legacy is a major issue and should be addressed at all opportunities due to its ongoing environmental impact. Note that sub-surface is an increasingly used source of energy and there are further opportunities though there may be implications for issues such as the water environment.	

number of areas of contaminated land could be considerable.			
Cultural Heritage – there is a substantial cultural heritage resource across England and Wales; however, there is considerable variation in the condition and integrity of assets. There is a need for a strategic perspective that promotes contextual understanding and supports regeneration where this contributes to conservation and enhancement Those cultural heritage assets of the greatest recognition in England and Wales are the 22 World Heritage Sites. These sites are recognised as having Outstanding Universal Value and the management plans note that this is to be understood, protected and sustained. In addition, there is also a very large number of Scheduled Monuments across England and Wales (in excess of 24,000), including a large number which are at particular risk of being lost through neglect, decay or deterioration. Similarly, there is a very significant number of listed buildings across England and Wales (in excess of 10,000) and many of these are at particular risk of being lost through neglect, decay or deterioration. Likewise, Conservation Areas are under increasing pressure from development, neglect, decay or deterioration. In addition, Areas of Ancient Woodland, i.e. those areas that have been continuously wooded since at least 1600AD are scattered across England and Wales. These areas have a significant contribution to the cultural heritage of an area and are also of importance to biodiversity and landscape.	**Stable/Declining** Designated heritage assets benefit from protection that will continue without the NPS. However, in the absence of a national level strategic plan there is a greater risk of uncoordinated and piecemeal energy development resulting in contributing to the successive erosion of the quantum and integrity of the nation's cultural heritage resource.	New energy related development may result in pressure on areas of importance for their cultural heritage and aesthetic quality. There is a requirement for development proposals to be carefully considered such that assets are preserved and enhanced – the NPS will need to respond to context such that preservation is pursued where appropriate, but pro-active management and redevelopment can be supported where this secures viable futures for cultural heritage resources that are currently threatened. Additional energy related development may be inappropriately located or designated to pose a risk to the cultural heritage assets as well as their setting. Without a co-ordinated strategic approach to development and infrastructure there is an increased potential for this risk to result. As well as those sites of the very highest value such as World Heritage Sites, similar potential impacts can be identified in respect of the range of scheduled monuments, Listed Buildings, Conservation Areas and locally listed cultural heritage assets. It is important to note that the nature of cultural heritage features means that not all are known at present; in particular, buried archaeological remains. As such, any energy related development should be as sensitively designed as possible to recognise and be sympathetic to the	Protect and enhance cultural heritage assets and their settings, and the wider historic environment

Of course, by its nature, there are also a number of undesignated assets or unknown archaeological remains which could have national regional or local value. The importance of the protection of the historic environment is increasingly being recognised at a national and regional level, with the loss of heritage resources being difficult to mitigate. Development affects the historic environment through loss, damage or changes to setting for instance from visual intrusion, increased traffic, noise, or air pollution.		existing cultural character and quality and opportunities for improving settings should be examined.	
Landscapes & Townscapes – there are marked contrasts in the quality, character and distinctiveness of landscapes and townscapes across England and Wales. There is a need to fully protect the highest quality locations, whilst driving best practice principles through all energy development to address poor landscape and townscape environments. There are a total of 13 National Parks within England and Wales. There are also 34 AONB's in England and 4 within Wales. In addition, there are a total of 46 Heritage Coasts around both England and Wales. England and Wales have been divided into a series of National Character Areas, each with their own characteristics and then further sub-divided into a range of Landscape Character Areas. There are also significant areas designated as Green Belt, with "a fundamental aim to prevent urban sprawl by keeping land permanently open. This designation serves five main purposes of checking unrestricted sprawl in large built up areas; prevents neighbouring towns from merging; assists safeguarding the countryside from encroachment; preserves the setting and special character of	**Improving** Many of the most exceptional landscape and townscapes benefit from protection through designations that will persist in the absence of the NPS. In general terms, modern design principles are promoting a renewed focus on the quality of design and this trend is likely to continue; however, without the NPS energy infrastructure development may lack strategic focus and direction, resulting in variable quality and some pressure on greenfield land.	The NPS should seek to preserve and enhance the character of the wider landscape and townscape by ensuring that its integrity and valuable natural open space is not lost. Particular attention to be paid to those areas designated for their landscape value, such as AONBs. Opportunities for landscape enhancement should be explored, e.g. through sympathetic design and enhancements to existing landscape improvement areas, as well as new planting opportunities associated with new energy development and be in keeping with the aims of the Nature Recovery Network. Increased energy development poses a serious risk to tranquillity through increased disturbance (including light and noise) and visitors. As such, there is a need to protect the special quality of those areas of relative tranquillity of many parts of England and Wales. Without a co-ordinated strategic approach to development and infrastructure degradation of the special qualities of the	Protect and enhance the character and quality of the landscapes and townscapes, protect and enhance visual amenity

historic towns and assists in regeneration , by encouraging the recycling of derelict and other urban land”[6]. While there are areas of great beauty and tranquillity across England and Wales, it is also important to recognise that there are significant parts that are characterised by urban development, major infrastructure and other noise and visual intrusion (including light pollution). This is largely associated with the main urban areas. Nevertheless, there exists across England and Wales, significant elements of green infrastructure that includes for example, parks, open spaces, playing fields, woodlands and private gardens, as well as agricultural and upland areas. This, alongside ‘blue infrastructure’ of rivers, canals, streams and other water bodies can act in a multi-functional way across a range of issues by supporting, for example, biodiversity, carbon storage, natural drainage and flood storage and health and wellbeing. However, increased urbanisation and general development has acted to erode the connectivity of this green and blue infrastructure, resulting in a decrease in its integrity. The townscapes across England and Wales includes substantial cultural heritage assets. There are many areas benefitting from associated designations, which include World Heritage Sites, Conservation Areas and local listings (refer to the cultural heritage key issue description). In many areas, 20th and 21st century redevelopment and regeneration have introduced a juxtaposition of modern architecture		most special areas such as AONBs may result. The NPS should also aim to ensure that energy developments and associated infrastructure avoid sensitive areas and respect particular landscape or townscape settings. Careful consideration should be given to design quality in both an urban and rural setting, promoting placemaking principles and seeking to inject character and distinctiveness where possible and where this enhances the sense of place. Design, where possible, should respond positively to the local characteristics, including vernacular architecture when appropriate. Without a co-ordinated strategic approach to development and infrastructure, there is increased potential for planning decisions to lead to inappropriate development, which could fragment existing networks of open space thereby reducing connectivity.	

[6] National Planning Policy Framework (2019), Paragraphs 133 to 134

with historic fabric, delivering distinctiveness within the townscape. However, there are also areas where the quality and integrity of townscape has been eroded by successive and often piecemeal regeneration activities and there is a need to promote enhanced design through all energy development proposals.			
Resources and Waste – growth continues to be associated with increased resource use and waste generation. There is an urgent need to reverse trends in order to move towards a circular economy where resource efficiency is maximised, and waste generation curbed. New energy development will impact on and interact with a wide range of resources such as energy (fuel) use, use of construction materials (aggregate, concrete, etc.), waste generation and disposal etc. Construction will contribute to increases in the levels of waste generated if building materials are not efficiently used / reused. With more waste being produced, trip kilometres to transport such waste for disposal will result in greater transport trip generation and increased emissions of air pollutants or greenhouse gases. The UK generated 221.0 million tonnes of total waste in 2016, and it is estimated that 41.1 million tonnes of this was commercial and industrial (C&I) waste.. In 2018, 26,411,000 tonnes of Waste from Households (WfH) were generated in the UK with an overall recycling rate of 45%. In England, the recycling rate was 44.7%, in Wales it was 54.1%. Around 14,644,000 tonnes of the UK's municipal waste went to landfill in 2018.	**Declining** Continued growth will contribute towards a trend of increased waste and resource use. Interventions outside the planning system are helping to shift towards greater efficiencies in resource use and adherence to the waste hierarchy, but underlying waste generation volumes are anticipated to increase cumulatively with population growth.	The NPS should seek to reduce consumption of resources such as construction materials, e.g. through encouraging the use of recycled or secondary materials. This will also reduce the need to transport these materials and transport the waste by-products. The NPS can also help reduce the consumption of fuel by helping to promote a shift to more sustainable forms of energy generation (including potentially using waste as a source of energy where it cannot be recycled or reused) and transport such as active modes like cycling and walking, as well as Low and Zero Emission Vehicles by helping to provide / enable the appropriate infrastructure in new development areas. Design of new energy development can help to encourage better recycling, as well as resource sharing initiatives and allow a ‘Circular Economy’ to develop.	Promote sustainable use of resources and natural assets

Total UK commercial and industrial waste, comprising inert, non-hazardous arising which result from trade or businesses, was 41.1 million tonnes in 2017. Around 80% of this total was generated in England. This was split between the commercial and industrial sectors by 27.5 and 13.6 million tonnes respectively.			
Economic activity, opportunity and deprivation – there are marked spatial contrasts in economic activity and GVA by job across England and Wales and the challenge is to achieve more equitable access to opportunity as a means of tackling deprivation. The economy across the UK has been subject to challenging conditions throughout 2020 and into 2021 due to impacts from COVID-19 and 'Brexit'. As of March 2021, it remains uncertain as to how these will continue to impact in coming years. Main points from the ONS note that UK gross domestic product (GDP) is estimated to have increased by a record 16.0% in Quarter 3 (July to Sept) 2020, revised from the first estimate of 15.5% growth. Though this reflects some recovery of activity following the record contraction in Quarter 2 (Apr to June) 2020, the level of GDP in the UK is still 8.6% below where it was at the end of 2019, revised from an initial estimate of 9.7%. Compared with the same quarter a year ago, the UK economy fell by a revised 8.6%. While output in the services, production and construction sectors increased by record amounts in Quarter 3 2020, the level of output remains below Quarter 4 (Oct to Dec) 2019 levels, before the	**Improving** The headline statistics generally show an upward trend in employment and GVA by job; and a falling trend in unemployment. However, there are clear spatial disparities between the value of jobs, which can be a proxy for the quality of job opportunities available. The impact of Covid-19 on these trends is not yet readily apparent in data.	Without the strategic approach to energy development the required development and associated infrastructure is less likely to be provided to encourage investment in areas where highest numbers of residents can benefit from new employment opportunities. The NPS also offers the opportunity to help shape the spatial distribution of employment generation helping to overcome some traditional barriers to opportunities, such as accessibility. The pattern of deprivation across England and Wales is geographically complex, incorporating stark contrasts between wealthy and severely deprived communities. Without the strategic approach to energy development, opportunities to deliver development and infrastructure which can improve equitable and inclusive access to employment and increases in income of local people are less likely to be achieved.	Promote a strong economy with opportunities for local communities

impact of the coronavirus (COVID-19) pandemic was seen. There has been a recovery in private consumption, government consumption and, to a lesser extent, business investment in Quarter 3 2020 in line with the easing of public health restrictions, however, the levels remain below their pre-lockdown level. As of March 2020, the unemployment rate in England was 4%, while it was 3.1% in Wales. Economic activity in the same period was 79.8% in England and 76.4% in Wales. These issues will undoubtedly play a major role in deprivation and economic outcomes for all parts of England and Wales, with those areas of current deprivation most likely to have the worst economic recovery and future outcome. The Indices of Multiple Deprivation show that the majority of the most deprived areas in the UK are located within urban centres of population. The south east, south west and east of England are the least deprived areas in the UK. Deprivation increases in urban areas, with towns and cities generally being more deprived that rural areas. The north west and north east are the most deprived areas of England. Middlesbrough, Knowsley, Kingston upon Hull, Liverpool and Manchester are the five local authority districts with the largest proportions of highly deprived neighbourhoods in England. The south east and north east coast are the most deprived areas in Wales. Deprivation is most concentrated in the south east, around the urban areas of Cardiff, Newport, Swansea and Bridgend. The smaller towns within the valleys of the south east, such as Caerphilly and Merthyr Tydfil are			

similarly deprived. Comparatively the rural areas of Wales are considerably less deprived. These areas have relatively lower income, less access to services, higher unemployment and increased crime rates. There has been little variance in the locations of the most deprived areas of the UK over the last 20 years, with certain areas being in a state of persistent deprivation. It is important to note that there are also pockets of deprivation surrounded by less deprived places in every region of England. These areas have relatively poorer health and well-being in comparison as those classed as less deprived.			
Population growth and demographics – England and Wales have a growing population, with a general underlying trend towards an ageing population, though there are areas with younger population profiles. These demographic characteristics contribute to a complex pattern of highly-contrasting communities, with differing requirements for economic and social infrastructure. The population of England in June 2019 was 56,287,000 which accounts for 84% of the UK's population. The population of Wales in June 2019 was 3,153,000 which accounts for 5% of the UK's population. Over the year to mid-2019, decreasing numbers of births and net international migration have resulted in the slowest rate of growth that the UK has seen in 15 years, returning it to the level seen in mid-2004 at 0.5% (361,000). Despite population growth slowing, this was the 37th consecutive year (since 1982) that the total UK population has increased It is also	**Increasing** Population growth is projected to continue to increase across the UK and the overall trend is towards an ageing population.	Both England and Wales (along with the UK as a whole) are expected to see population growth in the coming years, with the proportion of residents of an older age. This growth will be uneven across the country, with a focus on larger urban areas most likely in relation to population growth (though the move to home working induced by COVID-19 may have implications for smaller towns, villages and rural areas). Smaller villages and rural areas may experience an increasingly older demographic (as would less deprived areas), though again, the implications of COVID-19 are unclear in this regard.	Promote a strong economy with opportunities for local communities

anticipated that the population profile will age, though all age groups will increase in numbers. Local authorities with the highest proportions of older people in the UK are most commonly found in coastal areas of southern and eastern England. The population of the UK is spread unevenly, with the population density ranging from 5,700 people per square kilometre across London to fewer than 50 people per square kilometre in the most rural local authorities of the UK. The south east of England, in particular London and the surrounding areas are highly populated. Large urban areas are located along the south coast, including Brighton, Southampton, Portsmouth and Bournemouth. The midlands and north west are also locations of large urban areas, including Birmingham, Leicester, Nottingham, Greater Manchester and Liverpool. The east, north east and south west of England contain fewer major settlements, however large urban areas are located in these regions, including Newcastle, Sunderland, Leeds and Bristol. The most populated area of Wales is the south coast, where the large urban areas of Cardiff, Newport, Bridgend and Swansea are located. The north coast has fewer major urban settlements, however areas of population are present in Rhyl, Colwyn Bay and Bangor. Central and western Wales have smaller towns and villages distributed throughout the regions.			
Communities: Supporting Physical Infrastructure – infrastructure investment is delivered by a range of providers across the United Kingdom	**Improving** There are various infrastructure investment	There is a role for the NPS in promoting infrastructure provision in a co-ordinated and pro-active manner, delivering the means to	Promote sustainable transport and

and can often be reactive. Significant new infrastructure, or upgrades to existing infrastructure is planned across a range of sectors. The strategic rail network in England is well developed. All major cities are connected as are the majority of significant towns. Extensive rail networks are located around large conurbations such as London and Greater Manchester, with the major cities in the midlands being well connected. Remote, rural and coastal areas are less well served by rail. Both the north and south coast of Wales are well connected by rail, linking the major coastal cities such as Cardiff and Swansea in the south, and Llandudno, Bangor and Holyhead in the north. Few major branch lines extend from these links, and the central and western regions of Wales are comparatively poorly severed by rail. England is covered by a comprehensive network of motorways and A roads. All major cities are served by motorways, whilst towns and larger villages are connected by A routes. Areas not serviced by these connections are generally rural and in areas of low population. The south and north coast of wales are the only areas with motorway connections. The remaining regions are serviced by the A road network which links the major towns and villages. Comparatively the central and upland regions are less provisioned with strategic network links. There is a well-established electricity generation and distribution network across both England and Wales, which is being increasingly utilised for an expanding EV charging network. As would be expected, greatest provision of electricity network capacity is to	plans and programmes being developed and implemented and these should continue to enhance the supporting transport, utilities and digital infrastructure to support growth levels.	catalyse, rather than react to demands for growth. The NPS should seek to ensure that energy development provides opportunities for utilisation of electric vehicles, as well as access to more sustainable transport modes.	minimise detrimental impacts on strategic transport network and disruption to basic services and infrastructure Promote a strong economy with opportunities for local communities

the more urbanised areas. This network is increasingly supplied by renewable sources. As would be expected, there is significant wastewater infrastructure across the area, though, as with other areas there are legacy and capacity issues with some elements. For example, many areas still have both a combined and separate sewer systems for collecting all wastewater and sewage and under heavy storm conditions, the sewer capacity can be exceeded. Consequently, these areas have above average risk for sewer incapacity and also has several frequent spilling storm overflows. Provision of gas networks is variable across the country. Across the United Kingdom, the areas with ultrafast broadband connectivity are mainly located in urban residential areas, though it should be noted that there are pockets within many urban areas where only standard broadband is available.			
Communities: Physical Health and mental wellbeing – in general terms there are significant differences in measures of good physical and mental health as well as life expectancy across England and Wales, many indicators reflecting the spatial distributions of economic activity and income, age, deprivation, race and similar - there is a need to tackle spatial inequalities in health regards. There is also a growing appreciation of the importance of supporting good mental health and generating a sense of well-being as a means of promoting healthy communities. There is a role for the environment in enabling people to feel connected to place; and growing evidence	**Stable / Uncertain** While population levels are likely to continue to rise, there is uncertainty over migration levels due to a lack of clarity on issues such as 'Brexit', COVID-19 and general global economic uncertainty. These factors will all have major implications for health outcomes for the wider	Indirectly, health and wellbeing levels could be improved through secondary effects of policies that help to create healthy environments. This involves the protection of existing and creation of new open spaces, contributing to a strengthened multi-functional green infrastructure network; and policy approaches designed to reduce air pollution, decreasing noise pollution and reducing traffic congestion. Good design principles can combine with broader green infrastructure as key factors in fostering active travel, recreation and healthy lifestyles.	Improve health and well-being and safety for all citizens and reduce inequalities in health

that physical activity and access to nature and opportunities for community interaction is an important contributor to mental health and well-being. It is worth noting that different groups or different areas of the UK feel differently about their lives and have different experiences, however data that compares different UK geographies has not yet been released. Four measures of personal well-being are examined: how satisfied people feel with their lives; how worthwhile they feel the things they do are; how happy they were yesterday; and how anxious they felt yesterday. Overall, personal well-being levels have increased in the UK: • Mental well-being improved by 4.6 percentage points between 2011 and 2016, compared with the EU-28 average change of 2.2 percentage points. • Feelings of worthwhile increased by 4.1 percentage points between 2011 and 2016 in the UK, compared with the EU-28 average decrease of 0.5 percentage points. • There was little change in ratings of happiness between 2011 and 2016, but the UK remains similar to the EU-28 average of 7.4 out of 10. According to data from the Organisation for Economic Co-operation and Development (OECD), the average (mean) rating of life satisfaction of people aged 15 years and over in the UK was 6.7 out of 10 from 2014 to 2016. According to 2016 data from the European Quality of Life Survey (EQLS), 86% of adults aged 18 years and over in the UK agreed or strongly agreed that	population but particularly for those in more deprived or vulnerable groups. Population profiles are also likely to continue to get older – this will likely result in changes to overall health outcomes with an increased number of long-term conditions and place an increasing burden on health provision and facilities.	The NPS should seek to ensure continued access to and provision of quality greenspace along with improvement of the physical environment in general. Ensuring continued or enhanced access to employment, educational, recreational / leisure and health services and facilities, along with adequate provision, should also be a priority. Improved walking and cycling facilities, along with open spaces and outdoor recreational facilities are vital to ensuring people have opportunities to undertake informal and formal physical activity outdoors in a safe manner. This will help to increase physical activity levels and improve general health and wellbeing. The NPS needs to ensure that energy developments are safe, both in terms of crime as well as accidents and engender a perception of safety.	

they generally felt that what they did in life was worthwhile. This was a 4.1-percentage point increase from 2011, where 82% agreed or strongly agreed. When the EQLS asked adults aged 18 years and over to rate how happy they were, the average happiness rating for the UK was 7.8 out of 10 in 2016. The EQLS also asked adults aged 18 years and over the questions on the World Health Organisation's (WHO-5)'s mental well-being index. This comprises five questions about feeling cheerful, calm, active, rested, and interested. A higher percentage score on the index indicates better mental well-being. The UK scored an average of 63.2% on the scale in 2016; an increase from 58.6% in 2011. Loneliness was measured on the European Quality of Life Survey (EQLS) by asking adults aged 18 years and over to rate how often they felt lonely in the past two weeks. In 2016, of respondents in the UK, 5% reported that they felt lonely most or all of the time, compared with 7% in 2011. The labour market shocks associated with the coronavirus pandemic have been felt more by young people and the lowest paid; people aged under 30 years and those with household incomes under £10,000 were around 35% and 60%, respectively, more likely to be furloughed than the general population. Measurements of health and well-being as a result of the coronavirus pandemic are still to be confirmed and indications of mental health issues such as anxiety are being preliminarily explored. The reliability of such data is unknown at this stage. Crime across England shows regional variations, with the South West (particularly those rural parts)			

having the lowest rate of crime in 2018/19 (67.8 per 1000 people, as opposed to 110.3 per 1000 people in the north east). The level of crime has been broadly stable in recent years however, the latest figures from the Crime Survey for England and Wales estimate a significant 9% reduction in the year ending March 2020. Underlying this were significant falls in theft (12%) and criminal damage (13%) and almost all other crime types saw non-significant falls. However, while the most recent crime rate appears to be falling, it is unclear to what extent Covid-19 is impacting crime rates.			

4.3: Appraisal Objectives and Guide Questions (AoS Framework)

The establishment of appropriate objectives and guide questions is central to the appraisal process and provides a method to enable the consistent and systematic assessment of the effects of the NPSs. The appraisal objectives described in this section have been informed by: the examination of the baseline evidence, incorporating the identification of key issues; the review of plans and programmes; and comments received during the consultation on the Scoping Report (see Appendix B). Their development also reflects national guidance on SEA and SA practice. Broadly, the objectives present the preferred social, economic or environmental outcome which typically involves minimising detrimental effects and enhancing positive effects where relevant. Guide questions were also developed for each of the objectives to illustrate its relevance to energy infrastructure development and give more detail and focus to the appraisal process. Table 4-5 sets out the AoS Framework.

Table 4-5 - AoS Objectives and Guide Questions

No	AoS Objective	Guide Questions
1	Consistent with the national target of reducing carbon emissions to Net Zero by 2050	Will the NPS… • Reduce carbon emissions of the national portfolio of major energy infrastructure? • Reduce direct and indirect emissions of all greenhouse gases, including carbon dioxide, during construction, operation and decommissioning? • Maximise supply of energy from low carbon/renewable energy sources / use of low carbon/renewable energy? • Maximise opportunities for making use of waste heat? • Use negative carbon emissions to offset residual emissions from energy such as Bioenergy with Carbon Capture & Storage (BECCS) and Nature Based Solutions? • Create new carbon sinks/removals through natural sequestration including that provided by green Infrastructure and soils and protection of key habitats which contribute to carbon sequestration?
2	Maximise adaptation and resilience to climate change* *Adaptation is about taking steps to live with the effects of climate change such as building quay walls and flood barriers.	Will the NPS… • Promote future proofing of energy infrastructure against the effects and risks of climate change (e.g. flooding, sea level rise, coastal erosion)? • Lead to major infrastructure development that is flood resilient over its lifetime, considering the effects of climate change, without increasing the flood risk elsewhere and identifying opportunities to reduce the risk overall? • Minimise the risk and impact of flooding from all sources for the lifetime of the development? • Avoid development in flood risk areas (whether existing or future) when possible? • Manage the risks of flooding and coastal erosion, particularly through working with nature based solutions?

	Resilience is the ability of a system to adsorb and bounce back after an adverse event.	• Encourage energy infrastructure design for successful adaptation to the predicted changes in weather conditions and frequency of extreme weather events (freezing, heat waves, intense storms)?
3	Enhance biodiversity, promoting net gain, and supporting ecosystem resilience and functionality	Will the NPS… • Protect and enhance nationally designated sites such as SSSIs, National Nature Reserves and Marine Conservation Zones, including those of potential or candidate designation? • Protect and enhance valued habitat and populations of protected/scarce species on locally designated sites, including Key Wildlife Sites, Local Wildlife Sites and Local Nature Reserves? • Protect the structure and function/ecosystem processes, including in the marine environment? • Protect and enhance the Nature Recovery Network? • Protect and enhance priority habitats, and the habitat of priority species? • Promote new habitat creation or restoration and linkages with existing habitats? • Protect and enhance the wider green infrastructure network? • Increase the resilience of biodiversity to the potential effects of climate change? • Promote a net gain in biodiversity for any new major infrastructure development?
4	Protect and enhance sites designated for their international importance for nature conservation purposes (linked to separate HRA process for Energy NPS)	Will the NPS… • Avoid the loss of sites of international importance (SPAs, SACs and Ramsar sites), including those of potential designation (candidate SPAs, proposed SACs, Sites of Community Importance (SCI) and proposed Ramsar sites) both onshore and offshore? • Support continued improvements to the condition status of the UK's national site network?
5	Protect and enhance cultural heritage assets and their settings, and the wider historic environment	Will the NPS… • Conserve and enhance designated heritage assets and their settings (World Heritage Sites, Scheduled Monuments, Listed Buildings and structures, Registered Parks and Gardens, Registered Battlefields and Conservation Areas), as well as maritime assets such as protected wrecks? • Conserve and enhance non-designated and / or locally listed heritage assets (including newly discovered heritage assets and archaeology) and their settings? • Avoid significant harm to heritage assets, for example from the generation of noise, pollutants and visual intrusion?

		• Ensure appropriate archaeological assessment prior to development? • Maintain or improve the interpretation, understanding and appreciation of the historic environment?
6	Protect and enhance the character and quality of the landscapes and townscapes, protect and enhance visual amenity	Will the NPS… • Support the integrity of any areas designated for landscape value, including in conjunction with the provisions of any relevant Management Plan (e.g. AONB and local landscape designations)? • Conserve and enhance the intrinsic character or setting of local landscapes or townscapes or waterscapes? • Minimise noise and light pollution from construction and operational activities on residential amenity and on sensitive locations, receptors and views? • Conserve, protect and enhance natural environmental assets (e.g. parks and green spaces, common land, woodland / forests etc) where they contribute to landscape and townscape quality?
7	Protect and enhance the water environment	Will the NPS… • Protect ground, surface, estuarine and coastal water quality? • Safeguard the availability of water resources (surface and groundwater)? • Minimise the use of water resources / water consumption?
8	Protect and enhance air quality	Will the NPS… • Minimise emissions of dust and other air pollutants that affect human health or biodiversity? • Improve air quality within AQMAs and avoid the need for new AQMAs? • Promote enhancements to green infrastructure networks to help improve air quality?
9	Protect soil resources and avoid land contamination	Will the NPS… • Assist in facilitating the re-use of previously developed land? • Avoid development upon the best and most versatile agricultural land? • Ensure the protection of soil resources and reduce soil quality degradation? • Seek to remediate contaminated land?
10	Protect, enhance and promote geodiversity	Will the NPS… • Protect and enhance geodiversity resource? • Protect or enhance SSSIs designated for their geological interest? • Avoid the degradation and removal, wherever possible, of RIGS? • Support access to, interpretation and understanding of geodiversity?
11	Improve health and well-being and safety for all citizens and reduce	Will the NPS… • Protect the health of communities through prevention of accidental pollutant discharges, exposure to electric and magnetic fields, shadow flicker or radiation?

	inequalities in health	• Minimise nuisance on communities and their facilities including air, noise and light pollution? • Provide for facilities that can promote more social interaction and a more active lifestyle and enjoyment of the countryside and coasts? • Promote initiatives that enhance safety and personal security for all? • Support enhanced security, reliability and affordability of the national energy supply?
12	Promote sustainable transport and minimise detrimental impacts on strategic transport network and disruption to basic services and infrastructure	Will the NPS… • Prevent adverse changes to strategic transport infrastructure road/rail/airport? • Prevent loss or disruption to basic services and infrastructure (e.g. electricity, gas)? • Promote transportation of goods and people by low/zero carbon transport modes? • Reduce travel distances to work and reduce the need for out commuting? • Facilitate working from home, remote working and home-based businesses?
13	Promote a strong economy with opportunities for local communities	Will the NPS … • Support enhanced security, reliability and affordability of the national energy supply? • Support creation of both temporary and permanent jobs and increase skills, particularly in areas of need? • Have wider socio-economic effects such as changes to the demographics, community services or house prices?
14	Promote sustainable use of resources and natural assets	Will the NPS… • Reduce consumption of materials, energy and resources? • Promote sustainable waste management practices in line with the waste hierarchy? • Encourage the use of recycled and / or secondary materials? • Promote the use of low carbon materials and technologies? • Produce waste by-products that require appropriate management? • Provide for safe and secure interim storage of waste, where necessary? • Promote the use of local suppliers that use sustainably-sourced and locally produced materials? • Support enhanced security, reliability and affordability of the national energy supply?

5: Assessment for Overarching NPS for Energy EN-1 (AoS-1)

5.1: Introduction

The findings of the AoS of the draft Overarching Energy NPS (EN-1) are set out in this section of the report and address each of the AoS Objectives in turn. Many issues and effects for sustainability are cross-cutting and effects are reported where they are most relevant to avoid duplication of appraisal. Inter- relationships between topics and likely significant secondary, synergistic and cumulative effects are also reported where appropriate in each topic. Where significant adverse effects were predicted, possibilities for mitigation were suggested.

Recommendations for clarifying and strengthening of the NPS were discussed with BEIS in an iterative fashion and the following sets out the assessment of the NPS as published for public consultation.

Technology specific sustainability effects are reported in detail in AoSs 2-5 (Sections 6 to 9 in this report); appraisal findings reported here relate to likely generic effects and the overall effects for the Overarching NPS (EN-1).

Note that for all assessments there is uncertainty as to the precise level of effect as this will be dependent upon the precise nature of the energy infrastructure and the area within which it is to be located.

5.2: AoS Objective 1: Consistent with the national target of reducing carbon emissions to Net Zero by 2050

5.2.1: Anticipated Effects

EN-1 excludes highly carbon intensive new coal and large scale oil-fired electricity generation from the need case as they are not consistent with the transition to net zero and recognises that there is an urgent need for different energy technologies to meet the decarbonisation target of Net Zero (100% reduction) by 2050 and the interim Government targets of reducing GHGs emissions by 68% by 2030 and 78% by 2035, from 1990 levels.

Known technologies that are included within the scope of EN-1 are: Offshore Wind (including floating wind), Solar PV, Wave, Tidal Range, Tidal Stream, Pumped Hydro, Energy from Waste (including ACTs) with or without CCS, Biomass with or without CCS, Natural Gas with or without CCS, low carbon hydrogen, large-scale nuclear, Small Modular Reactors, Advanced Modular Reactors, and fusion power plants. The need for all these types of infrastructure is established by this NPS and is urgent.

In addition, EN-1 sets out that the use of unabated natural gas for heat and electricity, and crude oil to provide fuels for transport will still be needed during the transition to a Net Zero economy and that some residual unabated gas or oil may even be needed beyond 2050. It notes that this can be consistent with the Net Zero target if the emissions from their use are balanced by from Greenhouse Gas Removal technologies, such as Bioenergy with Carbon Capture and Storage (BECCS) or Direct Air Carbon Capture and Storage (DACCS).

5.2.2: Approach to Development and Mitigation in EN-1

Operational carbon emissions

Although renewable, nuclear and hydrogen electricity generation technologies do not emit carbon during their operational life, other technologies identified in the NPS such as Natural Gas, Biomass and Energy from Waste will need CCS to reduce operational carbon emissions.

EN-1 sets out that Government will put in place a commercial framework which will enable developers to finance the construction and operation of a power CCS plant and stimulate a pipeline of projects. A business model based on the existing CfD framework will be introduced, adapted so that price signals incentivise power CCS to play a role in the system, which complements renewables. The Government are also bringing forward details in 2021 of a revenue mechanism to bring through private sector investment into industrial carbon capture and hydrogen projects via their new business models to support these projects.

In addition, the Government will use other levers to encourage further decarbonisation within the power sector:

- UK Emissions Trading Scheme (UKETS) - The UKETS will promote cost-effective decarbonisation, allowing businesses to cut carbon where it is cheapest to do so and thereby promote innovation and growth for UK businesses. The government is developing the scheme to expand its remit to help support the UK's negative emissions capacity. The UK ETS replaces the UK's participation in the EU Emissions Trading System and is a crucial step in achieving the UK's net zero target.
- Carbon Price Support (CPS) – The CPS is a tax on power sector CO_2 emissions that was established to accelerate decarbonisation by strengthening the price signal from the EU ETS allowance price. Currently, the CPS is added to the level of the UK ETS allowance price and HMT announced at the Budget 2021 that it would remain at £18/tCO_2 until 2022/23.
- Emissions Performance Standard (EPS) - The EPS is a regulatory backstop to ensure that new fossil fuel-fired electricity generation contributes to electricity security of supply in a manner consistent with the UK's decarbonisation objectives. It places a limit on the carbon dioxide emissions produced by fossil-fuel generation plants, which is currently set at of 450gCO_2/kWh for those plants above 50MWe operating at baseload and which received development consent after 18 February 2014.

EN-1 sets policies concerning CCS for natural gas, in addition to Carbon Capture Readiness (CCR) and Combined Heat and Power (CHP) requirements as follows.

Carbon Capture and Storage

EN-1 sets out that the Government has made its ambitions for CCS clear – committing to providing funding to support the establishment of CCS in at least four industrial clusters by 2030 and supporting, using consumer subsidies, at least one privately financed gas CCS power station by 2030. The barriers to CCS deployment to date have been commercial rather than technical, and the business models, which may evolve overtime, aim to support the deployment of the technology. The types of environmental impacts of a gas-fired power CCS station could be similar to an unabated gas-fired power station, and so the assessment principles for the generating station covered in EN2 should be similarly applied. Gas-fired power CCS stations may still emit residual CO_2 and so will be required to comply with any Emission Performance Standards that might be applicable, but this is not part of the consents process. The carbon capture plant required for a new build power CCS plant can

be included as associated development in the application for development consent for the relevant thermal generating station and will then be considered as part of that application.

Carbon Capture Ready

The Government's policy and criteria for CCR for new and refurbishing combustion generating stations with a generating capacity at or over 300 MW are set out in EN-1. If an application does not demonstrate that CCR has been assessed according to this policy, the Secretary of State should seek further information from the applicant. The Secretary of State should not give development consent unless it is satisfied that the proposed development meets all the criteria for CCR set out in EN-1 and is, therefore, CCR.

The Secretary of State should impose requirements on any consent, requiring operators to demonstrate:

1. that sufficient space is available on or near the site to accommodate carbon capture equipment in the future;
2. the technical feasibility of retrofitting their chosen carbon capture technology;
3. that a suitable area of deep geological storage offshore exists for the storage of captured CO_2 from the proposed power station;
4. the technical feasibility of transporting the captured CO_2 to the proposed storage area; and
5. the likelihood that it will be economically feasible within the power station's lifetime, to link it to a full CCS chain, covering retrofitting of capture equipment, transport and storage.

EN-1 notes that "*the Energy White Paper, published in December 2020, committed to consult on proposals to update the Carbon Capture Readiness requirements to reflect technological advances, such as conversion to low carbon hydrogen, and apply them more broadly, by removing the 300MW threshold and including all combustion technologies within scope. If that consultation leads to changes in the relevant legal or policy framework then those new requirements will apply and this NPS will be updated to reflect any revised requirements ahead of designation. In the meantime, CCR policy remains as set out in this section".*

Combined Heat and Power

The Government's strategy for CHP is described in EN-1. It notes in developing proposals for new thermal generating stations, developers should consider the opportunities for CHP from the very earliest point and it should be adopted as a criterion when considering locations for a project. Applicants are required either to include CHP or present evidence in the application that the possibilities for CHP have been fully explored. It is noted that if an application does not demonstrate that CHP has been considered the Secretary of State should seek further information from the applicant. The Secretary of State should not give development consent unless it is satisfied that the applicant has provided appropriate evidence that CHP is included or that the opportunities for CHP have been fully explored

For non-CHP stations, where there is reason to believe that opportunities to supply heat through CHP may arise in the future, the Secretary of State may also require that developers ensure that their stations are 'CHP ready' and are designed in order to allow heat supply at a later date.

EN-1 notes that CHP may require additional space than for a non-CHP generating station. It is possible that this might conflict with space required for a generating station to be CCR. The material provided by applicants should therefore explain how the development can both

be ready to provide CHP in the future and also be CCR or set out any constraints (for example space restrictions) which would prevent this.

Carbon emissions in planning applications

EN-1 notes (in a section related to 'Greenhouse Gas Emissions') that significant levels of energy infrastructure development are vital to ensure the decarbonisation of the UK economy. The construction, operation and decommissioning of that energy infrastructure will in itself lead to greenhouse gas emissions. While all steps should be taken to reduce and mitigate climate change impacts, it is accepted that there will be residual emissions from energy infrastructure, particularly during the economy wide transition to net zero, and potentially beyond. EN-1 therefore requires that all proposals for energy infrastructure projects should include a carbon assessment as part of their ES. This should include:

- A whole life carbon assessment showing construction, operational and decommissioning carbon impacts;
- An explanation of the steps that have been taken to drive down the climate change impacts at each of those stages;
- Measurement of embodied carbon impact from the construction stage;
- How reduction in energy demand and consumption during operation has been prioritised in comparison with other measures;
- How operational emissions have been reduced as much as possible through the application of best available technology for that type of technology;
- Calculation of operational energy consumption and associated carbon emissions;
- Whether and how any residual carbon emissions will be (voluntarily) offset or removed using a recognised framework; and
- Where there are residual emissions, the level of emissions and the impact of those on national and international efforts to limit climate change, both alone and where relevant in combination with other developments at a regional or national level, or sector level, if sectoral targets are developed.

EN-1 also notes that the Secretary of State must be satisfied that the applicant has as far as possible assessed the greenhouse gas emissions of all stages of the development.

In addition, EN-1 notes that the Secretary of State should be content that the applicant has taken all reasonable steps to reduce the greenhouse gas emissions of the construction and decommissioning stage of the development. The Secretary of State should also give positive weight to projects that embed nature-based or technological processes to mitigate or offset the emissions of construction and decommissioning within the proposed development. However, in light of the vital role energy infrastructure plays in the process of economy wide decarbonisation, the Secretary of State accepts that there are likely to be some residual emissions from construction and decommissioning of energy infrastructure.

EN-1 further notes that the Secretary of State should be content that the applicant has taken all reasonable steps to reduce the greenhouse gas emissions of the construction and decommissioning stage of the development. The Secretary of State should also give positive weight to projects that embed nature-based or technological processes to mitigate or offset the emissions of construction and decommissioning within the proposed development. However, in light of the vital role energy infrastructure plays in the process of economy wide decarbonisation, the Secretary of State accepts that there are likely to be some residual emissions from construction and decommissioning of energy infrastructure.

EN-1 notes that operational greenhouse gas emissions are a significant adverse impact from some types of energy infrastructure which cannot be totally avoided (even with full deployment of CCS technology). Given the characteristics of these and other technologies and the range of non-planning policies aimed at decarbonising electricity generation such as UK ETS, Government has determined that operational greenhouse gas emissions are not reasons to prohibit the consenting of energy projects including those which use these technologies or to impose more restrictions on them in the planning policy framework than are set out in the energy NPSs (e.g. the CCR requirements). Any carbon assessment will include an assessment of operational greenhouse gas emissions, but the policies set out in Part 2 to the NPS, including the UK ETS, apply to these emissions. Operational emissions will be addressed in a managed, economy-wide manner, to ensure consistency with carbon budgets, net zero and our international climate commitments. The Secretary of State does not, therefore need to assess individual applications for planning consent against operational carbon emissions and their contribution to carbon budgets, net zero and our international climate commitments.

Applicants should look for opportunities within the proposed development to embed nature-based or technological solutions to mitigate or offset the emissions of construction and decommissioning.

To be taken into account in the Secretary of State's decision making, steps taken to minimise and offset emissions should be set out in a Greenhouse Gas Reduction Strategy, secured under the development consent order.

5.2.3: Assessment made in respect of EN-1

EN-1 provides a clear steer on the range of energy technologies that are necessary to achieve the decarbonisation target. As opposed to Renewables, Nuclear and Green Hydrogen technologies, Natural Gas, Waste to Energy and Biomass technologies produce operational carbon emissions that will need to be captured and stored if they are to be aligned with the Net Zero target.

However, EN-1 doesn't set out requirements for CCS from the outset for any of these three technologies thus allowing for the development of unabated energy generation plant as long as they are capable of being retrofitted with CCS. EN-1 sets out requirements for CCR and CHP in relation to Natural Gas and Biomass, namely that all commercial scale (at or over 300 MW) combustion power stations (including gas, coal, oil or biomass) have to be constructed Carbon Capture Ready (CCR) and that applicants are required either to include CHP or present evidence in the application that the possibilities for CHP have been fully explored in their planning applications. EN-1 also notes that "the Energy White Paper, published in December 2020, committed to consult on proposals to update the Carbon Capture Readiness requirements to reflect technological advances, such as conversion to low carbon hydrogen, and apply them more broadly, by removing the 300MW threshold and including all combustion technologies within scope. If that leads to changes in the relevant legal or policy framework then those new requirements will apply and this NPS will be updated to reflect any revised requirements ahead of designation. In the meantime, CCR policy remains as set out in this section".

The CCR requirements do not apply to Energy from Waste plant. It is noted that carbon emissions from Energy from Waste (EfW) plants in the UK already exceed the cement and chemical industries and are almost on a par with emissions from refining iron and steel[7]. That figure is set to nearly double based on new EfW plants in construction or development.

[7] Can Energy from Waste drive CCS Energy? - Energy Systems Catapult

Fitting these plants with CCS, or as minimum making sure that any new such plant is CCR, would support economy-wide decarbonisation.

EN-1 acknowledges that unabated natural gas for heat and electricity, and crude oil to provide fuels for transport will still be needed during the transition to a Net Zero economy and that some residual unabated fossil fuels may even be needed beyond 2050. It notes that this can be consistent with the Net Zero target if the emissions from their use are balanced by negative emissions from Greenhouse Gas Removal technologies.

However, as an energy NPS, EN-1 does not cover Greenhouse Gas Removal technologies (except for BECCS in EN-3), the strategic approach to remove residual unabated emissions is thus unclear.

Chapter 2 of EN-1 does set out the Government's commitment to deliver net zero and the carbon budgets and notes that the government plans to "publish a comprehensive Net Zero Strategy ahead of COP26, setting out the Government's vision for transitioning to a net zero economy. This will outline our path to meet net zero by 2050, our carbon budgets and NDC". This is understood to be the correct vehicle for a Greenhouse Gas Removal Strategy rather than EN-1.

Further discussion of the potential impacts regarding unabated Natural Gas and Biomass and Waste to Energy is provided in AoS-2 for the Natural Gas Infrastructure NPS (see Section 6) and AoS-3 for the Renewable Infrastructure NPS (see Section 7).

Chapter 2 of EN-1 also sets out the levers outside of the planning system that can be used to reduce operational emissions from the energy sector, including emissions performance standards and carbon pricing which will be adjusted over time to ensure the Net Zero target is met.

EN-1 requires that a carbon assessment should be used to drive down greenhouse gas emissions at every stage of the proposed development and ensure that emissions are minimised as far as possible for the type of technology, taking into account the overall objectives of ensuring our supply of energy always remains secure, reliable and affordable, as we transition to net zero.

Considering the policy in EN-1 as discussed above, Table 5-1 provides the assessment of EN-1. Minor positive effects are predicted in the short term as unabated combustion technologies are potentially permitted alongside renewables and nuclear technologies. In the medium to long term, the effects become significant positive as earlier unabated combustion technologies get retrofitted with CCS, any new combustion technology is with CCS and renewables make a very significant proportion of the energy mix. Residual emissions from unabated natural gas plants used for peaking could still occur but they will be balanced by Greenhouse Gas Removal technologies. It is noted that this assessment does not consider the effects of Low Carbon Hydrogen production as EN-1 does not set provisions in this respect.

Table 5-1 - Reducing Carbon emissions to Net Zero Objective Summary

AoS Objective	**Assessment of generic effects (by timescale)**		
	S	M	L
Consistent with the national target of reducing carbon emissions to Net Zero by 2050 Guide questions:	**+**	**++**	**++**

• Reduce carbon emissions of the national portfolio of major energy infrastructure? • Reduce direct and indirect emissions of all greenhouse gases, including carbon dioxide, during construction, operation and decommissioning? • Maximise supply of energy from low carbon/renewable energy sources / use of low carbon/renewable energy? • Maximise opportunities for making use of waste heat? • Use negative carbon emissions to offset residual emissions from energy such as Bioenergy with Carbon Capture & Storage (BECCS) and Nature Based Solutions? • Create new carbon sinks/removals through natural sequestration including that provided by green Infrastructure and soils and protection of key habitats which contribute to carbon sequestration?			

5.3: AoS Objective 2: Maximise adaptation and resilience to climate change

5.3.1: Anticipated Effects

EN-1 sets out that climate change is likely to mean that the UK will experience hotter, drier summers and warmer, wetter winters. There is a likelihood of increased flooding, drought, heatwaves, and intense rainfall events, as well as rising sea levels. Adaptation is therefore necessary to deal with the potential impacts of these changes that are already happening.

EN-1 focuses on effects of onshore energy projects only. It recognises that the construction of an onshore energy project on the coast may involve, for example, dredging, dredge spoil deposition, cooling water, culvert construction, marine landing facility construction and flood and coastal protection measures which could result in direct effects on the coastline, seabed and marine ecology and biodiversity. Additionally, indirect changes to the coastline and seabed might arise as a result of a hydrodynamic response to some of these direct changes. This could lead to localised or more widespread coastal erosion or accretion and changes to offshore features such as submerged banks and ridges.

EN-1 recognises that flooding is a natural process that plays an important role in shaping the natural environment. However, flooding threatens life and causes substantial disruption and damage to property. The effects of weather events on the natural environment, life and property can be increased in severity both as a consequence of decisions about the location, design and nature of settlement and land use, and as a potential consequence of future climate change.

5.3.2: Approach to Development and Mitigation as set out in EN-1

EN-1 recognises that new energy infrastructure will typically be a long-term investment and will need to remain operational over many decades, in the face of a changing climate. There is a likelihood of increased flooding, drought, heatwaves, and intense rainfall events, as well as rising sea levels and coastal change. Adaptation is therefore necessary to deal with the

potential impacts of these changes that are already happening. Consequently, applicants must consider the impacts of climate change when planning the location, design, build, operation and, where appropriate, decommissioning of new energy infrastructure. It then sets out generic considerations that applicants and the Secretary of State should take into account to help ensure that energy infrastructure is resilient to climate change.

The Secretary of State should be satisfied that applicants for new energy infrastructure have taken into account the potential impacts of climate change using the latest UK Climate Projections and associated research and expert guidance (such as the Environment Agency's Climate Change Allowances for Flood Risk Assessments) available at the time the ES was prepared to ensure they have identified appropriate mitigation or adaptation measures. This should cover the estimated lifetime of the new infrastructure. Should a new set of UK Climate Projections or associated research become available after the preparation of the ES, the Secretary of State should consider whether they need to request further information from the applicant.

In addition, the Secretary of State should be satisfied that there are no features of the design of new energy infrastructure critical to its operation which may be seriously affected by more radical changes to the climate beyond that projected in the latest set of UK climate projections, taking account of the latest credible scientific evidence on, for example, sea level rise (for example by referring to additional maximum credible scenarios – i.e. from the Intergovernmental Panel on Climate Change or EA) and that necessary action can be taken to ensure the operation of the infrastructure over its estimated lifetime.

EN-1 notes that applicants should assess the impacts on and from their proposed energy project across a range of climate change scenarios, in line with appropriate expert advice and guidance available at the time. Applicants should be able to demonstrate that proposals have a high level of climate resilience built-in from the outset and how proposals can be adapted over their predicted lifetimes to remain resilient to a credible maximum climate change scenario. These results should be considered alongside relevant research which is based on the climate change projections. The resilience of the project to climate change should be assessed by the applicant in the ES accompanying an application.

In addition, in preparing measures to support climate change adaptation applicants should consider whether nature-based solutions could provide a basis for such adaptation. EN-1 further notes that in addition to avoiding further greenhouse gas emissions when compared with some more traditional adaptation approaches, nature based solutions can also result in biodiversity benefits as well as increasing absorption of carbon dioxide from the atmosphere. Cross reference is also made to elsewhere within EN-1 which further explores the role of green infrastructure.

EN-1 deals with Coastal Change specifically for onshore energy infrastructure projects situated on the coast, which should:

- ensure that policies and decisions in coastal areas are based on an understanding of coastal change over time;
- prevent new development from being put at risk from coastal change by:
    i. avoiding inappropriate development in areas that are vulnerable to coastal change or any development that adds to the impacts of physical changes to the coast, and
    ii. directing development away from areas vulnerable to coastal change.
- ensure that the risk to development which is, exceptionally, necessary in coastal change areas because it requires a coastal location and provides substantial

economic and social benefits to communities, is managed over its planned lifetime; and

- ensure that plans are in place to secure the long-term sustainability of coastal areas.

Where relevant, applicants should undertake coastal geomorphological and sediment transfer modelling to predict and understand impacts and help identify relevant mitigating or compensatory measures. The ES should include an assessment of the effects on the coast.

For any projects involving dredging or disposal into the sea, the applicant should consult the Marine Management Organisation (MMO) at an early stage. Where the project has the potential to have a major impact in this respect, this is covered in the technology-specific NPSs.

The applicant should be particularly careful to identify any effects of physical changes on the integrity and special features of Marine Protected Areas (MPAs). These could include Marine Conservation Zones, candidate marine Special Areas of Conservation (SACs), coastal SACs and candidate coastal SACs, coastal Special Protection Areas (SPAs) and potential coastal SPAs, Ramsar sites, Sites of Community Importance (SCIs) and potential SCIs and Sites of Special Scientific Interest.

The Secretary of State should be satisfied that the proposed development will be resilient to coastal erosion and deposition, taking account of climate change, during the project's operational life and any decommissioning period. Proposals that aim to facilitate the relocation of existing energy infrastructure from unsustainable locations which are at risk from coastal change, should be supported where it would result in climate-resilient infrastructure.

The Secretary of State should not normally consent new development in areas of dynamic shorelines where the proposal could inhibit sediment flow or have an adverse impact on coastal processes at other locations. Impacts on coastal processes must be managed to minimise adverse impacts on other parts of the coast. Where such proposals are brought forward consent should only be granted where the Secretary of State is satisfied that the benefits (including need) of the development outweigh the adverse impacts.

The Secretary of State should ensure that applicants have restoration plans for areas of foreshore disturbed by direct works and will undertake pre- and postconstruction coastal monitoring arrangements with defined triggers for intervention and restoration.

The Secretary of State should examine the broader context of coastal protection around the proposed site, and the influence in both directions, i.e. coast on site, and site on coast.

The Secretary of State should consult the MMO on projects which could impact on coastal change, since the MMO may also be involved in considering other projects which may have related coastal impacts. In addition to this NPS the Secretary of State must have regard to the appropriate marine policy documents, as provided for in the Marine and Coastal Access Act 2009. The Secretary of State may also have regard to any relevant SMPs.

Applicants should propose appropriate mitigation measures to address adverse physical changes to the coast, in consultation with the MMO, the EA/NRW, LPAs, other statutory consultees, Coastal Partnerships and other coastal groups, as it considers appropriate. Where this is not the case the Secretary of State should consider what appropriate mitigation requirements might be attached to any grant of development consent.

EN-1 notes the Secretary of State should be satisfied that the proposed development will be resilient to coastal erosion and deposition, taking account of climate change, during the project's operational life and any decommissioning period. Proposals that aim to facilitate the relocation of existing energy infrastructure from unsustainable locations which are at risk

from coastal change, should be supported where it would result in climate-resilient infrastructure.

EN-1 also deals with Flood Risk. It recognises that having resilient energy infrastructure not only reduces the risk of flood damages to the infrastructure, it also reduces the disruptive impacts of flooding on those homes and businesses that rely on that infrastructure. Although flooding cannot be wholly prevented, its adverse impacts can be avoided or reduced through good planning and management.

The Government's Flood and Coastal Erosion Risk Management Policy Statement sets out our ambition to create a nation more resilient to future flood and coastal erosion risk. It outlines policies and actions which will accelerate progress to better protect and better prepare the country against flooding and coastal erosion.

All buildings in flood risk areas can improve their preparedness to reduce costs and disruption to key public services when a flood happens. Where infrastructure is not better protected as part of a wider community scale flood defence scheme, those who own and run infrastructure sites – whether in public or private hands – are expected to take action to keep water out, minimise the damage if water gets in through flood-resilient materials, and reduce the disruption caused. This includes effective contingency planning to mitigate the impacts of flooding on the delivery of important services.

Climate change is already having an impact and is expected to have an increasing impact on the UK throughout this century. The applicant and the Secretary of State should take account of the policy on climate change adaptation.

The aims of planning policy on development and flood risk are to ensure that flood risk from all sources of flooding is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding, and to steer new development to areas with the lowest risk of flooding. Where new energy infrastructure is, exceptionally, necessary in such areas, policy aims to make it safe without increasing flood risk elsewhere and, where possible, by reducing flood risk overall. It should also be designed and constructed to remain operational in times of flood. Proposals that aim to facilitate the relocation of existing energy infrastructure from unsustainable locations which are or will be at unacceptable risk of flooding, should be supported where it would result in climate-resilient infrastructure.

A site-specific flood risk assessment should be provided by the applicant for all energy projects in Flood Zones 2 and 3 in England or Zones B and C in Wales. In Flood Zone 1 in England or Zone A in Wales, an assessment should accompany all proposals.

Applicants for projects which may be affected by, or may add to, flood risk should arrange pre-application discussions with the EA, and, where relevant, other bodies such as Lead Local Flood Authorities, Internal Drainage Boards, sewerage undertakers, navigation authorities, highways authorities and reservoir owners and operators. Such discussions should identify the likelihood and possible extent and nature of the flood risk, help scope the FRA, and identify the information that will be required by the Secretary of State to reach a decision on the application when it is submitted. The Secretary of State should advise applicants to undertake these steps where they appear necessary but have not yet been addressed.

If the Environment Agency or Natural Resources Wales has concerns about the proposal on flood risk grounds, the applicant should discuss these concerns with the EA or Natural Resources Wales and take all reasonable steps to agree ways in which the proposal might be amended, or additional information provided, which would satisfy the EA's or Natural Resources Wales concerns.

In determining an application for development consent, the Secretary of State should be satisfied that where relevant:

- the application is supported by an appropriate FRA;
- the Sequential Test has been applied and satisfied as part of site selection;
- a sequential approach has been applied at the site level to minimise risk by directing the most vulnerable uses to areas of lowest flood risk;
- the proposal is in line with any relevant national and local flood risk management strategy;
- sustainable drainage systems (SuDs) (as required in the next paragraph on National Standards) have been used unless there is clear evidence that their use would be inappropriate; and
- in flood risk areas the project is designed and constructed to remain safe and operational during its lifetime, without increasing flood risk elsewhere (subject to the exceptions set out in 5.7.17);
- the project includes safe access and escape routes where required, as part of an agreed emergency plan, and that any residual risk can be safely managed over the lifetime of the development.
- land that's likely to be needed for present or future flood risk management infrastructure has been appropriately safeguarded from development to the extent that development would not prevent or hinder its construction, operation or maintenance.

For energy projects which have drainage implications, approval for the project's drainage system, including during the construction period, will form part of the development consent issued by the Secretary of State. The Secretary of State will therefore need to be satisfied that the proposed drainage system complies with any National Standards published by Ministers under Paragraph 5(1) of Schedule 3 to the Flood and Water Management Act 2010. In addition, the development consent order, or any associated planning obligations, will need to make provision for appropriate operation and maintenance of any SuDS throughout the project's lifetime. Where this is secured through the adoption of any SuDS features, any necessary access rights to property will need to be granted. Where relevant, the Secretary of State should be satisfied that the most appropriate body is being given the responsibility for maintaining any SuDS, taking into account the nature and security of the infrastructure on the proposed site. Responsible bodies could include, for example the landowner, the relevant lead local flood authority or water and sewerage company (through the Ofwat-approved Sewerage Sector Guidance), or another body, such as an Internal Drainage Board.

If the EA continues to have concerns and objects to the grant of development consent on the grounds of flood risk, the Secretary of State can grant consent, but would need to be satisfied before deciding whether or not to do so that all reasonable steps have been taken by the applicant and the EA to try to resolve the concerns.

Preference should be given to locating projects in areas of lowest flood risk through the application of the Sequential Test. The Secretary of State should not consent development in flood risk areas (Flood Zone 2 in England or Zone B in Wales), accounting for all sources of flooding and the predicted impacts of climate change unless they are satisfied that the sequential test requirements have been met. It should not consent development in Flood Zone 3 or Zone C unless it is satisfied that the Sequential and Exception Test requirements have been met. The technology-specific NPSs set out some exceptions to the application of the sequential test. However, when seeking development consent on a site allocated in a

development plan through the application of the Sequential Test, informed by a strategic flood risk assessment, applicants need not apply the Sequential Test, provided the proposed development is consistent with the use for which the site was allocated and there is no new flood risk information that would have affected the outcome of the test. Consideration of alternative sites should take account of the policy on alternatives set out in the NPS. All projects should apply the sequential approach to locating development within the site.

If, following application of the sequential test, it is not possible, (taking into account wider sustainable development objectives), for the project to be located in areas of lower flood risk the Exception Test can be applied, as required by table 3 of the Planning Practice Guidance. The test provides a method of allowing necessary development to go ahead in situations where suitable sites at lower risk of flooding are not available.

The Exception Test is only appropriate for use where the sequential test alone cannot deliver an acceptable site. It would only be appropriate to move onto the Exception Test when the sequential test has identified reasonably available, lower risk sites appropriate for the proposed development where, accounting for wider sustainable development objectives, application of relevant policies would provide a clear reason for refusing development in any alternative locations identified. Examples could include alternative site(s) that are subject to national designations such as landscape, heritage and nature conservation designations, for example Areas of Outstanding Natural Beauty (AONBs), Sites of Special Scientific Interest (SSSIs) and World Heritage Sites (WHS) which would not usually be considered appropriate.

Both elements of the test will have to be satisfied for development to be consented. To pass the Exception Test it should be demonstrated that:

- the project provides wider sustainability benefits to the community that outweigh flood risk;
- the project reduces flood risk overall, where possible.

Exceptionally, where an increase in flood risk elsewhere cannot be avoided or wholly mitigated, the Secretary of State may grant consent if they are satisfied that the increase in present and future flood risk can be mitigated to an acceptable level and taking account of the benefits of, including the need for, nationally significant energy infrastructure. In any such case the Secretary of State should make clear how, in reaching their decision, they have weighed up the increased flood risk against the benefits of the project, taking account of the nature and degree of the risk, the future impacts on climate change, and advice provided by the EA and other relevant bodies.

To satisfactorily manage flood risk, mitigation arrangements are required to manage surface water and the impact of the natural water cycle on people and property.

Site layout and surface water drainage systems should cope with events that exceed the design capacity of the system, so that excess water can be safely stored on or conveyed from the site without adverse impacts.

The surface water drainage arrangements for any project should be such that the volumes and peak flow rates of surface water leaving the site are no greater than the rates prior to the proposed project, unless specific off-site arrangements are made and result in the same net effect.

It may be necessary to provide surface water storage and infiltration to limit and reduce both the peak rate of discharge from the site and the total volume discharged from the site. There may be circumstances where it is appropriate for infiltration facilities or attenuation storage to be provided outside the project site, if necessary through the use of a planning obligation.

The sequential approach should be applied to the layout and design of the project. Vulnerable aspects of the development should be located on parts of the site at lower risk

and residual risk of flooding. Applicants should seek opportunities to use open space for multiple purposes such as amenity, wildlife habitat and flood storage uses. Opportunities should be taken to lower flood risk by reducing the built footprint of previously developed sites and using SuDS.

Energy projects should not normally be consented within Flood Zone 3b the Functional Floodplain (where water has to flow or be stored in times of flood), or Zone C2 in Wales, or on land expected to fall within these zones within its predicted lifetime. However, where essential energy infrastructure has to be located in such areas, for operational reasons, they should only be consented if the development will not result in a net loss of floodplain storage and will not impede water flows.

The receipt of and response to warnings of floods is an essential element in the management of the residual risk of flooding. Flood Warning and evacuation plans should be in place for those areas at an identified risk of flooding. The applicant should take advice from the local authority emergency planning team, emergency services and, where appropriate, from the local resilience forum when producing an evacuation plan for a manned energy project as part of the FRA. Any emergency planning documents, flood warning and evacuation procedures that are required should be identified in the FRA.

5.3.1: Assessment made in respect of EN-1

The planning conditions set out in EN-1 sections on Climate Change Adaptation, Coastal Change and Flood Risk (as discussed above) address the majority of the guide questions associated with AoS Objective 2 Maximise adaptation and resilience to climate change. Together, they detail requirements for the applicants and considerations for the Secretary of State.

EN-1 ensures that at the time the ES is prepared by the applicants:

- The latest UK Climate Projections and associated research and expert guidance are taken into account
- impacts on and from their proposed energy project across a range of climate change scenarios are considered; and in particular demonstration of how proposals can be adapted over their predicted lifetimes to remain resilient to a credible maximum climate change scenario
- the proposed development will be resilient to coastal erosion and deposition

EN-1 details requirements and considerations in relation to onshore energy infrastructure projects situated on the coast. It covers coastal erosion and deposition specifically, acknowledging that the impact of climate change on such processes and the need to address this. It also deals with flooding in general including pluvial, riverine and coastal flooding, again acknowledging the impact of climate change on flooding and sets out specific planning conditions.

It is considered that EN-1 provides a robust approach to ensuring that issues relating to a changing climate and the need to adapt to this in the construction and operation of energy related infrastructure will be considered as part of any development. This will ensure that resilience is a key component of these developments and should have beneficial effects from the short, through to the long term.

Table 5-2 - Maximise adaptation and resilience to climate change Objective Summary

AoS Objective	Assessment of generic effects (by timescale)		
	S	M	L
Maximise adaptation and resilience to climate change Guide questions: • Promote future proofing of energy infrastructure against the effects and risks of climate change (e.g. flooding, sea level rise, coastal erosion)? • Lead to major infrastructure development that is flood resilient over its lifetime, considering the effects of climate change, without increasing the flood risk elsewhere and identifying opportunities to reduce the risk overall? • Minimise the risk and impact of flooding from all sources for the lifetime of the development? • Avoid development in flood risk areas (whether existing or future) when possible? • Manage the risks of flooding and coastal erosion, particularly through working with nature based solutions? • Encourage energy infrastructure design for successful adaptation to the predicted changes in weather conditions and frequency of extreme weather events (freezing, heat waves, intense storms)?	+	++	++

5.4: AoS Objective 3: Enhance biodiversity, promoting net gain, and supporting ecosystem resilience and functionality

5.4.1: Anticipated Effects

The scope and scale of the development enabled by the plan has the potential for a range of impacts on the natural environment, which EN-1 recognises will vary depending on the type of development and its location in relation to designated assets. They include:

- Loss of habitat (and species) – direct loss from land take, loss of seabed and intertidal habitat, or the abstraction of water resources, and indirect or temporary losses, for example during construction phases.
- Disturbance effects on species - through noise, light, vibration, visual and dust pollution arising from construction, operation and decommissioning activities.

- Pollution impacts - arising from emissions to water (including thermal impacts), ground and air, leading to reduced water, soil and air quality.
- Habitat fragmentation/severance/isolation - through development preventing migration/foraging leading to population isolation, genetic diversion / weakness and reduced opportunities for foraging and other activities. This is particularly likely where development intersects a linear habitat, or where the technology itself is linear or forms a barrier. This could also fragment or impede development of Local Nature Recovery Networks.
- Obstructions – from introduced/tall structures presenting obstacles to migration and flight paths (e.g. bats and birds), leading to disrupted navigation and potential for injury/death.
- Changes to microclimates from development – resulting in alterations to wind patterns/speeds, temperature, shading and shadow effects.
- Changes to coastal and marine processes – through physical changes to the coastline and marine environment (including flood management features), dredging, water abstraction and water discharge. This could result in changes to currents, shelter and sediment transportation.
- Habitat integrity and connectivity improvements, including contribution to Local Nature Recovery Networks - resulting from management, restoration and enhancements activities.

Construction of developments enabled through EN-1 and associated supporting infrastructure has the potential to result in direct adverse impacts in the short term on biodiversity assets of local, regional and national importance. Such effects include land take, degradation in water, land or soil quality and disturbance. Furthermore, it is likely that energy infrastructure development will be located in rural areas where there is generally a higher concentration of biodiversity designations. There is potential for direct and indirect effects on the natural environment to occur in the short and medium term as a result of operational activities. Long term effects will be dependent on the duration that infrastructure developments are in operation, which is likely to be many decades in the case of major generating infrastructure. The decommissioning stage of any of the generating infrastructure also has the potential to have direct negative effects on the natural environment, due to soil, water and air contamination, as well as disturbance. However, positive effects may be achieved in the long term, through restoration of a decommissioned site.

There is potential for negative cumulative effects on biodiversity assets in areas where there is a concentration or cluster of energy infrastructure development. The significance of these effects will be dependent on the locations and scales of development relative to natural environment designations.

5.4.2: Approach to Development and Mitigation as set out in EN-1

There is potential for the majority of adverse effects on biodiversity as a result of energy generating infrastructure development to be avoided, reduced and mitigated through careful siting, design and planning. However, the significance of any effects on biodiversity remains uncertain, and the effectiveness of the mitigation possibilities proposed will depend on the individual sensitivities of the receiving sites, in the context of specific details of the development design, layout and operation.

EN-1 recognises that careful siting and use of appropriate technologies can help to mitigate adverse impacts on the environment. Applicants are required to demonstrate how the design process was conducted and how it evolved. Where several different designs were

considered, the applicant should explain why the favoured choice was selected. This may offer scope for avoidance and mitigation of impacts on biodiversity assets at the design stage. EN-1 suggests that that development proposals provide opportunities for building in beneficial biodiversity features as part of good design, which can offer opportunities to deliver biodiversity net gain. To aid this, EN-1 requires that the Secretary of State should maximise opportunities for biodiversity within developments, using planning obligations.

EN-1 specifically also notes that applicants should therefore not just look to mitigate direct harms, but also consider whether there are opportunities for enhancements, and it is considered that Biodiversity Net Gain should be seen in this context.

Whilst it is noted within EN-1 that achieving biodiversity net gain is not an obligation for projects under the Planning Act 2008, EN-1 requires Energy NSIP proposals to seek opportunities to contribute to and enhance the natural environment by providing net gains for biodiversity where possible. Applicants are encouraged to use the most current version of the Defra biodiversity metric to calculate their biodiversity baseline and inform their biodiversity net gain outcomes and to present this data as part of their application. Biodiversity net gain should be applied in conjunction with the mitigation hierarchy and does not change or replace existing environmental obligations. EN-1 also notes the applicant is encouraged to consider how their proposal can contribute towards Biodiversity Net Gain in line with the ambition set out in the 25 Year Environment Plan. Energy infrastructure projects have the potential to deliver significant benefits and enhancements beyond Biodiversity Net Gain, which result in wider environmental gains. The scope of potential gains will be dependent on the type, scale, and location of each project.

EN-1 notes Green Infrastructure and how this can contribute to biodiversity recovery and notes specifically that applicants are encouraged to consider how new green infrastructure can be provided, or how existing green infrastructure can be enhanced as part of their application. EN-1 further notes that applicants should consider producing and implementing a Biodiversity Management Strategy as part of their development proposals. It is noted that this could include provision for biodiversity awareness training to employees and contractors so as to avoid unnecessary adverse impacts on biodiversity during the construction and operation stages.

EN-1 notes that applicants should demonstrate that the timing of construction has been planned to avoid or limit disturbance to birds during the breeding system and a footnote is provided for further guidance on this issue. Furthermore, during construction and operation, EN-1 notes that best practice will be followed to ensure that risk of disturbance or damage to species or habitats is minimised, including as a consequence of transport access arrangements.

EN-1 requires the consideration of any proposed development to include the potential contribution of such developments to ecological enhancement. These potential benefits are to be considered at national, regional and local scale, including in the marine environment.

EN-1 ensures that any proposals for energy generating infrastructure are subject to robust consideration by requiring that they are accompanied by an Environmental Statement (ES) (under the Infrastructure Planning Regulations 2017), which describes the significant likely effects of the proposal on the environment, including specific reference to biodiversity. Through this requirement, EN-1 ensures that the direct, indirect, secondary, transboundary and short to long term effects of the development on biodiversity will be considered, as these are requirements in The EIA Regulations. EN-1 suggests that consideration of potential effects should include potential benefits, which include biodiversity net gain.

EN-1 notes that in the design of any direct cooling system the locations of the intake and outfall should be sited to avoid or minimise adverse impacts on the receiving waters,

including their ecology. There should also be specific measures to minimise impact to fish and aquatic biota by entrainment and impingement or by excessive heat or biocidal chemicals from discharges to receiving waters.

In terms of the marine environment, EN-1 indicates that applicants for a Development Consent Order will need to take account of relevant marine plans and conduct a marine plan assessment. It is suggested that applicants refer to marine plans at an early stage to avoid less favourable locations. Applicants are encouraged to consult the Marine Management Organisation (MMO) on nationally significant projects as the MMO will advise the Secretary of State on what conditions should apply to deemed marine licence.

EN-1 suggests that proposals should consider and seek to provide improvements to natural capital and ecosystem services when considering how to achieve biodiversity net gain. Whilst EN-1 recognises that achieving biodiversity net gain is not an obligation for Energy NSIP proposals under the Planning Act 2008, it suggests that proposals should seek opportunities to provide net gains where possible through the use of the most recent version of the Defra biodiversity metric. Furthermore, EN-1 encourages the applicant to demonstrate how their proposal can contribute to biodiversity net gain in line with ambitions set out in the 25 Year Environment Plan. Considerations of biodiversity in EN-1 recognise that the potential impacts of climate change on biodiversity mean that the two policy considerations are intrinsically linked and that the benefits of nationally significant low carbon energy infrastructure development may also yield benefits for biodiversity interests.

EN-1 sets out an overarching principle in relation to protecting biodiversity, which is that development should at the very least aim to avoid significant harm to biodiversity interests, including through mitigation and consideration of reasonable alternatives. It is suggested that in cases where significant harm is unavoidable, then appropriate compensation measures should be sought. Where this is not possible, it is suggested that the Secretary of State gives significant weight to any residual harm.

In terms of designations, EN-1 notes that the Secretary of State should ensure that appropriate weight is given to designated sites of international, national and local importance, protected species, habitats and other species of importance for the conservation of biodiversity. For Sites of Specific Scientific Interests (SSSIs), or parts of SSSIs, that are not covered by an international designation, EN-1 states that such sites should be given a high degree of protection. EN-1 suggests that development on land within or outside a SSSI which is likely to have adverse effects (either individually or in combination with other developments) should not be permitted. EN-1 notes that an exception to this is possible where the benefits of the development in the location proposed clearly outweigh its impacts on the features of the site qualify it as a SSSI and impacts on the national network of SSSIs. Furthermore, EN-1 encourages the Secretary of State to use requirements and/or planning obligations to mitigate significant harm arising from the development on SSSIs and suggests that, where possible, development should enhance a site’s biodiversity.

At the regional and local scale, EN-1 suggests that Local Nature Reserves and Local Wildlife Sites require due consideration, but given the need for new energy generating infrastructure, these designations should not be used as the sole reason to refuse development consent. EN-1 notes that the valuable biodiversity resources within Ancient Woodland cannot be recreated and therefore the Secretary of State should not grant consent for any developments that would result in its deterioration or loss, unless it can be demonstrated that the benefit and need of the development outweighs the loss. The same level of protection through EN-1 is afforded to species and habitats that have been identified as being of principal importance for the conservation of biodiversity; it would need to be demonstrated that the benefits of and need for development outweighs the harm. However, it is also noted in this context that the Secretary of State should give substantial weight to any harm to the

detriment of biodiversity features of national or regional importance. EN-1 also suggests that proposals should maximise opportunities to restore, create and enhance wider biodiversity, which could include consideration of Local Nature Recovery Strategies and national goals.

Additionally, EN-1 recognises that, in coastal environments, the delivery of energy generating infrastructure may involve construction activities that would result in directs impacts on coastal and marine habits, or indirect impacts through changes to the hydrodynamic regime of an area. As such, EN-1 recommends that applicants should undertake coastal geomorphological and sediment transfer modelling where necessary.

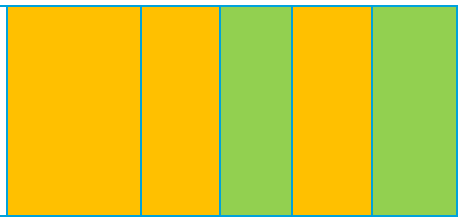
Some of the mitigation outlined in EN-1 has been detailed above, but EN-1 also highlights a number of mitigation measures which are specific to the delivery of sites. This includes limiting construction activities to the minimum area required, following best practice in terms of avoiding disturbance or damage to species or habitats, restoration of habitats following construction and enhancement of habitats where practicable. It is suggested that any habitat creation or enhancement delivery for biodiversity net gains should be managed for a minimum period of 30 years.

5.4.3: Assessment made in respect of EN-1

Significant negative effects are expected for EN-1 in relation to biodiversity in the short to long term. This is balanced with minor positive effects in the medium and long term, which the clear approach noted in EN-1 toward mitigating direct harm and seeking opportunities for enhancement e.g. through Biodiversity Net Gain, will help to realise. The effects identified are uncertain as they will depend on the specific location, nature, design and scale of development.

Table 5-3 - Enhance biodiversity, promoting net gain, and supporting ecosystem resilience and functionality Objective Summary

AoS Objective	**Assessment of generic effects (by timescale)**				
	S	**M**		**L**	
Enhance biodiversity, promoting net gain, and supporting ecosystem resilience and functionality Guide questions: • Protect and enhance nationally designated sites such as SSSIs, National Nature Reserves and Marine Conservation Zones, including those of potential or candidate designation? • Protect and enhance valued habitat and populations of protected/scarce species on locally designated sites, including Key Wildlife Sites, Local Wildlife Sites and Local Nature Reserves? • Protect the structure and function/ecosystem processes, including in the marine environment? • Protect and enhance the Nature Recovery Network? • Protect and enhance priority habitats, and the habitat of priority species? • Promote new habitat creation or restoration and linkages with existing habitats?	--	--	+	--	+

• Protect and enhance the wider green infrastructure network? • Increase the resilience of biodiversity to the potential effects of climate change? • Promote a net gain in biodiversity for any new major infrastructure development?	

5.5: AoS Objective 4: Protect and enhance sites designated for their international importance for nature conservation purposes

5.5.1: Anticipated Effects

The scope and scale of the development enabled by the plan has the potential for a range of impacts on sites designated for their international importance for nature conservation purposes. EN-1 recognises the effects will vary depending on the type of development and its location in relation to designated assets. Significant effects could arise as a result of development coming forward under the NPS, which could impact the qualifying features for which 'European sites' are designated (including Special Areas of Conservation (SAC), Special Protection Areas (SPA), and in the UK, Ramsar sites despite being designated at the international rather than European level). These potential effects and the qualifying features they could impact include:

- Air pollution - arising from emissions to air from transport to and from the site, and emissions directly from certain energy infrastructure.
    - Nutrient-sensitive habitats (including soils and water) and plants, plus species they support
- Noise pollution and vibration - arising from construction, operation and decommissioning activities.
    - Bird species
    - Mammal species
    - Fish species
- Light pollution - arising from construction, operation and decommissioning activities.
    - Bat species
    - Nocturnal bird and insect species
- Change in water quality/temperature - arising from emissions to water during construction and decommissioning, and emissions directly from certain energy infrastructure.
    - Freshwater habitats (such as rivers and lakes)
    - Marine habitats
    - Wetland habitats (including groundwater dependent terrestrial ecosystems)
    - Coastal habitats (saltmarsh, sand dunes)
    - Aquatic species (freshwater, brackish and marine)
- Changes in water quantity/flow/drainage - direct loss from the abstraction of water resources, and indirect or temporary losses, for example during construction phases.
    - Freshwater habitats

    - Marine habitats
    - Wetland habitats
    - Aquatic species (freshwater, brackish and marine)
- Land contamination – arising during construction and during operation from emissions to water (including thermal impacts) and ground.
    - Terrestrial habitats and species
    - Wetland habitats and species
- Habitat loss/fragmentation - direct loss from land take or the abstraction of water resources, and indirect or temporary losses, for example during construction phases.
    - All habitats and species
- Impingement and entrainment of fish – arising from operation processes such as cooling water intake.
- Coastal change - arising from construction, operation and decommissioning activities.
    - Coastal habitats
    - Fish species
    - Seabird species
    - Marine mammals
- Bird/bat strike - from introduced/tall structures presenting obstacles to migration and flight paths.
- Disturbance to marine species - arising from construction, operation and decommissioning activities.
- Climate change effects on habitats and species - arising from construction, operation and decommissioning activities.
- Changes to electromagnetic fields - arising from construction, operation and decommissioning activities.
- Introduction of invasive non-native species - arising from construction, operation and decommissioning activities.

There is also potential for development to result in positive effects on habitat condition and connectivity from management, restoration and enhancements activities.

The development of a range of major generating infrastructure that is enabled through EN-1 has the potential to result in direct adverse impacts on European sites in the short term, from the construction of developments enabled through EN-1 and associated supporting infrastructure. Furthermore, it is likely that energy infrastructure development will be located in rural and/or coastal areas where the majority of European sites tend to be located. There is potential for direct and indirect effects on European sites to occur in the short and medium term, as a result of operational activities. Long term effects will be dependent on the duration that infrastructure developments are in operation, which is likely to be many decades in the case of major energy generating infrastructure. The decommissioning stage of any of the generating infrastructure also has the potential to have direct negative effects on European sites, due to soil, water and air contamination, as well as disturbance. However, positive effects may be achieved in the long term, through restoration of a decommissioned site.

There is potential for negative cumulative effects on European sites in areas where there is a concentration or cluster of energy infrastructure development or where developments could

have similar effects on the same European sites. The significance of these effects will be dependent on the locations and scales of development relative to European sites.

5.2.2: Approach to Development and Mitigation as set out in EN-1

There is potential for the majority of adverse effects on European sites as a result of energy generating infrastructure development to be avoided, reduced and mitigated through careful siting, design and planning. However, the significance of any effects remains uncertain, and the effectiveness of the mitigation possibilities proposed will depend on the individual sensitivities of the receiving sites, in the context of specific details of the energy infrastructure development's design, layout and operation.

The need for Habitats Regulations Assessment (HRA) to determine whether individual energy infrastructure proposals will have an adverse effect on the integrity of European sites is recognised in EN-1, as they are important sites for biodiversity identified through international conventions and the Conservation of Habitats and Species Regulations 2017 (as amended) as well as the Conservation of Offshore Marine Habitats and Species Regulations 2017. In addition, EN-1 itself is subject to HRA, which is being carried out alongside this AoS and has informed this assessment.

EN-1 also highlights the need for proposals to be accompanied by and Environmental Statement (ES) (under the Infrastructure Planning Regulations 2017), which describes the likely significant effects of the proposal on the environment, including specific reference to biodiversity. Through this requirement, EN-1 ensures that the direct, indirect, secondary, transboundary and short to long term effects of the development on biodiversity will be considered, as these are requirements in The Regulations. Where development is subject to EIA, EN-1 suggests that the ES should clearly set out any effects on internationally designated sites of ecological or geological conservation importance.

EN-1 sets out an overarching principle in relation to protecting biodiversity, which is that development should at the very least aim to avoid significant harm to biodiversity and geological interests, including through mitigation and consideration of reasonable alternatives. EN-1 states that in cases where significant harm is unavoidable, then appropriate compensation measures should be sought. Where this is not possible, it states that the Secretary of State will give significant weight to any residual harm. EN-1 requires that appropriate weight should be attached to designated sites of international importance.

EN-1 recognises that, in coastal environments, the delivery of energy generating infrastructure may involve construction activities that would result in directs impacts on coastal and marine habits, or indirect impacts through changes to the hydrodynamic regime of an area. As such, EN-1 recommends that applicants should undertake coastal geomorphological and sediment transfer modelling where necessary.

EN-1 outlines mitigation measures which are likely to reduce direct and indirect effects on European sites. These include limiting construction activities to the minimum area required, following best practice in terms of avoiding disturbance or damage to species or habitats, restoration of habitats following construction and enhancement of habitats where practicable.

5.2.3: Assessment made in respect of EN-1

EN-1 has been subject to HRA to determine whether the strategic plan poses a risk to European sites and whether it would result in likely significant effects, either alone, or in combination with other plans. The NPSs do not include any sites, locations or other spatial proposals and, therefore, the HRA is an assessment of the policy content only. As such it is high-level and strategic in nature and it does not constitute or take the place of a project HRA for any energy infrastructure development that may come forward under the NPSs.

Given the strategic nature of the NPSs and the lack of geographically specific proposals, they allow for a wide range of potential energy development to take place in any part of England and Wales, territorial waters and within the Renewable Energy Zone offshore. As such, it was not possible for the HRA to conclude that there will be no effects on European sites as a result of development coming forward under the NPSs. It was not possible to screen out likely significant effects at the screening stage, nor adverse effects on integrity at the appropriate assessment stage. A number of alternatives to the NPSs were considered, but none of the reasonable alternatives would be able to avoid the potential for adverse effects on integrity on European Sites.

The Government has concluded that, whilst energy development should seek to avoid significant adverse effects on European sites, there is a case for imperative reasons of overriding public interest (IROPI). This means that the NPSs can be designated, even if they could result in adverse effects on the integrity of European sites. Where this is the case, sufficient compensatory measures must be provided.

Therefore, there is potential for significant negative effects on sites designated for their international importance and nature conservation purposes as a result of the plan implementation in the short, medium and long term. This could include on sites which are in the jurisdiction of other countries (transboundary). In the medium to long term, there is potential for minor positive effects also due to measures encouraged in EN-1, including biodiversity net gains. The effects identified are uncertain as they will depend on the specific locations and scale of development, which is uncertain given that the NPSs do not outline specific proposals.

Table 5-4 – Protect and enhance sites designated for their international importance for nature conservation purposes Objective Summary

AoS Objective	**Assessment of generic effects (by timescale)**				
	S	**M**		**L**	
Protect and enhance sites designated for their international importance for nature conservation purposes Guide questions: • Avoid the loss of sites of international importance (SPAs, SACs and Ramsar sites), including those of potential designation (candidate SPAs, proposed SACs, Sites of Community Importance (SCI) and proposed Ramsar sites) both onshore and offshore?	--	--	+	--	+

5.6: AoS Objective 5: Protect and enhance cultural heritage assets and their setting, and the wider historic environment

5.6.1: Anticipated Effects

As recognised within EN-1, the construction, operation and decommissioning of energy infrastructure has the potential to result in adverse impacts on the historic environment. EN-1 defines that historic environment includes all aspects of the environment (onshore or offshore) resulting from the interaction between people and places through time, including all

surviving physical remains of past human activity, whether visible, buried or submerged, landscaped and planted or managed flora. It is understood that this would include offshore marine shipwrecks, aircraft crash sites or other submerged artefacts. Those elements of the historic environment that hold value to this and future generations because of their historic, archaeological, architectural or artistic interest are called ”heritage assets”.

It is to be noted (as recognised in EN-1) that some heritage assets are of a level of significance that warrants official designation e.g. World Heritage Sites, Scheduled Monuments etc., but the absence of designation does not indicate lower significance – these are subject to the same policy considerations[8].

Enabling the development of energy infrastructure to meet the energy demands of the UK has the potential for a number of generic effects on archaeology and cultural heritage which are applicable across the different types of energy infrastructure development and which may be both direct and indirect. They include:

- Direct disturbance or loss of heritage assets during construction as a result of ground works or excavation; and
- Indirect impacts on the setting of nearby heritage assets, for example visual intrusion within a landscape or townscape context, or from noise or pollutants.

Direct effects are likely to occur in the short term during the construction of development and associated supporting infrastructure. Indirect effects are likely to occur in the short and medium term with long term effects dependent on infrastructure operational duration (which could be many decades) and decommissioning activities.

In areas where there is a concentration or cluster of energy infrastructure development there is also the potential for negative cumulative effects on the setting of heritage assets. The significance of these effects is highly dependent on the location and scale of development, as well as the importance of heritage assets and their setting relative to energy infrastructure.

5.6.2: Approach to Development and Mitigation as set out in EN-1

The majority of negative effects on heritage assets from energy infrastructure developments can be avoided, reduced and mitigated through careful design and planning. However, the long term significance of these effects remains uncertain, and the effectiveness of the mitigation possibilities proposed will depend on the individual sensitivities of the heritage assets, in the context of specific details of the development design, layout and operation.

EN-1 sets out a robust approach to assessment of any development applications in terms of cultural heritage. This notes that, through an EIA procedure, applicants should provide a description of the significance of the heritage assets affected by the proposed development and the contribution of their setting to that significance. The level of detail should be proportionate to the importance of the heritage assets and no more than is sufficient to understand the potential impact of the proposal on the significance of the heritage asset. Consultation with relevant statutory bodies is also required, with minimal requirements set out. It is also noted that where a development site includes, or the available evidence suggests it has the potential to include, heritage assets with an archaeological interest, the applicant should carry out appropriate desk-based assessment and, where such desk-based research is insufficient to properly assess the interest, a field evaluation. Where proposed

[8] It is to be noted that different parts of Government have different responsibilities in relation to heritage assets. For example, the issuing of licenses to undertake works on Protected Wreck Sites in English waters is the responsibility of the Secretary of State for Culture, Media and Sport and does not form part of development consents issued by the Secretary of State for BEIS. In Wales it is the responsibility of Welsh Ministers. The issuing of licences for Protected Military Remains is the responsibility of the Secretary of State for Defence.

development will affect the setting of a heritage asset, representative visualisations may be necessary to explain the impact. The applicant should ensure that the extent of the impact of the proposed development on the significance of any heritage assets affected can be adequately understood from the application and supporting documents.

EN-1 also notes considerations to be made in any decision relating to a proposed development take into account the particular nature of the significance of the heritage assets and the value that they hold for this and future generations, with a view that this should be used to avoid or minimise conflict between conservation of that significance and proposals for development. Consideration is also to be made of the desirability of sustaining and, where appropriate, enhancing the significance of heritage assets, the contribution of their settings and the positive contribution they can make to sustainable communities and economic vitality, along with the desirability of new development making a positive contribution to the character and local distinctiveness of the historic environment. The consideration of design is noted in EN-1 to include scale, height, massing, alignment, materials and use and regard should be made to any relevant local authority development plans or local impact report on the proposed development in respect of a range of heritage factors.

In addition, EN-1 notes that there should be a presumption in favour of the conservation of designated heritage assets and the more significant the designated heritage asset, the greater the presumption in favour of its conservation should be. Once lost heritage assets cannot be replaced and their loss has a cultural, environmental, economic and social impact. Significance can be harmed or lost through alteration or destruction of the heritage asset or development within its setting. Loss affecting any designated heritage asset should require clear and convincing justification. Substantial harm to or loss of a grade II listed building park or garden should be exceptional. Substantial harm to or loss of designated assets of the highest significance, including Scheduled Monuments; registered battlefields; grade I and II* listed buildings; grade I and II* registered parks and gardens; and World Heritage Sites, should be wholly exceptional.

As such, EN-1 ensures that sufficient weighting is given to designated sites and to elements of setting that enhance the significance of designated heritage assets and non- designated archaeological assets. It also advises that harmful impact on the significance of a designated heritage asset should be given significant weight when weighed against the public benefit of development, recognising that the greater the harm to the significance of the heritage asset the greater the justification will be needed for any loss. Where the application will lead to substantial harm to or total loss of significance of a designated heritage asset the Secretary of State should refuse consent unless it can be demonstrated that the substantial harm to or loss of significance is necessary in order to deliver substantial public benefits that outweigh that loss or harm.

Furthermore, EN-1 notes that recording our past is not as valuable as retaining it and as such the ability to record evidence of an asset is not an adequate mitigation of any harm. However, where loss of the whole, or a material part of an asset's significance is justified, there could be a requirement (proportionate to its significance) to record and advance understanding of an asset prior to its loss. In addition, during the planning stage an assessment of impacts would identify sites of significant importance and provide the opportunity to avoid potential sites.

5.6.3: Assessment made in respect of EN-1

There is the potential for minor negative effects (including cumulative effects) on heritage assets in the short, medium and long term as a result of the potential impacts on heritage assets and their settings (with some uncertainty about the extent of direct effects such as

disturbance and loss as these will be determined by location of any infrastructure in relation to the heritage assets). It is to be noted that some heritage assets such as shipwrecks are located offshore and may be in the legal ownership of or be of considerable historic interest to other countries (for example wrecks identified as war graves) and as such, there is a potential for trans-boundary effects. However, it is considered that all potential effects are addressed through the robust approach outlined in EN-1.

Table 5-5 – Protect and enhance cultural heritage Objective Summary

AoS Objective	Assessment of generic effects (by timescale)		
	S	M	L
Protect and enhance cultural heritage assets and their settings, and the wider historic environment Guide questions: • Conserve and enhance designated heritage assets and their settings (World Heritage Sites, Scheduled Monuments, Listed Buildings and structures, Registered Parks and Gardens, Registered Battlefields and Conservation Areas), as well as maritime assets such as protected wrecks? • Conserve and enhance non-designated and / or locally listed heritage assets (including newly discovered heritage assets and archaeology) and their settings? • Avoid significant harm to heritage assets, for example from the generation of noise, pollutants and visual intrusion? • Ensure appropriate archaeological assessment prior to development? • Maintain or improve the interpretation, understanding and appreciation of the historic environment?	-	-	-

5.7: AoS Objective 6: Protect and enhance the character and quality of the landscapes and townscapes, protect and enhance visual amenity

5.7.1: Anticipated Effects

The scope and scale of the development enabled by the plan has the potential for a range of landscape and visual effects which EN-1 recognises will vary according to the type of development, its location and the landscape setting of the proposed development. Note that references in EN-1 to landscape are taken to include seascape and townscape where appropriate.

EN-1 recognises that virtually all nationally significant energy infrastructure projects will have effects on the landscape and is likely to have visual effects for many receptors around proposed sites. Landscape effects depend on the existing character of the local landscape,

its current quality, how highly it Is valued and is capacity to accommodate change. Generic effects on landscape from energy infrastructure include:

- the introduction of a range of new, industrial structures, (often of significant size and requiring substantial landtake) including long term, permanent structures; and developments that are temporary in the short to medium term;
- introduction of associated outputs to industrial processes such as visible steam plumes, and
- visual effects for receptors (residents, tourists, visitors).

It is to be noted that many areas within England and Wales that could potentially host new energy infrastructure of a large scale (e.g. coastal locations), currently support a high level of local and national landscape designations[9]. The development of a mix of generating technologies will deliver large scale and tall structures, in both existing industrial locations and in new greenfield/offshore/coastal settings. Many of these structures are likely to be in predominantly rural, remote areas, including areas of high landscape value where visual impacts will be significant. The scale and severity of those effects will depend on the energy type, its overall setting context and the specifics of the site itself. EN-1 recognises that coastal areas are particularly vulnerable to visual intrusion because of the potential high visibility of development on the foreshore, on the skyline and affecting views along stretches of undeveloped coast.

Particular effects can be experienced in those areas that are designated for their landscape value such as National Parks, the Broads and AONBs. It is to be noted that each of these areas has specific statutory purposes that could be adversely affected by development.

5.7.2: Approach to Development and Mitigation as set out in EN-1

EN-1 recognises that all projects need to be designed carefully, taking account of the potential impact on the landscape, seascape and townscape and having regard to siting, operational and other relevant constraints the aim should be to minimise harm to the landscape, providing reasonable mitigation where possible and appropriate.

EN-1 notes a number of features of energy infrastructure that could have particular implications, such as cooling towers and exhaust stacks which in themselves can be of substantial height and which can have additional effects of visible steam plumes. Other cooling system technologies have less implications in terms of landscape and visual amenity, though, as recognised by EN-1, there may be implications for their use in terms of output. Nevertheless, these would be considered as ‘Best Available Techniques’ (BAT) and there is a presumption that these will be considered in the first instance and permission for other technologies with greater visual impact given only when BAT is not reasonably practicable.

EN-1 notes that a landscape and visual assessment (including construction and operation phases) should be made and reported through an Environmental Statement and should note landscape / seascape character and consideration of local plans and their policies. Consideration is also to be made of light pollution effects, including on local amenity as well as nature conservation, with specific note made that an assessment of effects should be undertaken that should demonstrate how noise and light pollution from construction and operational activities on residential amenity and on sensitive locations, receptors and views, will be minimised.

[9] EN-1 AoS Baseline, Landscape, Townscape and Visual.

In respect of those areas with nationally significant landscape designations, such as National Parks and AONBs, development consent can be granted in exceptional circumstances, having been demonstrated to be in the public interest and with any development carried out to high environmental standards. In relation to those areas that are not nationally designated, but which may be highly valued locally and protected by local designation, the policies within local development plans that are based on landscape or seascape character assessment should be paid particular attention. However, local landscape designations should not be used in themselves to refuse consent, as this may unduly restrict acceptable development. In addition, consideration of benefits of the project (including need) would be made.

EN-1 recognises that reducing the scale of a project can help to mitigate the visual and landscape effects of a proposed project. However, reducing the scale or otherwise amending the design of a proposed energy infrastructure project may result in a significant operational constraint and reduction in function – for example, the electricity generation output. This though may (in exceptional circumstances) be warranted. Other mitigation can include within a site elements of design, including colour and materials and landscaping schemes. Offsite mitigation can also take place, for example through filling gaps in existing tree or hedge lines – this may help to enhance landscape in local areas.

EN-1 further recognises that consideration should be made of how landscapes can be enhanced through landscape management plans as this will help to enhance environmental assets where they contribute to landscape and townscape quality. However, it is to be recognised that due to the nature and size of potential schemes (as well as likely potential locations such as coastal areas), opportunities for mitigation will be limited and while EN-1 sets out a robust approach to addressing impacts on landscape, townscape and waterscape across the short, medium and long timeframes, significant adverse effects are likely to remain.

5.7.3: Assessment made in respect of EN-1

Significant negative effects for landscape, townscape and visual receptors are likely as a result of the plan implementation in the short, medium and long term and it is to be noted that due to the size of likely Schemes, opportunities for mitigation will be limited. However, EN-1 sets out a robust approach to addressing impacts on landscape, townscape and seascape across those timeframes.

Table 5-6 – Protect and enhance landscapes Objective Summary

AoS Objective	**Assessment of generic effects (by timescale)**		
	S	**M**	**L**
Protect and enhance the character and quality of the landscapes and townscapes, protect and enhance visual amenity Guide questions: • Support the integrity of any areas designated for landscape value, including in conjunction with the provisions of any relevant Management Plan (e.g. AONB and local landscape designations)? • Conserve and enhance the intrinsic character or setting of local landscapes or townscapes or waterscapes?	--	--	--

• Minimise noise and light pollution from construction and operational activities on residential amenity and on sensitive locations, receptors and views? • Conserve, protect and enhance natural environmental assets (e.g. parks and green spaces, common land, woodland / forests etc) where they contribute to landscape and townscape quality?			

5.8: AoS Objective 7: Protect and enhance the water environment

5.8.1: Anticipated Effects

The scope and scale of the development enabled by the plan has the potential for a number of generic impacts on the water environment (groundwater, inland surface water, transitional waters and coastal waters) which are applicable across the different types of energy infrastructure development. They include:

- increased demand for water leading to volume abstractions and the modification of water levels resulting in reduced surface and groundwater flow;
- increased discharges to water and atmospheric pollution associated with industrial processes, which can lead to reduced water quality;
- construction, operation and decommissioning activities can increase the risk of spills, leaks and pollution events with negative effects on water quality, human health and protected biodiversity; and
- construction activities and the associated land take can result in physical modifications to the water environment.

The development of a range of major generating infrastructure that is enabled through EN-1 has the potential to result in direct adverse impacts in the short term on the water environment. Impacts are likely to occur from the construction of developments enabled through EN-1 and associated supporting infrastructure. Furthermore, it is likely that energy infrastructure development will be located in rural and coastal areas on land which has a strong relationship with ground, surface, estuarine and coastal water bodies. There is potential for indirect effects on the water environment to occur in the short and medium term. Long term indirect effects will be dependent on the duration that infrastructure developments are in operation, which is likely to be many decades in the case of major generating infrastructure. The decommissioning stage of any of the generating infrastructure also has the potential to have direct negative effects on the water environment.

There is potential for negative cumulative effects on the water environment in areas where there is a concentration or cluster of energy infrastructure development. The significance of these effects will be dependent on the locations and scales of development relative to water bodies.

5.8.2: Approach to Development and Mitigation as set out in EN-1

There is potential for the majority of adverse effects on the water environment as a result of energy generating infrastructure development to be avoided, reduced and mitigated through careful design and planning. However, the long term significance of these effects remains uncertain, and the effectiveness of the mitigation possibilities proposed will depend on the

individual sensitivities of the receiving sites, in the context of specific details of the development design, layout and operation.

In cases where there is potential for a project to have effects on the water environment, it is recommended through EN-1 that an assessment of the existing status of and potential impacts on water quality, water resources and physical characteristics of the water environment should be undertaken as part of an ES. EN-1 also suggests that ES for energy infrastructure proposals should demonstrate how proposals will minimise the use of water resources and water consumption.

In relation to water quality, EN-1 suggests applicants should identify existing water quality and the impacts of the proposed project on water quality, including noting any relevant existing discharges, proposed new discharges and any proposed changes to discharges. To protect water resources, EN-1 advises the applicant should note any relevant abstraction rates, proposed new abstraction rates and proposed changes to abstraction rates, which should include any impact to mains supplies and reference to Catchment Abstraction Management Strategies. The same approach is recommended by EN-1 for physical characteristics of water bodies. EN-1 also suggests that any impacts on water bodies protected under the Water Framework Directive (WFD) or source protection zones (SPZs) around potable groundwater abstractions should also be identified.

EN-1 notes that impacts on the water environment will be given more weight where a project is likely to have adverse effects on the achievement of objectives under the WFD. Additionally, EN-1 suggests that the Secretary of State will consider whether a proposal has had sufficient regard to River Basin Management Plans, Water Resources Management Plans and Shoreline/Estuary Management Plans.

EN-1 recognises the impacts that energy generating infrastructure's emissions can have on water bodies in terms of causing excessive enrichment of nutrients (eutrophication) as a result of air pollution containing NOx and ammonia. It is noted in EN-1 that changes in algal composition cause algal blooms, which remove oxygen from the water environment that adversely impacts plants and fish. To tackle this, EN-1 advises that where a project may have adverse impacts on air quality, the ES should describe any potential eutrophication impacts.

In terms of the marine environment, EN-1 indicates that applicants for a Development Consent Order will need to take account of relevant marine plans and conduct a marine plan assessment. It is suggested that applicants refer to marine plans at an early stage to avoid less favourable locations. Applicants are encouraged to consult the Marine Management Organisation (MMO) on nationally significant projects as the MMO will advise the Secretary of State on what conditions should apply to deemed marine licence. EN-1 recognises that in coastal environments, the delivery of energy generating infrastructure may involve construction activities that would result in directs impacts on coastal and marine habits, or indirect impacts through changes to the hydrodynamic regime of an area. As such, EN-1 recommends that applicants should undertake coastal geomorphological and sediment transfer modelling where necessary.

Further to mitigation outlined above, EN-1 also suggests that the Secretary of State should consider whether there are mitigation measures that could go over and above those outlined in a project application. Furthermore, EN-1 recommends that risks to the water environment can be reduced on sites by designated areas for storage and unloading, appropriate drainage facilities and efficient use of water. It is also to be noted that through EN-1, applicants are encouraged to manage surface water during construction by treating surface water runoff from exposed topsoil prior to discharging and to limit the discharge of suspended solids. Additionally, EN-1 encourages applicants to go beyond measures outlined

in Water Resource Management Plans, by considering protective measures to control the risk of pollution to groundwater, which could include the use of protective barriers.

5.8.3: Assessment made in respect of EN-1

Minor negative effects for water quality are likely as a result of the plan implementation in the short term through to the long term as it will not be possible to avoid all negative effects on the water environment, given the likely scale and nature of proposed developments, for example through construction activities as well as the need for cooling water abstraction and discharge. Across all timescales, there is potential for the measures outlined above, along with Environment Agency controls to appropriately mitigate these risks, though some minor adverse effects will remain. The effects identified are uncertain as they will depend on the specific locations and scale of development.

Table 5-7 – Protect and enhance water environment Objective Summary

AoS Objective	**Assessment of generic effects (by timescale)**		
	S	**M**	**L**
Protect and enhance the water environment Guide questions: • Protect ground, surface, estuarine and coastal water quality? • Safeguard the availability of water resources (surface and groundwater)? • Minimise the use of water resources / water consumption?	-	-	-

5.9: AoS Objective 8: Protect and enhance air quality

5.9.1: Anticipated Effects

Enabling the development of energy infrastructure to meet the energy demands of the UK has the potential for a number of generic adverse effects on air quality which are applicable across the different types of energy infrastructure development. They 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
- emissions from plant, machinery and vehicles during the decommissioning of projects (including transport to and from site).

5.9.2: Approach to Development and Mitigation as set out in EN-1

EN-1 notes that adverse effects may occur at all stages of the project, as a result of emissions released during construction, operation, and decommissioning. The significance

of effects will depend upon local site-specific factors, such as transport routes and proximity to sensitive receptors and these will be dealt with during the project level EIA.

EN-1 identifies that applicants will be required to undertake an assessment of impacts of the proposed project on air quality as part of the Environmental Statement. EN-1 notes that substantial weight should be given to air quality where a project would lead to a deterioration in an area where national air quality limits are breached, and air quality considerations will also be important where substantial changes in air quality are expected, even if this does not lead to any breaches of national air quality limits. EN-1 states that where a project is located within, or in close proximity to, an Air Quality Management Area or Clean Air Zone, applicants should engage with the relevant local authority to ensure the project is compatible with the local air quality plan. Consent for a project should be refused where there will be non-compliance with a statutory limit.

EN-1 also notes that the provision and enhancement of green infrastructure can improve air quality, particularly in urban areas. Applicants are therefore encouraged to consider how new green infrastructure can be provided, or how existing green infrastructure can be enhanced, as part of their application.

The Secretary of State should consider whether mitigation measures are needed both for operational and construction emissions over and above any which may form part of the project application. The measures outlined for transport and traffic impacts in EN-1 will also help to mitigate the effects of air emissions from transport.

5.9.3: Assessment made in respect of EN-1

While EN-1 notes a robust approach to managing effects on air quality, it is anticipated that effect on air quality is still expected to slightly adverse, due to the potential for emissions of air pollutants at all stages of the project.

Table 5-8 – Protect and enhance air quality Objective Summary

AoS Objective	**Assessment of generic effects (by timescale)**		
	S	**M**	**L**
Protect and enhance air quality **Guide questions:** • Minimise emissions of dust and other air pollutants that affect human health or biodiversity? • Improve air quality within AQMAs and avoid the need for new AQMAs? • Promote enhancements to green infrastructure networks to help improve air quality?	-	-	-

5.10: AoS Objective 9: Protect soil resources and avoid land contamination

5.10.1: Anticipated Effects

Enabling the development of energy infrastructure to meet the energy demands of the UK has 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 (including best and most versatile agricultural land) and geologically important sites.
- Increased risk of pollution and potential contamination of soils.

Direct, short term effects on soil resources, through loss or contamination, are likely to occur from the construction of developments for energy generation and associated infrastructure, especially given that such developments will often be located on greenfield land. There is potential for contamination of soil resources to occur in the medium to long term as a result of air and water pollution arising from construction or the operations of energy generating infrastructure or potentially as a result of spills during the operation of such developments. The decommissioning stage of energy generating infrastructure may also cause direct negative effects on soil resources due to spills and contaminated waste left on-site, but also offer potential for the remediation of land. Similarly, delivery of energy generating infrastructure on previously developed land may create opportunities to deliver local regeneration. Cumulative negative effects on soil resources may occur where there is a cluster or concentration of energy infrastructure development, particularly power stations. The significance of any effects will be dependent on the locations and scales of development.

5.10.2: Approach to Development and Mitigation as set out in EN-1

There is potential for the majority of adverse effects on soil resources as a result of energy generating infrastructure development to be avoided, reduced and mitigated through careful design and planning. However, the long term significance of these effects remains uncertain, and the effectiveness of the mitigation possibilities proposed will depend on the individual sensitivities of the receiving sites, in the context of specific details of the development design, layout and operation.

EN-1 recognises that careful siting and use of appropriate technologies can help to mitigate adverse impacts on the environment. Applicants are required to demonstrate how the design process was conducted and how it evolved. Where several different designs were considered, the applicant should explain why the favoured choice was selected. EN-1 notes that, whilst it is not possible to mitigate the direct effects of an energy project on the existing use of site, applicants should seek to minimise these effects and effects near the site by the application of good design principles and protection of soils during construction. EN-1 suggests that whilst using previously developed land for new development can reduce impacts on the countryside in terms of land take, it may not be a viable option for many forms of energy infrastructure.

EN-1 ensures that any proposals for energy generating infrastructure are subject to robust consideration by requiring that they are accompanied by an Environmental Statement (ES) (under the Infrastructure Planning Regulations 2017), which describes the significant likely effects of the proposal on the environment, including specific reference to soil. Through this requirement, EN-1 ensures that the direct, indirect, secondary, transboundary and short to long term effects of the development on soil quality will be considered, as these are

requirements in The EIA Regulations. This includes the measures that the applicant envisages for the avoidance of significant adverse effects.

EN-1 suggests that the applicant should seek to minimise impacts on the best and most versatile agricultural land (grades 1, 2 and 3a of the Agricultural Land Classification) and should seek to use land in areas of poorer quality (grades 3b, 4 and 5), unless this would result in negative impacts on other sustainability considerations. For developments on previously developed land, EN-1 requires that applicants should consider the risk posed by existing land contamination. In terms of Secretary of State decision making in relation to the loss of agricultural land, EN-1 suggests that there should be sufficient justification for the loss of the best and most versatile agricultural land, but little weight should be given to the loss of poorer quality agricultural land. However, EN-1 suggests exceptions to this may include uplands, where particular agricultural practices themselves contribute to local character of the environment or the local economy.

EN-1 notes that the Secretary of State should decide whether a development is an acceptable use of the land and should be satisfied that the relevant pollution control authorities agree that potential pollution can be adequately regulated and there will not be cumulative effects arising from the proposed development.

In terms of mitigating impacts on soil resources, EN-1 requires applicants to identify any effects on soil quality, seek to minimise them, and take account any mitigation measures proposed. EN-1 also encourages applicants to develop and implement a Soil Management Plan as part of energy infrastructure proposals and this would also likely help to minimise potential land contamination. EN-1 also notes that where contamination is present, applicants should consider opportunities for remediation where possible.

5.10.3: Assessment made in respect of EN-1

Minor negative effects on soil resources are likely as a result of the plan implementation in the short, medium and long term due to the potential for loss of agricultural land and contamination of soil, potentially from spills of oil or chemicals used in the construction, operations and decommissioning of energy infrastructure. The effects identified are uncertain as they will depend on the specific nature, location and scale of development.

The mitigation outlined above has the potential to ensure that energy generating development enabled development through EN-1 will avoid the best and most versatile agricultural land, where possible. Additionally, the requirement that development should not be given consent unless they have been considered by relevant pollution authorities is likely to minimise the potential for land contamination.

Table 5-9 – Protect soil resources and avoid land contamination Objective Summary

AoS Objective	Assessment of generic effects (by timescale)		
	S	M	L

Protect soil resources and avoid land contamination Guide questions: • Assist in facilitating the re-use of previously developed land? • Avoid development upon the best and most versatile agricultural land? • Ensure the protection of soil resources and reduce soil quality degradation? • Seek to remediate contaminated land?	-	-	-

5.11: AoS Objective 10: Protect, enhance and promote geodiversity

5.11.1: Anticipated Effects

The scope and scale of development enabled by the plan has the potential for a range of effects on geodiversity, which will vary depending on the type of energy generating development and its location in relation to geodiversity assets. These include:

- Disturbance or loss of geologically important sites – direct loss from land take, loss of seabed and indirect or temporary losses during construction phase.
- Changes to coastal and marine processes – through physical changes to coastline and marine environment (including flood management features), dredging, water abstraction and water discharge. This could result in direct loss of exposed features, as well as changes in erosion and sediment transportation.
- Obstructions – from introduced structures presenting obstacles to access and study geodiversity assets

5.11.2: Approach to Development and Mitigation as set out in EN-1

There is potential for the majority of adverse effects on geodiversity as a result of energy generating infrastructure development to be avoided, reduced and mitigated through careful siting, design and planning. However, the significance of any effects on geodiversity remains uncertain, and the effectiveness of the mitigation possibilities proposed will depend on the individual sensitivities of the receiving sites, in the context of specific details of the development design, layout and operation.

EN-1 recognises that careful siting and use of appropriate technologies can help to mitigate adverse impacts on the environment. Applicants are required to demonstrate how the design process was conducted and how it evolved. Where several different designs were considered, the applicant should explain why the favoured choice was selected. This may offer scope for avoidance and mitigation of impacts on geodiversity assets at the design stage.

EN-1 ensures that any proposals for energy generating infrastructure are subject to robust consideration by requiring that they are accompanied by an Environmental Statement (ES) (under the Infrastructure Planning Regulations 2017), which describes the significant likely effects of the proposal on the environment. Through this requirement, EN-1 ensures that the direct, indirect, secondary, transboundary and short to long term effects of the development

on the environment will be considered, as these are requirements in the EIA Regulations. In locations where energy generating infrastructure will be delivered in close proximity to geodiversity assets, the above requirements are likely to outline any potential impacts to their status and potential mitigation measures.

EN-1 sets out an overarching principle in relation to geological conservation interests, which is that development should at the very least aim to avoid significant harm to geological interests, including through mitigation and consideration of reasonable alternatives. It is suggested that in cases where significant harm is unavoidable, then appropriate compensation measures should be sought. Where this is not possible, it is suggested that the Secretary of State gives significant weight to any residual harm.

In terms of designations, EN-1 notes that the Secretary of State should ensure that appropriate weight is given to designated sites of international, national and local importance for the conservation of geological interest. In particular, EN-1 suggests that Sites of Specific Scientific Interests (SSSIs) should be given a high degree of protection. EN-1 suggests that development on land within or outside a SSSI which is likely to have adverse effects (either individually or in combination with other developments) should not be permitted. EN-1 notes that an exception to this is possible where the benefits of the development in the location proposed clearly outweigh its impacts on the features of the site that qualify it as a SSSI. Furthermore, EN-1 encourages the Secretary of State to use requirements and/or planning obligations to mitigate significant harm arising from the development on SSSIs and suggests that, where possible, development should enhance a site's geological interest. At the regional and local scale, which includes Local Geological Sites, EN-1 suggests that due consideration should be given to such sites, but given the need for new energy generating infrastructure, these designations should not be used as the sole reason to refuse development consent. EN-1 also encourages applicants to produce and implement a Geodiversity Management Strategy with an aim that these strategies will also preserve and enhance access to geological interest features as part of relevant development proposals.

EN-1 recognises that, in coastal environments, the delivery of energy generating infrastructure may involve construction activities that would result in directs impacts on coastal environments and indirect impacts through changes to the hydrodynamic regime of an area. As such, EN-1 recommends that applicants should undertake coastal geomorphological and sediment transfer modelling where necessary.

Further to any mitigation outlined above, EN-1 encourages the Secretary of State to maximise opportunities (using planning obligations) for building in beneficial geological features as part of good design. EN-1 also encourages the applicant to ensure construction of developments should be confined to the minimum area required for the works.

5.11.3: Assessment made in respect of EN-1

There is potential for negative effects on geodiversity due to NPS implementation in the short, medium and long term, through loss of land / seabed, changes to coastal processes etc., particularly during construction. However, due to the potential for enhancement of geological features outlined above, there is also potential for minor positive effects in the medium to long term. The effects identified are uncertain as they will depend on the specific location, nature, design and scale of development.

Table 5.10– Protect, enhance and promote geodiversity Objective Summary

AoS Objective	Assessment of generic effects (by timescale)				
	S	M		L	
Protect, enhance and promote geodiversity Guide questions: • Protect and enhance geodiversity resource? • Protect or enhance SSSIs designated for their geological interest? • Avoid the degradation and removal, wherever possible, of RIGS? • Support access to, interpretation and understanding of geodiversity?	-	-	+	-	+

5.12: AoS Objective 11: Improve health and well-being and safety for all citizens and reduce inequalities in health

5.12.1: Anticipated Effects

Energy production and distribution has the potential to impact on the health and well-being of the population; potential generic effects of EN-1 implementation include:

- positive effects resulting from security and affordability of supply, and potential enhancements to employment and economic opportunities;
- potential significant negative impacts from energy production and supply, in particular during construction phases (dust, noise, odour, vibration, artificial light, exposure to pollutants, smoke and steam, waste products and an increase in pest incidence); and
- indirect negative impacts through loss of amenity, access, including access to open spaces/transport networks, changes (increases) to local populations placing pressure on essential services.

5.12.2: Approach to Development and Mitigation as set out in EN-1

EN-1 notes that where a proposed energy infrastructure project has an effect on human beings, an Environmental Statement should be undertaken that should assess these effects for each element of the project, identifying any potential adverse health impacts, and identifying measures to avoid, reduce or compensate for these impacts as appropriate. Consideration should also be made of how the impacts of more than one development may affect people simultaneously, so the applicant should consider the cumulative impact on health in the ES where appropriate. In addition, it is recognised within EN-1 that new energy infrastructure may also affect the composition, size and proximity of the local population, and in doing so have indirect health impacts, for example if it in some way affects access to key public services, transport or the use of open space for recreation and physical activity.

EN-1 recognises that those areas of energy infrastructure which are most likely to have a significantly detrimental impact on health are subject to separate regulation (for example for air pollution) which will constitute effective mitigation of them, so that it is unlikely that health concerns will either by themselves constitute a reason to refuse consent or require specific

mitigation under the Planning Act 2008. However, not all potential sources of health impacts will be mitigated in this way and the Secretary of State will want to take account of health concerns when setting requirements relating to a range of impacts such as noise. Opportunities should also be taken to mitigate indirect impacts, by promoting local improvements to encourage health and wellbeing.

It is to be noted that EN-1 provides further clarity on pollution control as well as the role of safety legislation and notes how this can help to protect health. Further consideration is made within relevant discrete sections with particular direct relevance to health, such as air quality or noise and vibration, as well as indirect relevance such as green space that can help promote healthy living.

EN-1 notes the need to identify any potential adverse health impacts and reflect and address the potential for health effects across the whole of society and the different groups within it and recognises the need to protect the most vulnerable. EN-1 also reflects that not all health impacts will be addressed through separate regulation and notes the need for opportunities to be taken to mitigate indirect impacts, by promoting local improvements to encourage health and wellbeing, this includes potential impacts on vulnerable groups within society i.e. those groups within society which may be differentially impacted by a development compared to wider society as a whole.

5.12.3: Assessment made in respect of EN-1

Reliable energy supplies nationally will contribute to positive effects generally on the economy and skills with indirect positive effects for health and well-being in the medium to longer term through helping to secure affordable supplies of energy and minimising fuel poverty. Opportunities for employment (across the short, medium and long term) are also likely, with consequent beneficial effects on wellbeing.

EN-1 also makes clear recognition of the need to identify potential adverse health impacts, including on vulnerable groups within society and notes that opportunities should be taken to mitigate direct impacts by promoting local improvements to encourage health and wellbeing. Beneficial effects will be from the short through to the long term.

Table 5-11 – Improve health and well-being Objective Summary

AoS Objective	**Assessment of generic effects (by timescale)**		
	S	**M**	**L**
Improve health and well-being and safety for all citizens and reduce inequalities in health Guide questions: • Protect the health of communities through prevention of accidental pollutant discharges, exposure to electric and magnetic fields, shadow flicker or radiation? • Minimise nuisance on communities and their facilities including air, noise and light pollution? • Provide for facilities that can promote more social interaction and a more active lifestyle and enjoyment of the countryside and coasts? • Promote initiatives that enhance safety and personal security for all?	+	+	+

• Support enhanced security, reliability and affordability of the national energy supply?			

5.14: AoS Objective 12: Promote sustainable transport and minimise detrimental impacts on strategic transport network and disruption to basic services and infrastructure

5.14.1: Anticipated Effects

Enabling the development of energy infrastructure to meet the energy demands of the UK has the potential for a number of generic effects on traffic and transport which are applicable across the different types of energy infrastructure development. They 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. This could include new sustainable transport modes.

5.14.2: Approach to Development and Mitigation as set out in EN-1

EN-1 notes that if a project is likely to have significant transport implications, the applicant's ES should include a transport assessment, using the NATA/WebTAG methodology stipulated in Department for Transport guidance, or any successor to such methodology. Applicants should consult the Highways England and Highways Authorities as appropriate on the assessment and mitigation.

Where appropriate, the applicant should prepare a travel plan including demand management measures to mitigate transport impacts. The applicant should also provide details of proposed measures to improve access by public transport, walking and cycling, to reduce the need for parking associated with the proposal and to mitigate transport impacts.

EN-1 also notes that where mitigation is required, possible demand management measures must be considered and if feasible and operationally reasonable, required, before considering requirements for the provision of new inland transport infrastructure to deal with remaining transport impacts.

Consideration should also be made as to the cost-effectiveness of demand management measures compared to new transport infrastructure, as well as the aim to secure more sustainable patterns of transport development when considering mitigation measures.

EN-1 notes that water-borne or rail transport is preferred over road transport at all stages of the project, where cost-effective. Developers should consider the DfT policy guidance "Water Preferred Policy Guidelines for the movement of abnormal indivisible loads" when preparing their Application.

EN-1 further notes that a transport assessment should also consider any possible disruption to services and infrastructure (such as road, rail and airports). Further clarity is also provided in relation to water borne transport and notes that Developers should consider the DfT policy guidance "Water Preferred Policy Guidelines for the movement of abnormal indivisible loads" when preparing their Application.

EN-1 further notes that there may be requirements to a consent where there is likely to be substantial HGV traffic that:

- control numbers of HGV movements to and from the site in a specified period during its construction and possibly on the routing of such movements;
- make sufficient provision for HGV parking, either on the site or at dedicated facilities elsewhere, to avoid 'overspill' parking on public roads, prolonged queuing on approach roads and uncontrolled on-street HGV parking in normal operating conditions; and
- ensure satisfactory arrangements for reasonably foreseeable abnormal disruption, in consultation with network providers and the responsible police force.

5.14.3: Assessment made in respect of EN-1

EN-1 provides for a robust approach to promoting sustainable transport, as well as minimising detrimental impacts on the strategic transport network and disruption to services and infrastructure. It also describes the need to promote sustainable transport modes (including water borne transport, as well as improving access by public transport, walking and cycling), as well as to reduce the need for parking. As such, it is anticipated that uncertain effects may be experienced in the short (construction) term but with benefits experienced across the later timescale of the development.

Table 5-13 – Promote sustainable transport Objective Summary

AoS Objective	Assessment of generic effects (by timescale)		
	S	M	L
Promote sustainable transport and minimise detrimental impacts on strategic transport network and disruption to basic services and infrastructure Guide questions: • Prevent adverse changes to strategic transport infrastructure road/rail/airport? • Prevent loss or disruption to basic services and infrastructure (e.g. electricity, gas)? • Promote transportation of goods and people by low/zero carbon transport modes? • Reduce travel distances to work and reduce the need for out commuting?	-	+	+

5.15: AoS Objective 13: Promote a strong economy with opportunities for local people

5.15.1: Anticipated Effects

EN-1 clearly recognises that businesses and jobs rely on the use of energy and there is a clear expectation from Government, as outlined in EN-1 and the Energy White Paper, that the energy system will help to support at a national level a green recovery, growing the economy and support thousands of jobs across the country in new industries. It will also create a fair deal for consumers, protecting the fuel poor, providing opportunities to save money on bills, giving warmer, more comfortable homes and balancing investment against bill impacts.

In addition, it is anticipated that the construction, operation and decommissioning of energy infrastructure can be expected to have socio-economic effects at local and regional levels.

5.15.2: Approach to Development and Mitigation as set out in EN-1

Clear recognition is made within EN-1 of the need for a secure, reliable and affordable national energy system. EN-1 sets out that applicants for new energy infrastructure should describe the existing socio-economic conditions in the areas surrounding the proposed development and should also refer to how the development's socio-economic impacts correlate with local planning policies. It is anticipated, though not explicitly stated that this would include consideration of demographics, community services and house prices. Consideration should also be made of how impacts can be cross cutting in nature, with the example of impacts on landscape potentially affecting the tourism industry.

Consideration will also be made of the need for whether mitigation measures are necessary to mitigate any adverse socio-economic impacts of the development. For example, high quality design can improve the visual and environmental experience for visitors and the local community alike. There is also potential need for consideration noted to include requirement for the approval by the local authority of an employment and skills plan detailing arrangements to promote local employment and skills development opportunities – it is anticipated that this would include for the provision of apprenticeships to local communities, though this is not explicitly stated. Further consideration would be made of any relevant positive provisions the developer has made or is proposing to make to mitigate impacts (for example through planning obligations) and any legacy benefits that may arise as well as any options for phasing development in relation to the socio-economic impacts.

EN-1 notes that applicants are encouraged, where possible, to ensure local suppliers are considered in any supply chain. It is also noted that applicants should also consider developing accommodation strategies where appropriate, especially during construction and decommissioning phases, that would include for the need to provide temporary accommodation for construction workers if required. In addition, EN-1 now states that the Secretary of State may wish to include a requirement that specifies the approval by the local authority of an employment and skills plan detailing arrangements to promote local employment and skills development opportunities, including apprenticeships, education, engagement with local schools and colleges and training programmes to be enacted.

In addition, EN-1 also notes the consideration should be made through an Environmental Statement of:

- the creation of jobs and training opportunities. Applicants may wish to provide information on the sustainability of the jobs created, including where they will help to develop the skills needed for the UK's transition to Net Zero;

- the contribution to the development of low-carbon industries at the local and regional level as well as nationally;
- the provision of additional local services and improvements to local infrastructure, including the provision of educational and visitor facilities;
- any indirect beneficial impacts for the region hosting the infrastructure, in particular in relation to use of local support services and supply chains;
- effects on tourism;
- the impact of a changing influx of workers during the different construction, operation and decommissioning phases of the energy infrastructure. This could change the local population dynamics and could alter the demand for services and facilities in the settlements nearest to the construction work (including community facilities and physical infrastructure such as energy, water, transport and waste). There could also be effects on social cohesion depending on how populations and service provision change as a result of the development; and
- cumulative effects – if development consent were to be granted to for a number of projects within a region and these were developed in a similar timeframe, there could be some short-term negative effects, for example a potential shortage of construction workers to meet the needs of other industries and major projects within the region.

5.15.3: Assessment and Recommendations made in respect of EN-1

Development of new energy infrastructure will support the security, reliability and affordability of the national energy supply and lead to the provision of jobs in local areas to the development and further afield. Some of these jobs are likely to be specialist in nature, but others will be lower skilled, or suitable for apprenticeships or will provide opportunities to further develop skills. It is anticipated that most jobs would be during the construction phase, with significantly less jobs during operation and then an increase during any decommissioning phase. As noted though, a significant increase in workers can lead to stress on local housing and labour markets (particularly in more rural areas / smaller towns), however, EN-1 sets out a clear approach to addressing such issues. As such, some slight adverse effects are anticipated in the short term, but overall, there should be significant benefits in local areas during construction, with ongoing benefits through the medium to long term.

It is also important to note that the NPS will help to provide a robust and secure national supply of energy. This will have significant benefits across the wider economy, through for example allowing people and businesses to make long term investment decisions and could be expected to provide significant benefits through to the long term.

Table 5-14 – Promote a strong economy Objective Summary

AoS Objective	**Assessment of generic effects (by timescale)**		
	S	**M**	**L**

Promote a strong economy with opportunities for local communities Guide questions: • Support enhanced security, reliability and affordability of the national energy supply? • Support creation of both temporary and permanent jobs and increase skills, particularly in areas of need? • Have wider socio-economic effects such as changes to the demographics, community services or house prices?	-	++	++	++

5.16: AoS Objective 14: Promote sustainable use of resources and natural assets

5.16.1: Anticipated Effects

All large infrastructure projects will require the use of natural resources (potentially of very significant quantities and including from virgin sources) and are likely to generate hazardous and non-hazardous waste (particularly during the construction phase, but also to a lesser degree during operation and decommissioning).

5.16.2: Approach to Development and Mitigation as set out in EN-1

EN-1 notes criteria for 'Good Design' for energy infrastructure and this sets out that applying 'Good Design' to energy projects should produce sustainable infrastructure efficient in the use of natural resources and energy used in their construction and operation. It is also noted that given the benefits of "good design" in mitigating the adverse impacts of a project, applicants should consider how "good design" principles can be applied to a project during the early stages of the project lifecycle.

EN-1 notes that where possible, applicants are encouraged to source materials from recycled or reused sources and use low carbon materials, sustainable sources and local suppliers. Construction best practices should be used to ensure that material is reused or recycled onsite where possible.

Applicants are also encouraged to use construction best practices in relation to storing materials in an adequate and protected place on site to prevent waste, for example, from damage or vandalism. The use of Building Information Management tools (or similar) to record the materials used in construction can help to reduce waste in future decommissioning of facilities, by identifying materials that can be recycled or reused.

EN-1 also notes that it is Government policy on hazardous and non-hazardous waste is intended to protect human health and the environment by producing less waste and by using it as a resource wherever possible. Where this is not possible, waste management regulation ensures that waste is disposed of in a way that is least damaging to the environment and to human health. EN-1 also notes the 'waste hierarchy' that sets out priorities to be used when managing waste and includes prevention, reuse, recycling, other recovery and eventually disposal. Disposal should only be used where other options are not available or in the event that this is the best overall environmental outcome.

Note is also made that the EA's Environmental Permitting (EP) regime incorporates operational waste management requirements for certain activities. When an applicant

applies to the EA for an Environmental Permit, the EA will require the application to demonstrate that processes are in place to meet all relevant EP requirements.

EN-1 requires that all applicants should set out the arrangements that are proposed for managing any waste produced and prepare a Site Waste Management Plan. The arrangements described and Management Plan should include information on the proposed waste recovery and disposal system for all waste generated by the development, and an assessment of the impact of the waste arising from development on the capacity of waste management facilities to deal with other waste arising in the area for at least five years of operation. The applicant is encouraged to refer to the Waste Prevention Programme for England, and should seek to minimise the volume of waste produced and the volume of waste sent for disposal unless it can be demonstrated that this is the best overall environmental outcome. If the applicant's assessment includes dredged material, the assessment should also include other uses of such material before disposal to sea, for example through re-use in the construction process.

Consideration will be made in the application process as to the effectiveness of proposed waste management systems, including ensuring that the waste arisings will not have an adverse effect on waste facilities local to the development. Consideration will also be made of whether adequate steps have been taken to minimise volume of waste arisings and disposal. Waste management plans may need periodic review.

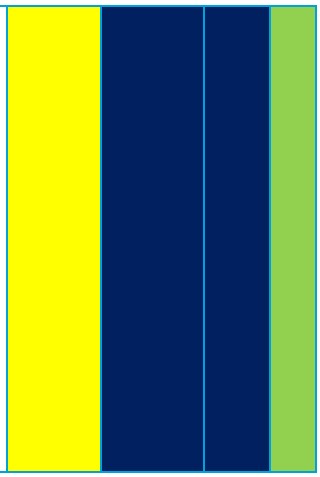
Finally, reference is made to environmental regulatory regimes and in certain circumstances this would apply to waste management.

5.16:3 Assessment made in respect of EN-1

EN-1 provides a robust approach to promoting sustainable use of resources and natural assets and notes how good design can reduce the requirement for consumption of materials and applying this to a project at as early a stage as possible will act to reduce consumption. Clear note is also made of a number of key aspects such as the waste hierarchy, and the requirement for waste management plans, as well as the sourcing of materials from recycled or reused sources and the use of low carbon materials. While there will be a high level of consumption of sources in the short term (construction phases), including virgin material, this will reduce during the operational phase and techniques such as the use of Building Information management tools (or similar) will provide opportunities in the long term for realising the recovery and reuse of materials used at the construction stage.

Table 5-15 – Promote sustainable use of resources and natural assets Objective Summary

AoS Objective	**Assessment of generic effects (by timescale)**			
	S	M	L	
Promote sustainable use of resources and natural assets Guide questions: • Reduce consumption of materials, energy and resources? • Promote sustainable waste management practices in line with the waste hierarchy?	**-**	**0**	**0**	**+**

• Encourage the use of recycled and / or secondary materials? • Promote the use of low carbon materials and technologies? • Produce waste by-products that require appropriate management? • Provide for safe and secure interim storage of waste, where necessary? • Promote the use of local suppliers that use sustainably-sourced and locally produced materials? • Support enhanced security, reliability and affordability of the national energy supply?	

5.17: Assessment of EN-1 Alternatives

5.17.1: Introduction

The Environmental Assessment of Plans and Programmes Regulations 2004 ("the SEA Regulations") require 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".

In line with the principles of good policy making and with the requirements of the SEA legislation, reasonable alternatives for implementing the aims of the NPS have been considered.

This section of AoS-1 is concerned with the analysis of reasonable alternatives. The analysis of reasonable alternatives provides a strategic context for the detailed assessment of the likely significant effects of EN-1, as well as a means of evaluating it by comparing it 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.

Four potential reasonable strategic alternatives that appear capable of fulfilling the objectives of EN-1 have then been tested against the AoS objectives. The assessment of the reasonable strategic alternatives against the AoS objectives is presented in Section 5.19, with a summary of the findings in Section 5.20. As noted in Section 2, the 14 AoS objectives have been grouped into 6 more appropriate headline sustainable development themes for the purpose of the alternatives assessment as set out in Table 5-15.

The preferred policy approach as set out in EN-1 is appraised in detail using the AoS framework of objectives in Section 5 of this report.

In addition to the overarching policies presented in EN-1, more detailed requirements for specific energy technologies are set out in EN-2 to EN-5. The framework for considering consents for new energy infrastructure projects comprises EN-1 and where relevant one or more of the technology-specific NPSs. The formulation of technology-specific alternatives is discussed further and assessed in the relevant technology-specific AoSs, provided in Sections 6 to 9 in this report.

Table 5-15 - Sustainable Development (SD) Themes and AoS Objectives

Headline SD Themes	AoS/SEA Objectives (numbers refer to AoS objectives)
Climate Change	Net Zero (1)
Security of Energy Supply	Health (11), , Economy (13)
Health & Well- Being	Air Quality (8), Health (11)
The Economy	Health (11), Economy (13), Resources (14)
The Built Environment	Transport (12), Heritage (5), Adaptation and Resilience (2)
The Natural Environment	Adaptation and Resilience (2), Biodiversity (3 & 4), Landscapes and Townscapes (6), Water (7), Soils (9), Geodiversity (10)

5.18: Alternatives Considered for AoS of EN-1

The NPSs set a strategic framework within which it is for industry to propose new energy infrastructure projects. The reasonable alternatives that have been formulated to inform the development of EN-1 are based on the fundamental premise that a combination of technologies, not one single technology, will be required to deliver secure and affordable supplies of energy which are compatible with net zero and protect the environment. Table 5-16 summarises EN-1 and the four alternatives that have been considered for EN-1. It is important to note that all of the Alternatives are variations of EN-1 but are differentiated by the removal or restriction of specific technologies.

Table 5-16 - Plan and Alternatives considered for EN-1

Plan/Alternative	Overview of technologies
EN-1	EN-1 combines infrastructure set out in Chapter 3 of this NPS. In summary: Renewables (including Biomass and Energy from Waste with or without CCS), Natural Gas-fired electricity generation with or without CCS, Hydrogen-fired electricity generation, Pumped Hydro Storage, Nuclear, associated electricity network infrastructure, and natural gas, oil, hydrogen and CCS infrastructure.
Alternative 1 (A1)	As EN-1 without Nuclear and Unabated Natural Gas.
Alternative 2 (A2)	As EN-1 without Unabated Natural Gas.
Alternative 3 (A3)	As EN-1 without Nuclear.
Alternative 4 (A4)	As EN-1 but with an even stricter protection of the marine environment.

Note that in consideration of Alternatives, the assessment is undertaken in comparison to EN-1 and as such, the findings of the AoS in respect of EN-1 in Section 5.2 to 5.16 broadly apply to all of the alternatives – the key differentiator being the inclusion or absence of specific technologies and the relative outcomes of such inclusion or absence. In order to

draw comparison between the Alternatives on a broad level, the following scale has been used:

Table 5-17: Differentiator scale for Alternatives

Scale	Description
Large Positive	A materially different positive outcome is anticipated compared to EN-1
Positive	A more positive outcome is anticipated compared to EN-1
Neutral	This alternative is anticipated to have the same outcome as EN-1
Negative	A more adverse outcome is anticipated compared to EN-1
Large Negative	A materially different adverse outcome is anticipated compared to EN-1

5.19: Appraisal of Alternatives

The findings of the appraisal of the strategic alternatives for EN-1 are set out below, arranged by Sustainable Development (SD) theme. As noted, consideration of the Alternatives is in comparison to the proposed EN-1 and not to each other alternative.

5.19.1: Climate Change (Net Zero)

Alternative A1 – As EN-1 without Nuclear and Unabated Natural Gas

By focusing solely on a combination of Renewables, Natural Gas with CCS, Hydrogen and Energy Storage technologies, Alternative A1 has the potential to deliver materially different positive, cumulative effects in the medium to long term than EN-1. These technologies will produce very low carbon intensity energy contributing significantly to emissions reduction and the Net Zero target.

Alternative A2 – As EN-1 without Unabated Natural Gas

Alternative A2 adds Nuclear energy to the technology mix for Alternative A1. Nuclear power stations provide continuous, reliable, power and produce no direct carbon emissions during operation. Nuclear, alongside other technologies could also offer broader system benefits, such as clean hydrogen production or low carbon heat. In comparison to EN-1, this alternative does not include unabated gas, which therefore is materially beneficial for emissions reduction and the achievement of Net Zero.

Alternative A3 – As EN-1 without Nuclear

Alternative A3 adds Unabated Natural Gas Technologies to the technology mix for A1 which could be used as mid merit plant (adjusting its power output as demand for electricity fluctuates throughout the day) or as dispatchable peak capacity.

Allowing unabated generation without balancing emissions out of the atmosphere has adverse effects on emissions reduction and the achievement of Net Zero. Emissions to the atmosphere will continue either until such point CCS is installed in power stations or for as long as mid merit and peak unabated power stations operate.

Direct Air Carbon Capture (DACC) technologies are challenging due to the low concentration of carbon dioxide in the air (as compared to capturing carbon dioxide at point sources, such as at industrial facilities and thermal power stations) and the technology itself requires a lot of energy. Due to these challenges, DAC technologies may not be available until CCS infrastructure is available to allow the storage of the carbon dioxide (and thus negative emissions), or until carbon utilisation markets are available and economic. This may result in

unnecessary accumulation of emissions in the atmosphere until such time DAC technologies are fully available.

In comparison to EN-1, this alternative does not include Nuclear, which may lead to greater reliance on unabated gas technology and negative emission technologies, such as Direct Air Carbon Capture and Storage.

Alternative A4 – As EN-1 but with an even stricter protection of the marine environment

As with EN-1, Alternative A4 combines use of all technologies, but it assumes that offshore renewables cannot deploy to their fullest extent due to even stricter protection of the marine environment. This will mean increased reliance on fewer low carbon electricity generation technologies.

The Committee for Climate Change (CCC) has recognised that offshore wind will play a crucial role in providing affordable low carbon power and have suggested that we will likely need 75GW of offshore generation by 2050 to meet the target[10]. Therefore, it is expected that a lower level of offshore wind capacity will likely have a materially adverse impact on the target of meeting Net Zero by 2050, than that of EN-1.

Headline SD themes	EN-1	Alternative A1	Alternative A2	Alternative A3	Alternative A4
Climate Change (Net Zero)		Large Positive	Large Positive	Negative	Large Negative

5.19.2: Security of Energy Supply

Alternative A1 – As EN-1 without Nuclear and Unabated Natural Gas

The effect of this alternative on the security of energy supply will depend to a large extent on whether a mix of Renewables, Natural Gas with CCS, Hydrogen and Energy Storage technologies can provide safe and secure energy supplies. As the timing of availability of Hydrogen and Energy Storage at scale is currently uncertain, reliance of such technologies could have a materially adverse effect on security of supply in the short to medium term, than that of EN-1.

Alternative A2 – As EN-1 without Unabated Natural Gas

The inclusion of Nuclear in this alternative (in comparison to the technology mix in A1) allows for a continuous and reliable technology which would enhance security of supply as it would lead to less reliance on technologies still under development such as Hydrogen and Energy Storage. In comparison to EN-1, this alternative does not have Unabated Natural Gas, so there could potentially be issues surrounding peak capacity.

Alternative A3 – As EN-1 without Nuclear

In this alternative, Unabated Natural Gas technologies would have the role of enhancing security of supply through providing reliable peak capacity as well as providing a baseline of continuous reliable security of supply of electricity and placing less reliance on technologies still under development, such as Hydrogen and Energy Storage. However, this alternative

[10] https://www.theccc.org.uk/wp-content/uploads/2019/05/Net-Zero-Technical-report-CCC.pdf

would still be reliant on a smaller range of generating technologies with adverse impacts on security of supply compared to EN-1.

Alternative A4 – As EN-1 but with an even stricter protection of the marine environment

Any reduction in the contribution of offshore renewables will mean that security of supply will be reliant on a smaller range of generation technologies with adverse impacts on security of supply compared to EN-1.

Headline SD themes	EN-1	Alternative A1	Alternative A2	Alternative A3	Alternative A4
Security of Energy Supply		**Large Negative**	**Negative**	**Negative**	**Negative**

5.19.3: Health and Well-being

Alternative A1 – As EN-1 without Nuclear and Unabated Natural Gas

As with EN-1, Alternative A1 has the potential to result in significant indirect positive effects for health and well-being because of improved employment opportunities and the predicted, enhanced economic conditions arising from investment in energy infrastructure. These positive effects have the potential to be cumulative in the long term from improved vibrancy in the energy industry sector.

Alternative A2 – As EN-1 without Unabated Natural Gas

As with EN-1 and Alternative A1, Alternative A2 has the potential to result in significant indirect positive effects for health and well-being because of improved employment opportunities and the predicted, enhanced economic conditions arising from investment in energy infrastructure. These positive effects have the potential to be cumulative in the long term from improved vibrancy in the energy industry sector.

Alternative A3 – As EN-1 without Nuclear

As with EN-1 and the other two Alternatives, Alternative A3 has the potential to result in significant indirect positive effects for health and well-being because of improved employment opportunities and the predicted, enhanced economic conditions arising from investment in energy infrastructure. These positive effects have the potential to be cumulative in the long term from improved vibrancy in the energy industry sector.

Alternative A4 - As EN-1 but with an even stricter protection of the marine environment

As with EN-1, and the other two alternatives, Alternative A4 has the potential to result in significant indirect positive effects for health and well-being because of improved employment opportunities and the predicted, enhanced economic conditions arising from investment in energy infrastructure. These positive effects have the potential to be cumulative in the long term from improved vibrancy in the energy industry sector.

Headline SD themes	EN-1	Alternative A1	Alternative A2	Alternative A3	Alternative A4

Health & Well-Being		**Neutral**	**Neutral**	**Neutral**	**Neutral**

5.19.4: The Economy

Alternative A1 – As EN-1 without Nuclear and Unabated Natural Gas

Alternative A1 provides for a range of low carbon energy sources to meet the UK's future energy needs. Short to medium term positive effects are likely to be significant for the economy and employment across the range of technology types during construction and operation phases given the scale of development required/proposed. These benefits should accrue at local and regional levels and there may be positive cumulative effects nationally for the energy and associated sectors overall, from increased investment in infrastructure. These effects may also be particularly significant in the context of current (2021) COVID-19 Pandemic conditions, and there are opportunities for the development and establishment of new industries, particularly in the renewables sector and hydrogen.

There is a potential for minor negative effects in the short to medium term where the impacts arising from new energy infrastructure are detrimental to existing industries (e.g. tourism, through a loss of amenity/negative landscape impacts/lower property values, and agriculture/fisheries/shipping through direct impacts on natural resources from direct land loss or windfarm exclusion zones).

Similar to EN-1, the overall long term impacts for Alternative A1 are assessed as positive for the economy as plan implementation will support the creation of jobs and skills development across the energy sector.

Alternative A2 – As EN-1 without Unabated Natural Gas

Alternative A2 provides for a range of low carbon energy sources to meet the UK's future energy needs. Short to medium term positive effects are likely to be significant for the economy and employment across the range of technology types during construction and operation phases given the scale of development required/proposed. These benefits should accrue at local and regional levels and there may be positive cumulative effects nationally for the energy and associated sectors overall, from increased investment in infrastructure. These effects may also be particularly significant in the context of current (2021) COVID-19 Pandemic conditions, and there are opportunities for the development and establishment of new industries, particularly in the renewables sector and hydrogen.

There is a potential for minor negative effects in the short to medium term where the impacts arising from new energy infrastructure are detrimental to existing industries (e.g. tourism, through a loss of amenity/negative landscape impacts/lower property values, and agriculture/fisheries/shipping through direct impacts on natural resources from direct land loss or windfarm exclusion zones). The overall long term impacts for Alternative A2 are assessed as positive for the economy as plan implementation will support the creation of jobs and skills development across the energy sector.

It is to be noted that this Alternative, as with EN-1 does also include Nuclear technologies and while all the Alternatives will bring benefits to the local economies, due to the longer construction and operation periods for nuclear projects, these impacts (both positive and negative) may be longer lasting. It is anticipated that any negative impacts during construction, for example, a large influx of workers (often to a rural area) that can disrupt local employment and housing markets, can be mitigated to a great extent by industry developers.

Similar to EN-1, the overall long term impacts for Alternative A2 are assessed as positive for the economy as plan implementation will support the creation of jobs and skills development across the energy sector.

Alternative A3 – As EN-1 without Nuclear

Alternative A3 provides for a range of low carbon energy sources to meet the UK's future energy needs. As with EN-1, short to medium term positive effects are likely to be significant for the economy and employment across the range of technology types during construction and operation phases given the scale of development required/proposed. These benefits should accrue at local and regional levels and there may be positive cumulative effects nationally for the energy and associated sectors overall, from increased investment in infrastructure. These effects may also be particularly significant in the context of current (2021) COVID-19 Pandemic conditions, and there are opportunities for the development and establishment of new industries, particularly in the renewables sector and hydrogen.

There is a potential for minor negative effects in the short to medium term where the impacts arising from new energy infrastructure are detrimental to existing industries (e.g. tourism, through a loss of amenity/negative landscape impacts/lower property values, and agriculture/fisheries/shipping through direct impacts on natural resources from direct land loss or windfarm exclusion zones). The overall long term impacts for Alternative A3 are assessed as positive for the economy as plan implementation will support the creation of jobs and skills development across the energy sector.

Similar to EN-1, the overall long term impacts for Alternative A3 are assessed as positive for the economy as plan implementation will support the creation of jobs and skills development across the energy sector.

Alternative A4 – As EN-1 but with an even stricter protection of the marine environment

Alternative A4 provides for a range of low carbon energy sources to meet the UK's future energy needs. As with EN-1, short to medium term positive effects are likely to be significant for the economy and employment across the range of technology types during construction and operation phases given the scale of development required/proposed. These benefits should accrue at local and regional levels and there may be positive cumulative effects nationally for the energy and associated sectors overall, from increased investment in infrastructure. These effects may also be particularly significant in the context of current (2021) COVID-19 Pandemic conditions, and there are opportunities for the development and establishment of new industries, particularly in the renewables sector and hydrogen.

There is a potential for minor negative effects in the short to medium term where the impacts arising from new energy infrastructure are detrimental to existing industries (e.g. tourism, through a loss of amenity/negative landscape impacts/lower property values, and agriculture/fisheries/shipping through direct impacts on natural resources from direct land loss or windfarm exclusion zones).

Similar to EN-1, the overall long term impacts for Alternative A4 are assessed as positive for the economy as plan implementation will support the creation of jobs and skills development across the energy sector.

Headline SD themes	EN-1	Alternative A1	Alternative A2	Alternative A3	Alternative A4
The Economy		**Neutral**	**Neutral**	**Neutral**	**Neutral**

5.19.5: The Built Environment

Alternative A1 – As EN-1 without Nuclear and Unabated Natural Gas

Renewable technologies tend to involve more extensive land use than thermal power plants of equivalent capacity although Natural Gas with CCS technology also may require extra land for the installation of CCS. This means that with more emphasis on renewable energy in this alternative, in comparison to EN-1, there may be negative effects on attributes such as built heritage due to the additional land area affected.

However, effects to and from flood risk on the built environment would be attenuated due to less need for energy technologies that tend to locate near to coasts, estuaries or rivers (such as nuclear) due to their water resource needs.

Potentially more abated natural gas with CCS in this alternative is likely to result in a greater clustering of generating capacity proposals around preferred locations as the closer a power station is to a viable route to transport and store CO_2, the lower the costs of retrofitting CCS to that power station could be. As such there is the potential for more cumulative local negative effects on the built environment.

Alternative A2 – As EN-1 without Unabated Natural Gas

As per EN-1, inclusion of Nuclear in this alternative, could give rise to infrastructure clustering in areas where there are existing skills in the workforce and ancillary infrastructure such as transport connections.

This alternative does not have Unabated Natural gGs, unlike EN-1 and as such may require more overall land take compared to EN-1, due to the potential requirement of additional land for CCS.

Nuclear also results in a more efficient use of land as more energy can be generated per unit of land area. Compared to Solar Renewables, the need for land area can be significantly lower for the same energy output potentially resulting in less direct potential impact on the built environment. However, effects to and from flood risk to the built environment could be heightened due to preferential location of nuclear power stations near to coasts, estuaries or rivers to satisfy water resource needs for cooling.

Inclusion of only Natural Gas with CCS in this alternative is also likely to result in clustering of generating capacity proposals around preferred locations than that of EN-1, as the closer a power station is to a viable route to transport and store CO_2, the lower the costs of retrofitting CCS to that power station could be. As such, there is the potential for more cumulative local negative effects on the built environment.

Alternative A3 – As EN-1 without Nuclear

In comparison to EN-1, more emphasis on Renewable energy will also have potentially more negative impacts on the built environment due to the additional land area affected by wind and solar Renewables. There will also be more need for energy technologies that need to be located near to coasts, estuaries or rivers due to their water resource needs, in particular in the case of Natural Gas with or without CCS, affecting flood risk to built environment.

Alternative A4 – As EN-1 but with an even stricter protection of the marine environment

This alternative, in comparison to EN-1, assumes that offshore renewables cannot deploy to their fullest extent due to even stricter protection of the marine environment. This could lead to greater emphasis on onshore facilities, likely resulting in more negative effects on the built environment compared to EN-1.

Headline SD themes	EN-1	Alternative A1	Alternative A2	Alternative A3	Alternative A4
The Built Environment		**Positive / Negative**	**Negative**	**Negative**	**Negative**

5.19.6: The Natural Environment

Alternative A1 – As EN-1 without Nuclear and Unabated Natural Gas

Renewable technologies tend to involve more extensive land use than thermal power plants of equivalent capacity although Natural Gas with CCS technology also requires extra land for the installation of CCS. This means that with more emphasis on renewable energy in this alternative, in comparison to EN-1, there may be negative effects on the natural environment due to the additional land area affected.

In the case of offshore renewables power, they involve extensive sea use and there are clearly effects on the natural marine environment such as on biodiversity and visual impact, though these could be mitigated by careful siting.

This means that while more emphasis on renewable energy may have a positive effect on certain natural environment attributes, by contributing to the mitigation of climate change, there will also be potentially negative impacts on other environmental attributes such as visual impact and direct habitat loss due to the additional land / sea area affected.

Alternative A2 – As EN-1 without Unabated Natural Gas

As per EN-1, the inclusion of Nuclear in this alternative would result in a more efficient use of land as more energy can be generated per square meter in comparison to the use of land based renewables, thus potentially resulting in less direct habitat, heritage, soil, water features etc loss.

However, in comparison to EN-1, this alternative does not have unabated gas and as such there may be a requirement for more land take (to allow for CCS) and this may have a greater effect on the natural environment.

Alternative A3 – As EN-1 without Nuclear

The absence of Nuclear from this alternative, in comparison to EN-1, means that there would be less overall efficient use of land / sea, as less energy can be generated per square metre. This would likely result in more direct habitat, heritage, soil, water features etc loss.

Alternative A4 – As EN-1 but with even stricter protection of the marine environment

This alternative, in comparison to EN-1, assumes that offshore renewables cannot deploy to their fullest extent due to even stricter protection of the marine environment. This could lead to greater emphasis on onshore facilities, likely resulting in more negative effects on the land based natural environment compared to EN-1, though it would result in less impact on the marine natural environment due to less disturbance.

Headline SD themes	EN-1	Alternative A1	Alternative A2	Alternative A3	Alternative A4

The Natural Environment		**Negative**	**Negative**	**Negative**	**Positive / Negative**

5.20: Summary Alternative Findings and Preferred Approach for the NPS

The findings of the assessment of alternatives are summarised on Table 5-18 This shows how Alternatives A1, A2, A3 and A4 were assessed as affecting the headline SD topics compared to EN-1. The detailed assessment of EN-1, appraising the absolute effects of the Plan on the AoS objectives, is presented above in Section 5 of this report.

Table 5-18 - Summary of Alternatives assessment

Headline SD themes	EN-1	Alternative A1	Alternative A2	Alternative A3	Alternative A4
Climate Change (Net Zero)		**Large Positive**	**Large Positive**	**Negative**	**Large Negative**
Security of Energy Supply		**Large Negative**	**Negative**	**Negative**	**Negative**
Health & Well-Being		**Neutral**	**Neutral**	**Neutral**	**Neutral**
The Economy		**Neutral**	**Neutral**	**Neutral**	**Neutral**
The Built Environment		**Positive / Negative**	**Negative**	**Negative**	**Negative**
The Natural Environment		**Negative**	**Negative**	**Negative**	**Positive / Negative**

In comparison with EN-1, the alternatives are assessed as being beneficial in respect of climate change for Alternative 1 and 2, but negative for Alternative 3 and 4. All Alternatives are considered negative in terms of Security of Supply due to the reduction in generation options. In terms of Health and Wellbeing and Economy, no differences have been identified between any of the Alternatives and EN-1. In respect of the other sustainability development themes of the Built and Natural Environment there is a more mixed picture of having adverse effects under some Alternatives and beneficial effects under others. The key differences between the different alternatives and the plan (EN-1) are highlighted below.

Alternative A1 As EN-1 without Nuclear and Unabated Natural Gas would:

- be materially beneficial for the achievement of Net Zero due to no emissions from unabated gas, although reliant on smaller group of low carbon technologies for delivery;
- be materially adverse on security of supply as reliant on technologies still under development such as Hydrogen and Energy Storage at scale to ensure peak supply and maintain the stability and security of the electricity system;
- have no differential effects on the economy or human health (compared to EN-1) because of providing for a range of low energy sources to meet future energy needs,

as well as economic stimulus and improved employment opportunities, though note some negative effects may arise due to disruption to existing industries / communities; and

- have a mix of beneficial and negative effects on the built and natural environment due to positive environment effects through for example mitigation of climate change, though negative due to large areas of land and sea required for renewables.

Alternative A2 As EN-1 without Unabated Natural Gas would:

- be materially beneficial for the achievement Net Zero due to no emissions from unabated gas;
- have adverse effects on Security of Supply, as although it would be less reliant (than alternative A1) on yet to be fully proven technologies, such as Hydrogen and Energy Storage at scale, there would still be a need for them to ensure peak supply and maintain the stability and security of the electricity system;
- be neutral (compared to EN-1) in relation to benefits to the Health and Well-being and Economy SD themes by providing for a range of low energy sources to meet future energy needs, as well as economic stimulus and improved employment opportunities though there may also be economic and community costs at the local scale; and
- have a negative effect for the Built and Natural Environment as greater use of Natural Gas with CCS (compared to EN-1) may require more land take due to the associated need for CCS infrastructure.

Alternative A3 As EN-1 without Nuclear would:

- have adverse effects on the achievement of Net Zero due to greater ongoing emissions from unabated gas;
- have adverse effects on Security of Supply as reliant on a smaller range of electricity generating technologies;
- be neutral in terms of Health and Well-being and the Economy by providing for a range of low energy sources to meet future energy needs, as well as economic stimulus and improved employment opportunities though there may also be economic and community costs at the local scale;
- have adverse effects for the Built Environment due to additional land take by wind and solar Renewables and location near to coasts, estuaries or rivers by Natural Gas with or without CCS, affecting flood risk; and
- have adverse effects for the Natural Environment as emphasis on Renewables and Natural Gas with CCS would require larger areas to meet the same energy output as EN-1.

Alternative A4 is the same as EN-1, but with even stricter protection of the marine environment would (compared to EN-1):

- be materially adverse for the achievement of Net Zero as reliant on a smaller range of low carbon technologies compared to EN-1
- have adverse effects on Security of Supply as reliant on a smaller range of electricity generating technologies.
- be neutral on Health and Well-being and the Economy due to providing for a range of low energy sources to meet future energy needs, as well as economic stimulus and

improved employment opportunities though there may also be economic and community costs at the local scale.

- be adverse on the Built Environment and aspects of the Natural Environment due to increased pressure on land for energy generation. However, the natural environment could benefit in marine areas due to less disturbance.

None of these alternatives are as good as, or better than, the proposals set out in EN-1 and therefore the government's preferred option is to take forward the Energy NPS EN-1 (and the technology-specific NPSs EN-2 to EN-5, see following sections).

6: Assessment for Natural Gas Electricity Generating Infrastructure EN-2 (AoS-2)

6.1: The NPS for Natural Gas Electricity Generating Infrastructure

The NPS for Natural Electricity Generating Infrastructure (EN-2), in conjunction with the Overarching NPS for Energy (EN-1), sets out the relevant policy and planning factors that should be considered by the Secretary of State when determining whether development consent should be granted for a proposed scheme.

As for EN-1, EN-2 has been developed via an iterative process, taking account of the appraisal of the predicted sustainability effects both for EN-2 preferred polices and reasonable alternatives.

6.2: Appraisal Findings for EN-2

Natural gas electricity generating infrastructure may have various impacts on communities and the environment depending on the nature of the development and its location. As noted in EN-2, all of the generic impacts detailed in EN-1 are likely to be relevant to electricity generating infrastructure, even if only during specific stages of the development (such as construction), or at one specific part of the development (such as a substation).

While reference should be made to AoS-1 for consideration of all effects in full, this AoS-2 focuses on those potentially significant sustainability effects associated with the technologies set out in EN-2. The effects considered relate to:

- Carbon emissions;
- Air pollution;
- Water Quality and Resources; and
- Biodiversity.

It should be noted that, following an initial review, noise and vibration effects and landscape and visual effects for this technology were considered to be adequately addressed within EN-1 as informed by the findings of AoS-1 (see EN-1 for further information). As such, this AoS does not consider these effects further even though EN-2 specifically refers to them.

The likely significant effects of the technology specific policies, requirements and guidance in EN-2 have been appraised against the corresponding objectives in the AoS framework as set out in Section 4.

Section 2.3 of this report explains how the results of the assessment of likely significant effects are shown. For ease of reference, the table is reproduced here.

Table 6-1 - Key to Appraising Significance of Predicted Effects

Likely Significance of Effects		
Significant positive effect likely	**++**	Policy is expected to address an existing sustainability problem or deliver sustainability enhancements, such as substantial environmental net gain above existing/emerging policy.
Minor positive effect likely	**+**	Policy is expected to lead to environmental net gain in line with existing or emerging Government policy OR result in

		protection and conservation of a sustainability asset (for example, a designated biodiversity site or designated heritage asset).
No effect likely or not applicable	0	No perceptible effects expected, or the objective is not relevant to the part of the NPS being assessed.
Minor negative effect likely	-	Policy is expected to result in adverse effects of a lower magnitude or smaller scale, which can be mitigated through standard measures and best practice.
Significant negative effect likely	--	Policy is expected to result in adverse effects of a greater magnitude or larger scale, which cannot be mitigated OR will require extensive and bespoke mitigation solutions (further studies may be required to identify appropriate solutions).

The appraisal focused on the identification of technology specific effects (non-generic) with consideration of mitigation measures as set out in AoS-1, in order to establish whether additional mitigation would be required as part of AoS-2. It is noted that an initial assessment was undertaken on a draft EN-2 document dated April 2021 and that this resulted in suggestions of additional mitigation (in the form of recommendations, see Appendix E) to be considered in the drafting of EN-2 for public consultation.

An assessment of residual non-generic effects is provided for the EN-2 document as presented for public consultation in the following sections. The likely non-generic effects arising specifically from electricity generating infrastructure are presented together with a summary of the residual non-generic effects for each AoS objective over the short, medium and long term. In this context, for the purposes of the appraisal, the “short term” has been defined as the effects arising generally during the infrastructure construction period typically 2-7 years (different technologies have different construction times); the “medium term” as typically between 5 and 30 years (operational lifetimes vary with the characteristics of different technologies); and the “long term” as beyond 30 years (and including decommissioning where relevant).

In addition, consideration is given to the cumulative effects associated with the adoption of EN-2.

6.2.1: AoS Objective 1: Consistent with the national target of reducing carbon emissions to Net Zero by 2050

6.2.1.1: Anticipated Effects

Natural gas electricity generating infrastructure plays a vital role in providing reliable electricity supplies as the UK makes the transition to a low carbon economy. It is, however, a significant source of carbon emissions if these emissions are unabated. EN-2 sets out that “electricity generated from unabated natural gas will continue to be needed during the transition to a net zero economy in 2050, and potentially beyond, while we develop and deploy the low carbon alternatives that can replicate its role in the electricity system, ensuring that the system is reliable and affordable”.

6.2.1.2: Approach to Development and Mitigation in EN-1 and EN-2

Generating stations to which EN-2 applies are required to be “carbon capture ready” as set out in EN-1 and EN-2. To ensure that no foreseeable barriers exist to retrofitting CCS

equipment on combustion generating stations, all applications for new combustion plant which are of generating capacity at or over 300MW and of a type covered by The Carbon Capture Readiness (Electricity Generating Stations) Regulations 2013 should demonstrate that the plant is “Carbon Capture Ready” (CCR) before consent may be given. It follows that if an application does not demonstrate that CCR has been assessed according to this policy, the Secretary of State should seek further information from the applicant. The Secretary of State should not give development consent unless it is satisfied that the proposed development meets all the criteria for CCR set out in EN-1.

EN-1 sets out that the Government has made its ambitions for CCS clear – committing to providing funding to support the establishment of CCS in at least four industrial clusters by 2030 and supporting, using consumer subsidies, at least one privately financed gas CCS power station by 2030. The barriers to CCS deployment to date have been commercial rather than technical, and the business models, which may evolve overtime, aim to support the deployment of the technology. Natural gas-fired power CCS stations may still emit residual CO_2 and so will be required to comply with any Emission Performance Standards that might be applicable, but this is not part of the consents process. The carbon capture plant required for a new build power CCS plant can be included as associated development in the application for development consent for the relevant thermal generating station and will then be considered as part of that application

However, as noted within EN-1, there is uncertainty associated with CCS as it is a developing technology and there is a need to demonstrate its viability. As such, CCS is not a requirement for new natural gas electricity generating infrastructure in EN-2.

The Government’s strategy for Combined Heat and Power (CHP) is described in EN-1 and EN-2. It notes in developing proposals for new thermal generating stations, developers should consider the opportunities for CHP from the very earliest point and it should be adopted as a criterion when considering locations for a project. Applicants are required either to include CHP or present evidence in the application that the possibilities for CHP have been fully explored. It is noted that if an application does not demonstrate that CHP has been considered the Secretary of State should seek further information from the applicant. The Secretary of State should not give development consent unless it is satisfied that the applicant has provided appropriate evidence that CHP is included or that the opportunities for CHP have been fully explored

For non-CHP stations, where there is reason to believe that opportunities to supply heat through CHP may arise in the future, the Secretary of State may also require that developers ensure that their stations are ‘CHP ready’ and are designed in order to allow heat supply at a later date, as described in draft EN-1 and the guidance on CHP issued by BEIS.

EN-1 notes that CHP may require additional space than for a non-CHP generating station. It is possible that this might conflict with space required for a generating station to be CCR. The material provided by applicants should therefore explain how the development can both be ready to provide CHP in the future and also be CCR or set out any constraints (for example space restrictions) which would prevent this.

EN-1 further notes that operational greenhouse gas emissions are a significant adverse impact from some types of energy infrastructure which cannot be totally avoided (even with full deployment of CCS technology). Given the characteristics of these and other technologies, as noted in Part 3 of EN-1, and the range of non-planning policies aimed at decarbonising electricity generation such as UK ETS (see EN-1), Government has determined that operational greenhouse gas emissions are not reasons to prohibit the consenting of energy projects including those which use these technologies or to impose more restrictions on them in the planning policy framework than are set out in the energy

NPSs (e.g. the CCR requirements). Any carbon assessment will include an assessment of operational greenhouse gas emissions, but the policies set out, including the UK ETS, apply to these emissions. Operational emissions will be addressed in a managed, economy-wide manner, to ensure consistency with carbon budgets, net zero and our international climate commitments. The Secretary of State does not, therefore need to assess individual applications for planning consent against operational carbon emissions and their contribution to carbon budgets, net zero and our international climate commitments

EN-1 (in a section relating to 'Greenhouse Gas Emissions') notes that significant levels of energy infrastructure development are vital to ensure the decarbonisation of the UK economy. The construction, operation and decommissioning of that energy infrastructure will in itself lead to greenhouse gas emissions. While all steps should be taken to reduce and mitigate climate change impacts, it is accepted that there will be residual emissions from energy infrastructure, particularly during the economy wide transition to net zero, and potentially beyond. EN-1 therefore requires that all proposals for energy infrastructure projects should include a carbon assessment as part of their ES. This should include:

- A whole life carbon assessment showing construction, operational and decommissioning carbon impacts;
- An explanation of the steps that have been taken to drive down the climate change impacts at each of those stages;
- Measurement of embodied carbon impact from the construction stage;
- How reduction in energy demand and consumption during operation has been prioritised in comparison with other measures;
- How operational emissions have been reduced as much as possible through the application of best available technology for that type of technology;
- Calculation of operational energy consumption and associated carbon emissions;
- Whether and how any residual carbon emissions will be (voluntarily) offset or removed using a recognised framework; and
- Where there are residual emissions, the level of emissions and the impact of those on national and international efforts to limit climate change, both alone and where relevant in combination with other developments at a regional or national level, or sector level, if sectoral targets are developed.

6.2.1.3: Assessment made in respect of EN-2

Whilst EN-2 technology does not promote the supply of energy from low carbon/renewable energy sources, the requirement for all new combustion plants which are at a generating capacity or over 300MW to be CCR and for CHP opportunities to be considered at the earliest opportunity alongside the Government's commitment to providing funding to support the establishment of CCS in at least four industrial clusters by 2030 are steps forward in aligning with the national target to reduce carbon emissions to Net Zero by 2050.

However, EN-2 will consent natural gas-fired electricity generating infrastructure over 50 MW in England that is not CCR, as the CCR requirement will only applies at or over 300MW. Unabated generation may thus continue either until such point CCS is installed in CCR power stations or for as long as unabated power stations operate. In this respect, provisions in EN-1 will go some way to address these operational emissions by requiring all proposals for energy infrastructure projects to include in a carbon assessment whether and how residual emissions will be (voluntarily) offset or removed and where there are residual emissions remaining these need to be considered in the context of sectoral targets. It is

noted that operational emissions will be addressed in a managed, economy-wide manner, to ensure consistency with carbon budgets, net zero and international climate commitments.

Considering the policy in EN-1 and EN-2 as discussed above, Table 6-2 provides the assessment of EN-2 with minor negative effects predicted in the short, medium and long term reflecting the residual emissions from unabated natural gas plants, unless balanced by negative emissions through voluntary or sectoral arrangements. Decommissioning in the long term will likely bring temporary effects similar to those for construction but effects will eventually become neutral through the cessation of operational aspects.

Table 6-2 - Reducing Carbon emissions to Net Zero Objective Summary

AoS Objective	Technology	Assessment of non-generic effects (by timescale)		
		S	M	L
Consistent with the national target of reducing carbon emissions to Net Zero by 2050 Guide questions: • Reduce carbon emissions of the national portfolio of major energy infrastructure? • Reduce direct and indirect emissions of all greenhouse gases, including carbon dioxide, during construction, operation and decommissioning? • Maximise supply of energy from low carbon/renewable energy sources / use of low carbon/renewable energy? • Maximise opportunities for making use of waste heat? • Use negative carbon emissions to offset residual emissions from energy such as Bioenergy with Carbon Capture & Storage (BECCS) and Nature Based Solutions? • Create new carbon sinks/removals through natural sequestration including that provided by green Infrastructure and soils and protection of key habitats which contribute to carbon sequestration?	Natural Gas Electricity Generating Infrastructure	-	-	-

6.2.2: AoS Objective 3: Enhance biodiversity, promoting net gain, and supporting ecosystem resilience and functionality

6.2.2.1: Anticipated Effects

The development of natural gas electricity generating infrastructure and specific effects on biodiversity is likely to be associated with impacts from infrastructure footprint and water demands.

Given the adoption of EN-2 technology is associated with the potential need for large volumes of process and cooling water, this indicates that coastal, estuarine and riverine locations are likely to be preferred. Such locations are likely to be associated with marginal habitats, specialist species and valuable ecological environments. Development in such locations increases the risk of permanent habitat fragmentation and loss with associated risks of species isolation and reduced biodiversity.

Meeting the requirements of CCR and CCS could increase the footprint at the location of the generating station further impacting terrestrial habitats, as well as giving rise to some development along the routes of CCS delivery systems on land and sea bed, and storage systems at sea impacting both terrestrial and marine habitats (although clustering of CCS or CCR generating plant in particular locations may help to minimise the amount of additional development arising from the transport and storage elements of each new scheme). This is likely to result in potential habitat fragmentation associated with larger site boundaries to meet CCR requirements, habitat disturbance in the short term associated with construction activity, and potentially permanent habitat loss due to carbon capture facilities taking up additional land.

Meeting of process and cooling water demands normally associated with natural gas electricity generation, compounded by the additional water required by CCS (the addition of a full-scale post-combustion capture system to a power plant can increase the water consumption per megawatt of electrical output (MWh) by as much as 90%[11]) is likely to have adverse effects on aquatic biodiversity.

Specifically, the design of the water cooling systems of natural gas electricity generating stations can result in both direct and indirect effects on aquatic biodiversity, including:

- the discharge of water at higher temperatures than receiving waters, which is likely to have an effect on aquatic flora and fauna;
- effects from the abstraction of water that will reduce flows in water courses, resulting in negative effects aquatic flora and fauna habitat;
- fish impingement and/or entrainment" – i.e. being taken into the cooling system during abstraction; and
- release of chemical anti-fouling treatment of water for use in cooling systems may have adverse impacts on aquatic biodiversity.

Potentially negative ecological effects will also result from noise above pre-construction ambient levels, beyond that considered within EN-1. EN-2 notes that sources of noise and vibration from natural gas generating stations may include the gas and steam, the gas and steam turbines that operate continuously during normal operation and external noise sources such as externally site air cooled condensers that operate continuously during normal operation. Disturbance of fauna is likely to result from the effects of higher noise levels.

6.2.2.2: Approach to Development and Mitigation in EN-1 and EN-2

EN-1 ensures that any proposals for energy generating infrastructure are subject to robust consideration by requiring that they are accompanied by and Environmental Statement (ES) (under the Infrastructure Planning Regulations 2017), which describes the significant likely effects of the proposal on the environment, including specific reference to biodiversity. Through this requirement, EN-1 ensures that the direct, indirect, secondary, transboundary and short to long term effects of the development on biodiversity will be considered, as these

[11] https://www.globalccsinstitute.com/news-media/insights/how-does-carbon-capture-affect-water-consumption/

are requirements in the Regulations. The applicant is required to consider the potential benefits of a proposal, which is likely to include biodiversity net gain.

In terms of designations, EN-1 notes that the Secretary of State should ensure that appropriate weight is given to designated sites of international, national and local importance, protected species, habitats and other species of importance for the conservation of biodiversity. At the regional and local scale, EN-1 suggests that Important Geological Sites, Local Nature Reserves and Local Wildlife Sites require due consideration, but given the need for new energy generating infrastructure, these designations should not be used as the sole reason to refuse development consent.

EN-2 notes that in addition to the mitigation measures set out in EN-1, design of the cooling system should include intake and outfall locations that avoid or minimise adverse impacts. EN-2 further notes there should also be specific measures to minimise fish impingement and/or entrainment and excessive heat from discharges to receiving waters.

It is noted, however, that EN-2 does not specify what specific mitigation measures could be included to reduce the effects of cooling water on water quality. Such measures could include:

- Design of cooling water system so as to minimise modification of sedimentary and hydrodynamic processes.
- Design the cooling water system to avoid the entrainment and impingement of marine organisms.
- Design the cooling water outfall to increase the momentum of the discharge, to help propel the thermal plume, and promote sufficient mixing and dispersal and decay of associated biocide products (if these are required) and reduce the risk of recirculation.
- Further studies could be carried out, including modelling studies, to establish effects of changes to water quality and water temperature to ascertain significance of impacts on local, national and international sites and species.
- If impacts are found to be significant after such studies, consideration to be given to habitats and species compensation requirements and delivery.

6.2.2.3: Assessment made in respect of EN-2

Adoption of EN-2 technology to facilitate the development of natural gas electricity generating capacity is likely to have negative effects with respect to biodiversity in the short, medium and long term (during the construction and operation of any natural gas powered facility and associated CCS infrastructure). However, the magnitude of these effects will be uncertain, as they will be dependent on the location of the facilities as well as on the character of the terrestrial and aquatic habitats affected and on their environmental sensitivities and designations.

There are ranges of mitigation measures, including those proposed in EN-2, that can minimise these effects, but the extent of the mitigation is uncertain. Therefore, the residual effects are likely to be minor, in the short, medium and long term but with uncertainty across these timescales given uncertainty associated with footprint and location. Decommissioning in the long term will likely bring temporary effects similar to those for construction but effects will eventually become neutral through the cessation of operational aspects such as cooling water discharge as habitats and biodiversity returns to a pre-development condition.

Table 6-3 - Enhancing biodiversity Objective Summary

AoS Objective	Technology	Assessment of non-generic

		effects (by timescale)		
		S	M	L
Enhance biodiversity, promoting net gain, and supporting ecosystem resilience and functionality Guide questions: • Protect and enhance nationally designated sites such as SSSIs and National Nature Reserves, including those of potential or candidate designation? • Protect and enhance valued habitat and populations of protected/scarce species on locally designated sites, including Key Wildlife Sites, Local Wildlife Sites and Local Nature Reserves? • Protect the structure and function/ecosystem processes, including in the marine environment? • Protect and enhance the Nature Recovery Network? • Protect and enhance priority habitats, and the habitat of priority species? • Promote new habitat creation or restoration and linkages with existing habitats? • Protect and enhance the wider green infrastructure network? • Increase the resilience of biodiversity to the potential effects of climate change? • Promote a net gain in biodiversity for any new major infrastructure development?	Natural Gas Electricity Generating Infrastructure	-	-	0

6.2.3: AoS Objective 7: Protect and enhance the water environment

6.2.3.1: Anticipated Effects

Natural gas energy generation infrastructure development can have adverse effects on the water environment, including groundwater, inland surface water, transitional waters and coastal waters. During the construction, operation and decommissioning phases, it can lead to increased demand for water, involve discharges to water and cause adverse ecological effects resulting from physical modifications to the water environment. There may also be an increased risk of spills and leaks of pollutants to the water environment. These effects could lead to adverse impacts on health or on protected species and habitats and could, in particular, result in surface waters, groundwaters or protected areas failing to meet environmental objectives established under the Water Framework Directive and the Marine Strategy Framework Directive (MSFD).

Specific effects associated with the adoption of EN-2 technology on water quality are primarily from impacts associated with the design of water cooling systems.

This includes discharging water at higher temperatures than receiving waters, which is likely to have an effect on aquatic flora and fauna (see appraisal of Biodiversity); linked effects

from the abstraction of water that will reduce flows in water courses, resulting in negative effects on water quality, sediment transport, and aquatic flora and fauna habitat (see appraisal of Biodiversity); and the release of anti-fouling chemicals from cooling water systems.

In addition, CCS technology has its additional water demands, above that of the generating technology. Volumes required will depend on the carbon capture technology used. This implies that favoured locations for new natural gas electricity generating facilities could be coastal, beside estuaries or alongside large rivers. As such, due to the proximity there are increased risk associated with impacts on these water bodies.

Decommissioning could bring adverse effects on water quality through de-construction activities involved. However, mitigation measures such as those utilised during construction e.g a CEMP, can reduce adverse effects, while beneficial effects could be experienced through the cessation of operational aspects such as cooling water discharge.

6.2.3.2: Approach to Development and Mitigation in EN-1 and EN-2

EN-1 requires that where a project is likely to have effects on the water environment, the applicant should undertake an assessment of the existing status of, and impacts of the proposed project on, water quality, water resources and physical characteristics of the water environment as part of the ES or equivalent.

EN-1 notes the Secretary of State should be satisfied that a proposal has regard to the River Basin Management Plans and meets the requirements of the Water Framework Directive (including Article 4.7) and its daughter directives, including those on priority substances and groundwater. The specific objectives for particular river basins are set out in River Basin Management Plans. In terms of Water Framework Directive compliance, the overall aim of development should be to prevent deterioration in status of water bodies to support the achievement of the objectives in the River Basin Management Plans and not to jeopardise the future achievement of good status for any affected water bodies.

EN-1 states the impact on local water resources can be minimised through planning and design for the efficient use of water, including water recycling. If a developer needs new water infrastructure, significant supplies or impacts other water supplies, the applicant should consult with the local water company and the EA/NRW.

In addition, EN-2 notes that where the project is likely to have effects on water quality or resources the applicant should undertake an assessment as required in EN-1. The assessment should particularly demonstrate that appropriate measures will be put in place to avoid or minimise adverse impacts of abstraction and discharge of cooling water.

Examples of such mitigation noted within EN-2 include designing intake and outfall locations to avoid or minimise adverse impacts. There should also be specific measures to minimise fish impingement and/or entrainment and excessive heat from discharges to receiving waters.

Whilst not specifically noted within EN-2, such measures could include:

- Design cooling water outfalls to increase the momentum of the discharge, to help propel the thermal plume, and promote sufficient mixing and dispersal and decay of associated biocide products and reduce the risk of recirculation.
- Alternative or complementary cooling methods such as indirect cooling could be considered. Further studies would be necessary as part of the planning application to establish best form of cooling and consider applicable mitigation measures considering Best Available Techniques at the time.

- Alternative water supply arrangements could be required. Further studies would be required as part of the planning application to assess the impacts of additional water supplies obtained locally, considering the presence of any water sensitive designations.

6.2.3.3: Assessment made in respect of EN-2

Overall, the effects described above are likely to be negative and occur through construction, operation (with potentially longer term legacy negative effects) and decommissioning of the respective facilities. However, their magnitude will be dependent on location and the character of water bodies affected, their environmental sensitivities and designations.

There are ranges of mitigation measures, including those proposed in EN-2, that can minimise these effects, but the extent of the mitigation is uncertain. Therefore, the residual effects are likely to be minor, in the short, medium and long term but with uncertainty across these timescales. Decommissioning in the long term will likely bring temporary effects similar to those for construction but effects will eventually become neutral through the cessation of operational aspects such as cooling water discharge as water quality returns to a pre-development condition.

The following provision set out in EN-1 *'The carbon capture plant required for a new build power CCS plant can be included as associated development in the application for development consent for the relevant thermal generating station, and will then be considered as part of that application. A supply of water will be needed for CCS processes and the volumes required will depend on the carbon capture technology used'* will ensure adequate coverage of the non-generic water environment effects arising from CCS in any ES accompanying a planning application.

Table 6-4 - Protect and enhance water environment Objective Summary

AoS Objective	Technology	Assessment of non-generic effects (by timescale)		
		S	M	L
Protect and enhance the water environment Guide questions: • Protect ground, surface, estuarine and coastal water quality? • Safeguard the availability of water resources (surface and groundwater)? • Minimise the use of water resources / water consumption?	Natural Gas Electricity Generating Infrastructure	-	-	0

6.2.4: AoS Objective 8: Protect and enhance air quality

6.2.4.1: Anticipated Effects

Infrastructure development can have adverse effects on air quality. The construction, operation and decommissioning phases can involve emissions to air which could lead to adverse impacts on human health, on protected species and habitats, or on the wider countryside and species.

EN-2 identifies that natural gas generating stations are likely to emit large amounts of nitrogen oxides (NOx). EN-1 notes that a particular effect of NOx from some energy infrastructure may be eutrophication,] which is the excessive enrichment of nutrients in the environment. The main emissions from energy infrastructure are from generating stations. Eutrophication can affect plant growth and functioning, altering the competitive balance of species and thereby damaging biodiversity. In aquatic ecosystems it can cause changes to algal composition and lead to algal blooms, which remove oxygen from the water, adversely affecting plants and fish. The effects on ecosystems can be short term or irreversible and can have a large impact on ecosystem services such as pollination, aesthetic services and water supply.

6.2.4.2: Approach to Development and Mitigation in EN-1 and EN-2

EN-1 notes that emissions from combustion plants are generally released through exhaust stacks and the design of exhaust stacks, particularly height, is the primary driver for the delivery of optimal dispersion of emissions and is often determined by statutory requirements. The optimal stack height is dependent upon the local terrain and meteorological conditions, in combination with the emission characteristics of the plant. EN-1 states the EA/NRW will require the exhaust stack height of a combustion generating plant, to be optimised in relation to impact on air quality. The Secretary of State need not, therefore, be concerned with the exhaust stack height optimisation process in relation to air emissions.

EN-1 further notes that to meet the requirements of Defra's legislation on industrial emissions, natural gas generating stations must apply a range of mitigation to minimise NOx and other emissions. These emissions are regulated by the Environment Agency (EA) and Natural Resources Wales (NRW) through the Environmental Permitting Regulations, which require developers to obtain an Environmental Permit (EP) before commencing operation of a new natural gas generating station. Details of the EP regime are set out in EN-1.

EN-2 notes the developer must carry out an assessment as required in EN-1, consulting the EA, NRW and other statutory authorities at the initial stages of developing their proposals, as set out in EN-1. In considering whether to grant consent, the Secretary of State is required to take account of likely environmental impacts resulting from air emissions and that in the case of NOx or particulates in particular, it follows the advice in EN-1 on interaction with the EA and NRW's regulatory processes. The assessment should propose mitigation where necessary and identify residual effects through the lifecycle of the development, as part of the Environmental Assessment.

EN-2 notes that mitigation will depend on the type and design of a generating station. However, Selective Catalytic Reduction (SCR) – which reduces NOx by the injection of a suitable reagent into flue gas over a catalyst – will have additional adverse impacts for noise and vibration, release of dust and handling of potentially hazardous materials, for example the ammonia used as a reagent.

Finally, EN-2 requires the Secretary of State, in consultation with EA and NRW, to be satisfied that any adverse impacts of mitigation measures for emissions proposed by the applicant have been described in the ES and taken into account in the assessments.

6.2.4.3: Assessment made in respect of EN-2

The development of natural gas electricity generating infrastructure is likely to have a negative effect with respect to air quality, mainly during plant operation. The significance of the effects varies between different technologies, between different releases to atmosphere, and whether there is an AQMA within proximity to the development. For example, the release of 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 power plant but provisions in EN-1 and EN-2 in respect of NOx and other emissions through the developer obtaining an Environmental Permit before commencing operation will likely mitigate such negative effects. 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.

Table 6-5 - Protect and enhance air quality Objective Summary

AoS Objective	Technology	Assessment of non-generic effects (by timescale)		
		S	M	L
Protect and enhance air quality Guide questions: • Minimise emissions of dust and other air pollutants that affect human health or biodiversity? • Improve air quality within AQMAs and avoid the need for new AQMAs? • Promote enhancements to green infrastructure networks to help improve air quality?	Natural Gas Electricity Generating Infrastructure	-	-	0

6.3: Cumulative Effects associated with adoption of EN-2

Cumulative effects associated with the adoption of EN-2 are likely to arise from the development of CCS infrastructure. Given the likely costs associated with the development of this infrastructure and the offshore location for the storage of the captured CO_2, there is likely to be a clustering of new natural gas and biomass co-fired stations, around strategically located land based transfer stations prior to onward pumping of the CO_2 to offshore head works. The locations of any demonstration projects are therefore likely to be initially attractive places to locate natural gas electricity generating capacity, which may reduce as the costs associated with CCS decline in the future.

Cumulative effects are likely to be initially associated with the construction of the CCS associated with natural gas power stations with reasons to be located in similar areas. These effects may actually be more sustained than would be the case with the construction of a single power station with CCS infrastructure as new natural gas electricity generating capacity could develop around CCS infrastructure clusters as highlighted earlier.

This clustering around CCS infrastructure and especially land based transfer stations prior to offshore storage reinforces other location drivers. This includes availability of water resources to meet process water demands and cooling water requirements, as well as locations close to ports to receive imported fuel stock and other raw materials and for outward transport of residues to export markets.

These potential cumulative effects will be felt across a number of AoS objectives in an adverse manner including air quality, water quality, resource use, biodiversity and traffic and

transport amongst others. These may be difficult to mitigate, where the location of suitable CCS storage reservoirs will be a key driver.

However, there is also the potential for positive cumulative effects at a regional scale associated with spatial clustering. These are across the AoS objectives economy and skills, health and well-being, and all relate to direct and indirect employment creation within these regions associated with development of CCS infrastructure with fossil fuel and other generating stations.

Similarly, cumulative effects of construction may arise in conjunction with the development of other energy technologies, particularly those contained in EN-4 where pipeline connections may be required to supply new gas or oil-fired power stations, and EN-3 with the development of off-shore wind generation capacity in potentially similar areas as those selected for CCS storage reservoirs. These will mainly affect the built and natural environment sustainable development themes.

Onshore cumulative effects across NPSs may further arise due to location/proximity. Natural gas electricity generating stations and CCS infrastructure favour coastal locations, as may other energy technologies in EN-3, EN-4 and EN-5. Cumulative effects on coastal landscapes and coastal change may arise should energy developments be concentrated in areas that provide the specific requirements of that development. Such effects would be permanent and long-term (until decommissioned), and also difficult to mitigate due to the scale of the energy developments, particularly where new fossil fuel electricity generating and CCS facilities are involved.

6.4: Summary of Key Findings of Appraisal of EN-2

Natural gas generating infrastructure development has similar effects to other types of energy infrastructure, resulting from impacts associated with large facilities at single sites; as well as those associated with linear features linked with potential development of CCS infrastructure. Therefore, for the majority AoS objectives, the strategic effects of EN-2 are considered to match those identified in AoS-1.

EN-1 (informed by AoS-1) includes extensive mitigations to ensure these effects are considered by applicants and the Planning Inspectorate when preparing and determining applications. EN-2 (informed by AoS-2) contains a range of technology specific mitigation measures, along with those proposed in EN-1, which seek to address the range of negative effects identified.

However, associated with additional detail provided about the technologies in EN-2, non-generic effects were considered for four AoS objectives (Carbon Emissions, Biodiversity, Water Environment and Air Quality). The non-generic effects have been found to be negative across short and medium term for all four AoS objectives linked to construction and operation activities of natural gas generating infrastructure.

Consistency with the national target of reducing carbon emissions to Net Zero by 2050 is also considered negative in the long term reflecting the residual emissions from unabated natural gas plants, unless balanced by negative emissions.

In the long term, following decommissioning, as discharges and emissions to the air and water would cease, the effect would be neutral for Water Environment and Air Quality.

It is important to note there is uncertainty over actual effects as this would be dependent upon location and sensitivity of the receiving environment.

A summary of the likely non-generic effects arising specifically from natural gas electricity generating infrastructure is set out in the following Table 6-6.

Table 6-6 - Summary of Key AoS Findings Specific to Natural Gas Electricity Generating Infrastructure

AoS Objective	Assessment of non-generic effects (by timescale)		
	S	M	L
1. Consistent with the national target of reducing carbon emissions to Net Zero by 2050	-	-	-
3. Enhance biodiversity, promoting net gain, and supporting ecosystem resilience and functionality	-	-	0
7. Protect and enhance the water environment	-	-	0
8. Protect and enhance air quality	-	-	0

6.5: Alternatives Considered in respect of EN-2

As explained in Section 1 to this report, the AoS exercise for the energy NPSs also fulfils the requirements of the Strategic Environmental Assessment (SEA) Regulations (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 Regulations 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".

The reasonable alternatives considered in the AoS for the 2011 Fossil Fuel Generating Infrastructure NPS were the following:

a) a stricter approach to Carbon Capture and Storage (CCS) (e.g. no new coal without full CCS, or no new fossil fuel plants without a substantial amount of CCS from the outset); and

b) a stricter approach to Carbon Capture Readiness (CCR) (i.e. more demanding criteria set for demonstrating that retrofit of CCS will be economically feasible).

Regarding alternative (a), the policy in the revised EN-2 does not support consent for any new coal-fired power station but allows for unabated natural gas fired power stations to come forward, so a reasonable alternative to EN-2 would be to only consent low carbon gas plant (i.e. natural gas with CCS or hydrogen-fired). For example, the NPSs could provide that no new natural gas-fired power plant will be consented unless it is fully fitted with CCS from the outset and that any other gas fired generation could only be from clean hydrogen. Broadly speaking, such an alternative would be aimed primarily at achieving the Net Zero aspects of overall NPS policy much quicker.

EN-2 continues to mandate CCR for new and refurbished combustion generating stations with a generating capacity at or over 300 MW. In addition, EN-2 references the commitment in the Energy White Paper, published in December 2020, to consult on proposals to update these Carbon Capture Readiness requirements to reflect technological advances, such as conversion to low carbon hydrogen and apply them more broadly, by removing the 300MW threshold and including all combustion technologies within scope. A reasonable alternative to EN-2 in this regard would be to adopt a blanket approach that all new combustion generation

plants, regardless of size or fuel, must be capable of converting to low carbon alternatives in the future. Broadly speaking, such an alternative would also contribute to achieving the Net Zero aspects of overall NPS policy earlier.

Thus, the reasonable alternatives for consideration in the AoS for the Natural Gas Electricity Generating Infrastructure NPS are:

- EN-2 a): only consent low carbon gas plant (i.e. natural gas with CCS or hydrogen-fired), and
- EN2 b): only consent natural gas generation plants which can demonstrate that they are capable of converting to low carbon alternatives in future.

6.6: Appraisal of Alternatives to EN-2

6.6.1: Introduction

The preferred policy approach (EN-2) was appraised in detail using the AoS framework of objectives in Section 4. The summary of key appraisal findings is set out above.

The scope and methods of appraisal of alternatives are detailed in Section 2 of this report. The two strategic alternatives identified for natural gas electricity generating infrastructure were assessed using Sustainable Development themes that better keep the appraisal at the higher and strategic level. The results are set out below.

Note that in consideration of Alternatives, the assessment is undertaken in comparison to EN-2 and not to each other alternative. As such, the findings of the AoS in respect of EN-2 broadly apply to all of the alternatives – the key differentiator being the inclusion or absence of particular aspects related to the Technology and the relative outcomes of such inclusion or absence. To draw comparison between the alternatives and EN-2 on a broad level, the following scale has been used.

Table 6-7 - Differentiator scale for Alternatives

Scale	Description
Large Positive	A materially different positive outcome is anticipated compared to EN-2
Positive	A more positive outcome is anticipated compared to EN-2
Neutral	This alternative is anticipated to have the same outcome as EN-2
Negative	A more adverse outcome is anticipated compared to EN-2
Large Negative	A materially different adverse outcome is anticipated compared to EN-2

6.7: Results of Appraisal of Alternatives to EN-2

The findings of the appraisal of the strategic alternatives for EN-2 are set out below, arranged by Sustainable Development (SD) theme.

The two alternatives under consideration are:

- EN-2 a): only consent low carbon gas plant (i.e. natural gas with CCS or hydrogen-fired), and
- EN2 b): only consent natural gas generation plants which can demonstrate that they are capable of converting to low carbon alternatives in future.

6.7.1: Climate Change (Net Zero)

Alternative (a), only consent low carbon gas plant (i.e. natural gas with CCS or hydrogen-fired), has the potential to further reduce CO_2 emissions from electricity generating infrastructure compared with EN-2 as no unabated natural gas-fired electricity generating stations could be proposed for approval by the Secretary of State.

Alternative (b), only consent combustion generations plants which can demonstrate that they are capable of converting to low carbon alternatives in future, may reduce the number of unabated natural gas-fired electricity generating stations proposed for approval by the Secretary of State. It may also reduce the number of unabated natural gas-fired electricity generating stations proposed for approval by the Secretary of State. This would be beneficial in the medium to longer term from a Net Zero point of view due to less emissions than under EN-2 and ensure that no new unabated gas plant is 'locked-in' without the capability to convert to low carbon alternatives when ready. It would not be as beneficial as alternative (a) as there could still be emissions until low carbon alternatives become available.

Headline SD themes	EN-2	Alternative (a)	Alternative (b)
Climate Change (Net Zero)		**Large Positive**	**Positive**

6.7.2: Security of Energy Supply

Alternative (a), only consent low carbon gas plant (i.e. natural gas with CCS or hydrogen-fired), would result in no unabated gas plant coming forward and an uncertain amount of low carbon gas plant as the viability of these low carbon alternatives has yet to be fully demonstrated. This is likely to have a strong negative effect on security of supply and could ultimately result in shortages of electricity.

Alternative (b), only consent natural gas generation plants which can demonstrate that they are capable of converting to low carbon alternatives in future, may reduce the number of proposals submitted to the Planning Inspectorate and Secretary of State, for natural gas generating stations below the current 300MW threshold, but would not rule them out altogether, unlike alternative (a). This could result in approval of a smaller total natural gas electricity generating capacity than would be the case with EN-2 and may therefore increase the risk of insufficient generating capacity being available to provide electricity supply through the transition to a low carbon economy.

Headline SD themes	EN-2	Alternative (a)	Alternative (b)
Security of Energy Supply		**Large Negative**	**Negative**

6.7.3: Health and Well-Being

Alternative (a), only consent low carbon gas plant (i.e. natural gas with CCS or hydrogen-fired), may result in decreased negative effects on health and well-being as compared with EN-2. Natural gas with CCS will likely result in reduced emissions to air, in particular very low SOx emissions, although NOx emissions may vary depending upon the type of CCS technology[12]. Hydrogen-fired plants produce water emissions only which are harmless. Reduced emissions of NOx and SOx have been associated with positive effects on health.

[12] file:///C:/Users/west9079/Downloads/Tech_14-2011_CCS-final.pdf

Alternative (a) is likely to result in a greater clustering of generating capacity proposals around preferred locations than would be the case with EN-2 as a power CCS station is likely to want to locate close to a viable route to transport and store CO_2 to reduce costs and sites may be limited. Clustering of CCS projects may therefore increase negative effects on health and well- being from increased air emissions, for NOx in particular, although within statutory limits for each facility, within these regions. Levels of noise at natural gas or hydrogen powered electricity generating facilities will remain, but these are likely to be felt at a smaller number of localities, as there would be fewer power plants consented compared to EN-2 in the short term. However, alternative (a) may also increase negative effects on health and well-being on a wider regional and national scale if security of energy supply cannot be maintained, and this has impacts on employment opportunities and economic growth.

Alternative (b), only consent natural generation plants which can demonstrate that they are capable of converting to low carbon alternatives in future, will result in the same effects described above for alternative (a) but these could be more intense if more natural gas capable of converting to CCS plant is consented or less intense if more hydrogen capable plant is consented.

Headline SD themes	EN-2	Alternative (a)	Alternative (b)
Health & Well-Being		**Positive / Negative**	**Positive / Negative**

6.7.4: The Economy

Alternative (a), only consent low carbon gas plant (i.e. natural gas with CCS or hydrogen-fired), is likely to result in reduced benefits to the economy compared with EN-2 under current market conditions. It may result in fewer proposals for low carbon gas plant coming forward than proposals for unabated gas along with low carbon gas plant under EN-2, until investors are confident of the viability of CCS and clean hydrogen generation. This is likely to increase negative effects on the economy if security of energy supply cannot be maintained, and this has impacts on employment opportunities and economic growth. This could also increase costs if higher capex plant is required to try to replicate the role of gas in the electricity system, and therefore potentially increase energy bills to consumers. However, if CCS and hydrogen are demonstrated to be economically viable on a larger scale, then the positive effects on the economy are likely to be greater than with the adoption of EN-2. This is related to greater employment opportunities in CCS and hydrogen compared to unabated gas.

Alternative (b), only consent natural gas generations plants which can demonstrate that they are capable of converting to low carbon alternatives in future, may reduce the number of smaller gas-fired electricity generating stations proposed for approval by the Secretary of State than would be the case with EN-2. This is likely to increase negative effects on the economy if security of energy supply cannot be maintained, and this has impacts on employment opportunities and economic growth. Lower potential uptake of low carbon alternatives is also likely to result in reduced employment opportunities compared with EN-2. However, if CCS and hydrogen are demonstrated to be economically viable on a larger scale, then the positive effects on the economy are likely to be greater than with the adoption of EN-2.

Headline SD themes	EN-2	Alternative (a)	Alternative (b)
The Economy		**Positive /**	**Positive/**

		Negative	**Negative**

6.7.5: The Built Environment

Alternative (a), only consent low carbon gas plant (i.e. natural gas with CCS or hydrogen-fired), may result in reduced negative effects on the built environment compared with EN-2. This alternative is likely to result in fewer proposals for low carbon gas plant coming forward than proposals for unabated gas along with low carbon gas plant under EN-2, and therefore likely to result in reduced negative effects on flood risk (gas-fired power stations tend to be located in coastal areas or in the floodplains of large rivers where flood risk is elevated, particular in light of climate change). There are also likely to be reduced negative effects on traffic and transport, although those that remain, as with EN-2, are likely to be localised and short term in duration associated with construction and decommissioning. Effects on archaeology and cultural heritage with adoption of alternative (a) are also likely to be less negative compared with EN-2, again associated with likely fewer generating stations actually being built, although those effects that remain are again likely to be local in extent. However, if CCS and hydrogen are demonstrated to be economically viable on a larger scale, then negative impacts on the built environment are likely to be larger compared with adoption of EN-2, because the footprint of plant with CCS is greater than that of plant without CCS and additional land area will be required to install hydrogen production plant.

Alternative (a) could result in greater clustering of generating capacity proposals around preferred locations than would be the case with EN-2 (as a power CCS station is likely to want to locate close to a viable route to transport and store CO_2 to reduce costs and sites may be limited). Clustering of CCS projects may therefore increase negative effects on the built environment within these locations, including cumulative impacts.

Alternative (b), only consent natural gas generation plants which can demonstrate that they are capable of converting to low carbon alternatives in future, will result in the same effects described above for alternative (a) but these could be more intense than for EN-2 if more natural gas capable of converting to CCS plant is consented or less intense if more hydrogen capable plant is consented.

Headline SD themes	EN-2	Alternative (a)	Alternative (b)
The Built Environment		**Positive / Negative**	**Positive / Negative**

6.7.6: The Natural Environment

Alternative (a), only consent low carbon gas plant (i.e. natural gas with CCS or hydrogen-fired), may result in reduced negative effects on the natural environment compared with EN-2. This alternative is likely to result in fewer proposals for low carbon gas plant than proposals for unabated gas along with low carbon gas plant under EN-2 and therefore likely to result in reduced negative effects on biodiversity as there would be less land take. There are also likely to be reduced negative effects on water quality as less need for cooling water. Effects on landscape, townscape and visual character, and soils and geology, are also likely to be less than would be the case with EN-2, again because there would be less land take. Those effects that remain are likely to be local in extent. However, if CCS and hydrogen generation is demonstrated to be economically viable on a larger scale, then impacts on the natural environment are likely to be of greater negative magnitude compared with adoption of EN-2 as there will potentially be more land take and more need for cooling water.

Alternative (a) could result in greater clustering of generating capacity proposals around preferred locations than would be the case with EN-2 (as a power CCS station is likely to want to locate close to a viable route to transport and store CO_2 to reduce costs and sites may be limited). Clustering of CCS projects may therefore increase negative effects on the natural environment within these locations, including cumulative impacts.

Alternative (b), only consent natural gas generation plants which can demonstrate that they are capable of converting to low carbon alternatives in future, will likely result in the same effects described above for alternative (a) but these could be more intense than for EN-2 if more natural gas capable of converting to CCS plant is consented or less intense if more hydrogen capable plant is consented.

Headline SD themes	EN-2	Alternative (a)	Alternative (b)
The Natural Environment		**Positive / Negative**	**Positive / Negative**

6.8: Summary of Alternatives Findings and Preferred Approach for the NPS

Table 6-8 - Summary of Alternatives Assessment

Headline SD themes	EN-2	Alternative (a)	Alternative (b)
Climate Change (Net Zero)		**Large Positive**	**Positive**
Security of Energy Supply		**Large Negative**	**Negative**
Health & Well-Being		**Positive / Negative**	**Positive / Negative**
The Economy		**Positive / Negative**	**Positive / Negative**
The Built Environment		**Positive / Negative**	**Positive / Negative**
The Natural Environment		**Positive / Negative**	**Positive / Negative**

Assessment showed that the Alternative policy (a), only consent low carbon gas plant (i.e. natural gas with CCS or hydrogen-fired), could have greater positive effects than EN-2 on contributing to the achievement of Net Zero as there would be less CO_2 emissions. Until these technologies are able to deploy at scale there would be no alternative for mid-merit or peaking plant (given no unabated gas could come forward under this alternative, significantly and negatively impacting Security of Supply and affordability of energy and ultimately resulting in shortages of electricity. Imposing a low carbon requirement for all gas electricity generation would carry significant risks while (as at present) the technology remains unproven at commercial scale and it is unclear how much it will cost to install and operate and may also present economic barriers to developers.

Across the remaining sustainable development themes (Health & Well-Being, Economy, Built Environment and Natural Environment), the adoption of alternative (a) compared with EN-2 could result in different effects depending upon technology economic viability. Where CCS and hydrogen economic viability is not demonstrated on a wider basis, then there are likely to be fewer negative effects compared with EN-2 by virtue of less gas fired plants of any type being built. This is related to reduced land and water resource use as well as reduced footprint on health and well-being. However, where CCS and hydrogen generation viability is demonstrated for widespread adoption for electricity generating plant, then there are likely to

be greater negative effects on these same topics. In particular, the potential for greater clustering of generating capacity proposals around preferred locations than would be the case with EN-2 (as a power CCS station is likely to want to locate close to a viable route to transport and store CO_2 to reduce costs and sites may be limited) will likely intensify cumulative negative effects in these preferential locations. However, if the low carbon alternative is hydrogen only small local clusters are likely and cumulative negative effects will likely be less of an issue.

Alternative policy (b), only consent natural gas generation plants which can demonstrate that they are capable of converting to low carbon alternatives in future, may also lead to fewer applications being presented than would be the case with EN-2 but more than in the case of alternative (a). This may reduce employment opportunities and affect the Economy in the natural gas energy sector, but conversely create new employment opportunities as CCS and hydrogen sectors grow. The impacts of this alternative on the contribution to Net Zero in comparison with EN-2 will be positive, as retrofitting of CCS and/or a change to hydrogen would be a condition for all natural gas plant but could have impacts for security if supply if applications for smaller gas plants reduce due to these additional requirements. Across the remaining sustainable development themes (Health & Well-Being, Built Environment and Natural Environment), the adoption of alternative (b) would result in the same sort of effects as for alternative (a).

Another key difference between alternatives (a) and (b) and EN-2 is that EN-2 is more likely to give confidence to developers to come forward with planning applications which if approved will contribute to security of supply and affordability. This is particularly true in the case of alternative (a) which will likely compromise security of supply and affordability under current market conditions and lead to adverse economic effects through seriously restricting development and investment.

Alternative (b) could present a more sustainable alternative than the policies set out in EN-1 and EN-2, if implemented in a way which minimises the potential impact on security of supply. In this respect, it is reassuring to see that, as set out in the Energy White Paper, published in December 2020, and referred to in EN-2, the government is committed to consult on proposals to update the Carbon Capture Readiness requirements to reflect technological advances, such as conversion to low carbon hydrogen and apply them more broadly, by removing the 300MW threshold and including all combustion technologies within scope. If that consultation leads to changes in the relevant legal or policy framework then those new requirements will apply and this NPS will be updated to reflect any revised requirements ahead of designation.

7: Assessment for Renewable Energy Infrastructure EN-3 (AoS-3)

7.1: The NPS for Renewable Energy Infrastructure

The NPS for Renewable Energy Infrastructure (EN-3), in conjunction with the Overarching NPS for Energy (EN-1), sets out the relevant planning factors that should be considered by the Secretary of State when determining whether development consent should be granted for a proposed scheme.

As for EN-1, EN-3 has been developed via an iterative process, taking account of the appraisal of the predicted sustainability effects both for EN-3 preferred polices and reasonable alternatives.

7.2: Appraisal findings for EN-3

Renewable Energy Infrastructure may have various impacts on communities and the environment depending on the nature of the development and its location. As noted in EN-3, all of the generic impacts detailed in EN-1 are likely to be relevant to this type of infrastructure, however, there are further specific considerations arising from the technologies covered which are covered in this AoS.

While reference should be made to AoS-1 for consideration of all effects in full, this AoS-3 focuses on those potentially significant sustainability effects associated with the technologies set out in EN-3. The effects considered relate to:

- Carbon emissions;
- Biodiversity;
- Landscape and Seascape;
- Air quality;
- Health and Wellbeing;
- Economy; and
- Resources.

It should be noted that for all other AoS Objectives effects were considered to be adequately addressed within EN-1. As such this AoS does not consider such issues further.

The likely significant effects of the technology specific policies, requirements and guidance in EN-3 have been appraised against the corresponding objectives in the AoS framework as set out in Section 4.

Section 2.3 of this report explains how the results of the assessment of likely significant effects are shown. For ease of reference, the table is reproduced here.

Table 7-1 - Key to Appraising Significance of Predicted Effects

Likely Significance of Effects		
Significant positive effect likely	**++**	Policy is expected to address an existing sustainability problem or deliver sustainability enhancements, such as substantial environmental net gain above existing/emerging policy.
Minor positive effect likely	**+**	Policy is expected to lead to environmental net gain in line with existing or emerging Government policy OR result in

		protection and conservation of a sustainability asset (for example, a designated biodiversity site or designated heritage asset).
No effect likely or not applicable	**0**	No perceptible effects expected, or the objective is not relevant to the part of the NPS being assessed.
Minor negative effect likely	**-**	Policy is expected to result in adverse effects of a lower magnitude or smaller scale, which can be mitigated through standard measures and best practice.
Significant negative effect likely	**--**	Policy is expected to result in adverse effects of a greater magnitude or larger scale, which cannot be mitigated OR will require extensive and bespoke mitigation solutions (further studies may be required to identify appropriate solutions).

The appraisal focused on the identification of technology specific effects (non-generic) with consideration of mitigation measures as set out in AoS-1, in order to establish whether additional mitigation would be required as part of AoS-3. It is noted that an initial assessment was undertaken on a draft EN-3 document dated April 2021 and that this resulted in suggestions of additional mitigation (in the form of recommendations, see Appendix E) to be considered in the drafting of EN-3 for public consultation.

An assessment of residual non-generic effects is provided for the EN-3 document as presented for public consultation in the following sections. The likely non-generic effects arising specifically from electricity generating infrastructure are presented together with a summary of the residual non-generic effects for each AoS objective over the short, medium and long term. In this context, for the purposes of the appraisal, the “short term” has been defined as the effects arising generally during the infrastructure construction period typically 2-7 years (different technologies have different construction times); the “medium term” as typically between 5 and 30 years (operational lifetimes vary with the characteristics of different technologies); and the “long term” as beyond 30 years (and including decommissioning where relevant).

In addition, consideration is given to the cumulative effects associated with the adoption of EN-3.

7.2.1: AoS Objective 1: Consistent with the national target of reducing carbon emissions to Net Zero by 2050

7.2.1.1: Anticipated Effects

Electricity generation from renewable sources of energy is an important element in the Government’s development of a low-carbon economy. Renewable energy sources of energy produce minimal CO_2 emissions. EN-1 states that the Government’s aim is to have an electricity system in 2050 where all electricity comes from low carbon sources, and where the only residual CO_2 emissions are due to generation from natural gas, biomass or waste-fired generation, with carbon capture, usage or storage. The use of carbon capture, usage and storage is required to abate carbon emissions generate by such technologies.

7.2.1.2: Approach to Development and Mitigation in EN-1 and EN-3

As regards carbon emissions mitigation, the policies set out in the draft EN-1 which have particular relevance to biomass and waste electricity generating stations include the requirement for CCS and CCR associated with the proposals for new and refurbishing combustion plants and the need to demonstrate that consideration has been given to opportunities to establish good quality CHP.

EN-1 sets out that the Government has made its ambitions for CCS clear – committing to providing funding to support the establishment of CCS in at least four industrial clusters by 2030 and supporting, using consumer subsidies, at least one privately financed gas CCS power station by 2030. The barriers to CCS deployment to date have been commercial rather than technical, and the business models, which may evolve overtime, aim to support the deployment of the technology. Gas-fired power CCS stations may still emit residual CO_2 and so will be required to comply with any Emission Performance Standards that might be applicable, but this is not part of the consents process. The carbon capture plant required for a new build power CCS plant can be included as associated development in the application for development consent for the relevant thermal generating station and will then be considered as part of that application.

The Government's policy and criteria on CCR for new combustion generating stations with a generating capacity at or over 300MW are set out in EN-1. They are relevant to proposed biomass plants at or over 300MW of generating capacity but not Energy from Waste plants.

If an application does not demonstrate that CCR has been assessed according to this policy, the Secretary of State should seek further information from the applicant. The Secretary of State should not give development consent unless they are satisfied that the proposed development meets all the criteria for CCR set out in EN-1 and is, therefore, CCR.

The Secretary of State should impose requirements on any development consent, requiring operators to:

- retain control over sufficient additional space (whether on or near the site) for the carbon capture equipment;
- retain their ability to build carbon capture equipment on this space (whether on or near the site) in the future; and
- submit update reports on the technical aspects of its CCR status to the Secretary of State. These reports should be required within three months of the date on which a consented station first begins to supply electricity to the grid and every two years thereafter until the plant moves to retrofit CCS.

EN-1 also notes that the Energy White Paper, published in December 2020, committed to consult on proposals to update the Carbon Capture Readiness requirements to reflect technological advances, such as conversion to low carbon hydrogen, and apply them more broadly, by removing the 300MW threshold and including all combustion technologies within scope. If that leads to changes in the relevant legal or policy framework then those new requirements will apply and this NPS will be updated to reflect any revised requirements ahead of designation. In the meantime, CCR policy remains as set out in this section.

EN-3 acknowledges that the combustion of biomass for electricity generation plays an important role in meeting the UK's energy needs and supports the decarbonisation of the sector. It also has a potentially significant role in supporting delivery towards the UK's net zero target, particularly when combined with CCS. It further acknowledges that the recovery of energy from the combustion of waste, where in accordance with the waste hierarchy, plays an important role in meeting the UK's energy needs.

EN-1 further notes that operational greenhouse gas emissions are a significant adverse impact from some types of energy infrastructure which cannot be totally avoided (even with full deployment of CCS technology). Given the characteristics of these and other technologies, as noted in EN-1, and the range of non-planning policies aimed at decarbonising electricity generation such as UK ETS (see EN-1), Government has determined that operational greenhouse gas emissions are not reasons to prohibit the consenting of energy projects including those which use these technologies or to impose more restrictions on them in the planning policy framework than are set out in the energy NPSs (e.g. the CCR requirements). Any carbon assessment will include an assessment of operational greenhouse gas emissions, but the policies set out, including the UK ETS, apply to these emissions. Operational emissions will be addressed in a managed, economy-wide manner, to ensure consistency with carbon budgets, net zero and our international climate commitments. The Secretary of State does not, therefore need to assess individual applications for planning consent against operational carbon emissions and their contribution to carbon budgets, net zero and our international climate commitments

EN-1 (in a section relating to 'Greenhouse Gas Emissions') notes that significant levels of energy infrastructure development are vital to ensure the decarbonisation of the UK economy. The construction, operation and decommissioning of that energy infrastructure will in itself lead to greenhouse gas emissions. While all steps should be taken to reduce and mitigate climate change impacts, it is accepted that there will be residual emissions from energy infrastructure, particularly during the economy wide transition to net zero, and potentially beyond. EN-1 therefore requires that all proposals for energy infrastructure projects should include a carbon assessment as part of their ES. This should include:

- A whole life carbon assessment showing construction, operational and decommissioning carbon impacts;
- An explanation of the steps that have been taken to drive down the climate change impacts at each of those stages;
- Measurement of embodied carbon impact from the construction stage;
- How reduction in energy demand and consumption during operation has been prioritised in comparison with other measures;
- How operational emissions have been reduced as much as possible through the application of best available technology for that type of technology;
- Calculation of operational energy consumption and associated carbon emissions;
- Whether and how any residual carbon emissions will be (voluntarily) offset or removed using a recognised framework; and
- Where there are residual emissions, the level of emissions and the impact of those on national and international efforts to limit climate change, both alone and where relevant in combination with other developments at a regional or national level, or sector level, if sectoral targets are developed.

7.2.1.3: Assessment made in respect of EN-3

EN-3 technologies promote the supply of energy from low carbon/renewable energy sources in general, but biomass and waste combustion technologies are also sources of CO_2 emissions. Whilst clear reference is made to CCS for biomass in EN-3, such reference is absent for waste. However, EN-1 notes that The Energy White Paper, published in December 2020, committed to consult on proposals to update the Carbon Capture Readiness requirements to reflect technological advances, such as conversion to low carbon

hydrogen, and apply them more broadly, by removing the 300MW threshold and including all combustion technologies within scope. The generic requirement for CCS for both type of combustion technology, when CCS is commercially available, would better align with the national target to reduce carbon emissions to Net Zero by 2050.

In addition, although biomass combustion technologies are covered by CCR in EN-1, waste combustion technologies are currently exempt from such requirement. Due to this exemption, it is deemed that waste combustion technology will likely have a non-generic significant negative effect in the short to long term. In this respect, provisions in EN-1 will go some way to address these operational emissions by requiring all proposals for energy infrastructure projects to include in a carbon assessment whether and how residual emissions will be (voluntarily) offset or removed and where there are residual emissions remaining these need to be considered in the context of sectoral targets. It is noted that operational emissions will be addressed in a managed, economy-wide manner, to ensure consistency with carbon budgets, net zero and international climate commitments.

Specific effects with regards to the AoS Net Zero objective are considered significant negative over the short, medium and long terms reflecting residual emissions from continuation of unabated waste combustion plants under current policy, in particular if negative emissions technologies are not used. This assessment is focused on energy sector impacts but the impact on overall emissions will depend on what happens to the waste if not used within the power sector (as energy recovery from residual waste is expected to have a lower greenhouse gas impact than landfill).

Table 7-2 - Reducing Carbon emissions to Net Zero Objective Summary

AoS Objective	Technology	Assessment of non-generic effects (by timescale)		
		S	M	L
Consistent with the national target of reducing carbon emissions to Net Zero by 2050 Guide questions: • Reduce carbon emissions of the national portfolio of major energy infrastructure? • Reduce direct and indirect emissions of all greenhouse gases, including carbon dioxide, during construction, operation and decommissioning? • Maximise supply of energy from low carbon/renewable energy sources / use of low carbon/renewable energy? • Maximise opportunities for making use of waste heat? • Use negative carbon emissions to offset residual emissions from energy such as Bioenergy with Carbon Capture & Storage (BECCS) and Nature Based Solutions? • Create new carbon sinks/removals through natural sequestration including that provided by green Infrastructure and soils and	Biomass and Waste combustion	--	--	--

protection of key habitats which contribute to carbon sequestration?				

7.2.2: AoS Objective 3: Enhance biodiversity, promoting net gain, and supporting ecosystem resilience and functionality

7.2.2.1: Anticipated effects

EN-3 identifies specific effects on biodiversity from all renewable energy projects other than biomass/ energy from waste combustion plants. This is due to biomass/ energy from waste combustion plants biodiversity effects being covered by generic provisions in EN-1 for electricity generating infrastructure.

EN-3 identifies a number of specific effects on marine biodiversity from offshore wind farms. These include impacts on fish; seabed habitats and species including intertidal and subtidal; marine mammals; and birds. In addition, the construction, operation and decommissioning of offshore energy infrastructure can impact the physical offshore environment, which can affect biodiversity. Key impacts include changes to the water quality; to waves and tides from the presence of turbines; to the scour effect from the presence of wind turbines and other infrastructure; to the sediment transport; and to suspended solids as a result of the release of sediment. Fish species can be affected from energy emissions into the environment such as noise or electromagnetic fields, as well as from the seabed sediments. Intertidal habitats and species can be affected by the installation of cable across the intertidal zone. Marine mammals can be affected by noise from construction activities, which can be high enough to cause disturbance, injury, or even death, by collision with construction and maintenance vessels, by entanglement from floating wind structures, and indirectly by impacts on fish which the marine mammals prey upon. Birds can be affected by: collisions with rotating blades; direct habitat loss; disturbance from construction activities; displacement during the operational phase resulting in loss of foraging/ roosting area; impacts on bird flight lines i.e. barrier effect, and associated increased energy use by birds for commuting flights between roosting and foraging areas; and impacts on prey species and habitat. Subtidal habitats and species can be affected by loss and temporary disturbance of subtidal habitat and benthic ecology.

Specific impacts on biodiversity from pumped hydro storage plant include: habitat loss resulting from flooding of land or vegetation clearance; soil removal for infrastructure; and compromised water quality impacting aquatic flora and fauna.

Specific considerations identified by EN-3 which apply to solar farms include the impact on ground nesting birds, wintering birds, bats, dormice, reptiles, and badgers.

Specific considerations which apply to tidal stream energy identified in EN-3 include fish; seabed habitats – intertidal and subtidal; and marine mammals. These could potentially be adversely affected by underwater noise and emission of electromagnetic fields, and also by collision with underwater turbine structures.

7.2.2.2: Approach to development and mitigation in EN-3

EN-3 (and EN-1) note that good design of a project should be applied to all energy infrastructure, to mitigate impacts such as the effects on ecology.

For offshore wind farms, the applicant should undertake an assessment of the impacts on onshore and offshore ecology, biodiversity and the physical environment for all stages of its

lifespan, and to consider biodiversity and environment net gain (in relation to onshore). The applicant should undertake consultation with appropriate statutory consultees at the early stages of the project. Reference must be made to relevant scientific research and literature on the impacts of offshore wind farms, and to data from existing offshore wind farms where appropriate.

With reference to fish, the applicant should identify the fish species most likely to be affected and the potential effects arising from underwater noise and electromagnetic fields.

With reference to intertidal habitats and species, the applicant should undertake an assessment of the effects of installing cable across the intertidal zone following the Crown Estate's cable route protocol and include information, where relevant, about: any alternative landfall sites that have been considered; any alternative cable installation methods that have been considered; potential loss of habitat; disturbance during cable installation, maintenance, and removal; increased suspended sediment loads in the intertidal zone during installation and maintenance; predicted rates at which the intertidal zone might recover from temporary effects; and protected sites.

With reference to marine mammals, the applicant should include within their assessment details of: likely feeding areas and impacts on prey species and habitats; known birthing areas/ haul out sites for breeding and pupping; migration routes; protected areas; baseline noise levels; predicted construction and soft start noise levels; operational noise; duration and spatial extent of the impacting activities; collision risk; entanglement risk and barrier risk. The applicant should consult with the relevant statutory bodies regarding the scope, effort and approach for surveys, and regarding any proposed noisy activities. Where noise thresholds are likely to be exceeded the applicant should look at alternatives or mitigation.

With reference to birds, the applicant should consult with the relevant statutory bodies regarding the scope, effort and approach for surveys, taking into consideration baseline and monitoring data from existing wind farms. The applicant must undertake collision risk modelling, and displacement and population viability assessments for certain species of birds. EN-1 notes that currently, cumulative impact assessments for ornithology are based on the consented Rochdale Envelope parameters of projects, rather than the 'as-built' parameters, which may pose a lower risk to birds. The Secretary of State will therefore require any consents to include provisions to define the final 'as built' parameters (which may not then be exceeded) so that these parameters can be used in future cumulative impact assessments. In parallel we will look to explore opportunities to reassess ornithological impact assessment of historic consents to reflect their 'as built' parameters. Any ornithological 'headroom' between the effects defined in the 'as built' parameters and Rochdale Envelope parameters can then be released. We will also consider the potential applicability of these principles to other consent parameters.

With reference to subtidal habitats and species, the applicant should follow the Crown Estate's cable route protocol and the assessment should include: loss of habitat due to foundation type; environmental appraisal of inter-array and export cable routes and installation/ maintenance methods including predicted loss of habitat; habitat disturbance; increased suspended sediment loads; predicted rates at which the subtidal zone might recover from temporary effects; and potential impacts from EMF on benthic fauna.

The Secretary of State should be satisfied that the applicant has used up to date research within their assessment, and assessed through HRA/MCZ processes, the impact on any protected species or habitats. EN-3 notes that the designation of an area as a protected site (including SACs, SPAs, MCZs and SSSIs) does not necessarily restrict the construction or operation of offshore wind farms in, near or through that area. However, where adverse effects on site integrity/conservation objectives are predicted, in coming to a decision, the

Secretary of State should consider the extent to which the effects are temporary or reversible and the timescales for recovery. With specific reference to intertidal habitats and species, the Secretary of State should be satisfied that the cable installation and decommissioning has been designed sensitively, and discussions with relevant conservation bodies have taken place. In terms of mitigation, general requirements and considerations are provided in EN-1. With specific reference to fish, the Secretary of State should consider the negative impacts on benthic habitats from the use of rock armouring to reduce effects from electromagnetic fields. The applicant should ensure the latest research on mitigation options for electromagnetic fields is presented. Construction of specific elements should be timed to reduce impacts on spawning or migration on fish, and underwater noise mitigation used to prevent death or injury to fish species. Review of up to date research should be undertaken and all potential mitigation options presented. Where applicable, use of horizontal directional drilling should be considered to avoid impacts on sensitive habitats and species. Where cumulative effects are predicted as a result of multiple cable routes, it may be appropriate for applicants of various schemes to work together to ensure that the number of cables crossing the intertidal zone are minimised. With specific reference to marine mammals, the Secretary of State may refuse consent where significant noise effects cannot be minimised. Before and during piling, monitoring of the surrounding area should be undertaken, and acoustic deterrent devices used to actively displace marine mammals outside potential injury zones. Soft start procedures during pile driving may be implemented to enable marine mammals in the area to move away from the piling before injury is caused. Where noise impacts cannot be reduced to acceptable levels, other mitigation should be considered including spatial/ temporal restrictions on noisy activities, alternative foundation types, alternative installation methods and noise abatement technology. The applicant should undertake a review of up-to-date research and present all potential mitigation options. With specific reference to birds, the Secretary of State must be satisfied that the collision risk and displacement assessments have been conducted to a satisfactory standard, and that advice from the relevant statutory bodies has been taken into account. The applicant should undertake a review of up-to-date research and present all potential mitigation options. Collision risk should be minimised by: considering how the wind turbines are laid out, taking into account other constraints; and optimising turbine parameters. Construction vessels should avoid rafting seabirds during sensitive periods, where practicable and compatible with operational requirements and navigational safety, and follow agreed navigation routes to and from the site. Shutting down turbines within migration routes during estimated peak migration periods is considered unlikely to offer suitable mitigation. With specific reference to subtidal habitats and species, the applicant should make reference to the Crown Estate's cable route protocol to avoid adverse impacts on protected areas. The applicant should undertake a review of up-to-date research and present potential mitigation options. The Secretary of State should expect the applicants to consider the following mitigation measures: surveying and micrositing or re-routing of the export and inter-array cables to avoid adverse effects on sensitive habitats, biogenic reefs or protected species; burying cables at a sufficient depth, taking into account other constraints, to allow the seabed to recover to its natural state; and minimising the use of anti-fouling paint on subtidal surfaces to encourage species colonisation on the structures. Ecological monitoring should be undertaken during the pre-construction, construction, and operational phases to identify the actual impacts and compare them to those predicted. Where impacts are greater than those forecast, an adaptive management process may need to be implemented and additional mitigation required.

For pumped hydro storage projects, the applicant should particularly take into account the ecological status of the water environment. No further specific mitigation measures to those identified in EN-1 are included in EN-3. However, some pumped hydro storage projects can

provide benefits to local biodiversity through habitat creation and/or enhancement, fish re-stocking and bankside planting.

For solar farms, the applicant should identify any particular ecological risk from developing on the proposed site. The applicant's assessment should consider earthworks associated with construction compounds, access roads and cable trenching; how security and lighting installations may impact on the local ecology; how site boundaries are managed, and whether any hedges/ scrub are to be removed; the impacts of mobile arrays or trackers to avoid animals becoming trapped in moving parts; the enhancement, management and monitoring of biodiversity given the potential for a net positive impact; and whether geotechnical and hydrological information should be provided, including identifying the presence of peat and the risk of landslide. A Flood Risk Assessment may also be required to consider the impact of drainage. The Secretary of State should consider the maximum adverse effects from water management in the consideration of the application. The Secretary of State should also specifically take into consideration where the location of the solar farm is on peat, to ensure minimal disruption to the ecology. Specific mitigation measures could include maintaining or extending existing habitats and potentially creating new important habitats. An ecological monitoring programme is recommended to monitor impacts upon the flora and any particular features at the site, the results of which would inform any changes needed to the land management of the site.

The effects from tidal stream energy are expected to be similar to those identified for offshore wind farms, with the exception of the effects on birds. The applicant should consult with relevant bodies and undertake appropriate ecological monitoring which can inform the mitigation of any adverse effects.

7.2.2.3: Assessment made in respect of EN-3

Specific effects on biodiversity are likely to occur with all renewable energy generation projects covered in EN-3, some of which could be significant. Effects on biodiversity may occur at all stages of the project, and may be direct or indirect, temporary or permanent. The significance of these effects will be determined during EIA and appropriate mitigation measures in accordance identified to minimise any adverse effects.

EN-3 emphasises the importance of ensuring that the applicant has used up to date research within their assessments, and that consultation has been carried out with relevant bodies to ensure where monitoring needs to take place the scope and approach is agreed, and appropriate mitigation measures are agreed. There could also be cumulative impacts which will need to be taken into account, where mitigation measures alone may not be able to address these issues, meaning that compensation may be required.

The non-generic effects on biodiversity are considered to be minor negative over all timeframes for all renewable infrastructure projects, apart from offshore wind with significant adverse non-generic effects, including transboundary effects, in terms of protected bird and marine mammal species and benthic habitats, although effects will clearly vary according to the type of impact, the specific location of the site, and the habitats and species affected.

Table 7-3 – Enhancing biodiversity, promoting net gain, and supporting ecosystem resilience and functionality Objective Summary

AoS Objective	Technology	Assessment of non-generic effects (by timescale)		
		S	M	L

Enhance biodiversity, promoting net gain, and supporting ecosystem resilience and functionality Guide questions: • Protect and enhance nationally designated sites such as SSSIs and National Nature Reserves, including those of potential or candidate designation? • Protect and enhance valued habitat and populations of protected/scarce species on locally designated sites, including Key Wildlife Sites, Local Wildlife Sites and Local Nature Reserves? • Protect the structure and function/ecosystem processes, including in the marine environment? • Protect and enhance the Nature Recovery Network? • Protect and enhance priority habitats, and the habitat of priority species? • Promote new habitat creation or restoration and linkages with existing habitats? • Protect and enhance the wider green infrastructure network? • Increase the resilience of biodiversity to the potential effects of climate change? • Promote a net gain in biodiversity for any new major infrastructure development?	Offshore wind	--	--	--
	Pumped hydro storage	-	-	-
	Solar Photovoltaic Generation	-	-	-
	Tidal Stream Energy	-	-	-

7.2.3: AoS Objective 6: Protect and enhance the character and quality of the landscapes and townscapes, protect and enhance visual amenity

7.2.3.1: Anticipated effects

EN-3 identifies that that there may be specific concern of the impact on landscape from biomass/ waste combustion generating stations, given the overall size of the buildings.

There will also be specific considerations on seascape and visual impact associated with offshore wind farms. Seascape is an important environmental, cultural and economic asset, especially where the seascape provides the setting for a nationally designated landscape and supports the delivery of the designated area's statutory purpose, and for Heritage Coasts.

Pumped hydro storage projects have the potential to specifically impact the landscape resulting from: construction of a concrete dam; construction of the generating station; substantial civil works for the scheme foundations and digging the reservoir; and flooding of land to create the reservoir.

Regarding effects from solar farms, these are likely to be in low lying areas of good exposure and as such may have a wider zone of visual influence than other types of onshore energy infrastructure. In addition, they may cover a significant surface area.

EN-3 also identifies that there may be impacts on seascape and visual impacts from tidal stream energy projects.

7.2.3.2: Approach to development and mitigation in EN-1 and EN-3

Regarding biomass/ energy from waste, the Secretary of State should be satisfied that the design of the proposed generating station is of appropriate quality and minimises adverse effects on the landscape character and quality. Good design that is sympathetic and contributes positively to the landscape character and quality of the area will go some way to mitigate adverse landscape and visual effects. Development proposals should consider the design of the generating station including the materials to be used in the context of the local landscape character. Mitigation is achieved primarily through aesthetic aspects of site layout and building design, although micro-siting within the development can help. Applicants should seek to visually enclose the generating station buildings at low level as seen from surrounding external viewpoints to help reduce the scale of impacts. Consideration could be given to using earth bunds and mounds, and / or tree planting to soften visual intrusion.

For offshore wind farms, a seascape and visual impact assessment (SLVIA) will be required where a coastal National Park, the Broads or AONB, or a Heritage Coast may be affected, and may be required in other circumstances in accordance with relevant offshore windfarm EIA policy. The SLVIA should be proportionate to the scale of the potential impacts. Where the offshore wind farm will not be visible from the shore, then a SLVIA will not be required. Where necessary, assessment of the seascape should include an assessment of four principal considerations on the likely effect of the offshore wind farm on the coast: the limit of visual perception from the coast; the effects of navigation and hazard prevention lighting on dark night skies; individual landscape and visual characteristics of the coast and the special qualities of designated landscapes; and how people perceive and interact with the coast and seascape. Photomontages will be required, and the viewpoints should be selected in consultation with statutory consultees. The Secretary of State should not refuse to grant consent for a development solely on the ground of an adverse effect on the seascape or visual amenity unless: it considers that an alternative layout within the identified site could be reasonably proposed which would minimise any harm taking into account any other constraints; or the harmful effects are considered to outweigh the benefits of the proposed scheme. Where adverse effects are anticipated, the Secretary of State should take into account the extent to which the effects are temporary or reversible. In terms of mitigation, it should be considered unlikely that mitigation in the form of reduction in scale will be feasible, however, the layout of the turbines should be designed appropriately to minimise harm, taking into account other constraints.

Regarding pumped hydro storage projects, the Secretary of State should be satisfied that the design of the proposed scheme is of appropriate quality and minimises adverse effects on the landscape character and quality. Good design that is sympathetic and contributes positively to the landscape character and quality of the area will go some way to mitigate adverse landscape and visual effects. Development proposals should consider the design of the dam and generating station including the materials to be used in the context of the local landscape. If spoil heaps are kept within the locality, they should be located in a way that minimises their visual impact. Mitigation is achieved primarily through the aesthetic aspects of site layout and building design to minimise intrusive appearance in the landscape as far as engineering requirements permit. For example, it may be possible to house some of the station underground or inside the dam. Applicants should seek to visually enclose the dam and generating station at low level as seen from surrounding external viewpoints to help reduce the scale of impacts. Consideration could be given to using earth bunds and mounds, and / or tree planting to soften visual intrusion.

For solar farms, the applicant may be required to show visualisations to demonstrate the effects of a proposed solar farm on the setting of heritage assets and any nearby residential areas or viewpoints. Applicants should follow the criteria for good design and will be

expected to direct considerable effort towards minimising the landscape and visual impact of the solar PV arrays. Security measures such as fencing should take into account the need to minimise the landscape and visual impact. The applicant should have regard in both the design layout and future maintenance plans for the retention of growth of vegetation on boundaries. Existing hedges and established vegetation should be retained wherever possible, and if necessary, tree surveys or hedge assessments should be undertaken to inform the impact of the proposed development. In terms of mitigation, applicants should consider the potential to mitigate landscape and visual impacts through screening with native hedges, to minimise the use and height of security fencing, to use existing features to screen security fencing or to assist in site security. The use of security lighting should be minimised, and any lighting should use a passive infra-red technology and its impact minimised through design and installation practices.

Potential effects on seascape may also occur with tidal array projects, although there is not yet sufficient evidence for these types of projects. Effects may be similar to those associated with offshore wind farms.

7.2.3.4: Assessment made in respect of EN-3

Specific effects on landscape or seascape and on visual impact are expected to occur with all types of renewable infrastructure projects. EN-3 notes that assessment of effects should be undertaken in accordance with EN-1, with the impact on seascape addressed where relevant. As set out in EN-1, proposals should demonstrate good design in respect of landscape and visual amenity.

Adverse effects may occur at all stages of the project. The significance of these effects will be determined during EIA and appropriate mitigation measures identified to minimise any adverse effects. The effects on landscape and visual impact are therefore considered to be minor negative over all timeframes although there is uncertainty associated with these effects.

Table 7-4 – Protect and enhance landscapes Objective Summary

AoS Objective	Technology	Assessment of non-generic effects (by timescale)		
		S	M	L
Protect and enhance the character and quality of the landscapes and townscapes, protect and enhance visual amenity Guide questions: • Support the integrity of any areas designated for landscape value, including in conjunction with the provisions of any relevant Management Plan (e.g. AONB and local landscape designations)? • Conserve and enhance the intrinsic character or setting of local landscapes or townscapes or waterscapes? • Minimise noise and light pollution from construction and operational activities on residential amenity and on sensitive locations, receptors and views? • Conserve, protect and enhance natural environmental assets (e.g. parks and green spaces, common land,	Biomass and Waste combustion	-	-	-
	Offshore wind	-	-	-
	Pumped hydro storage	-	-	-
	Solar Photovoltaic Generation	-	-	-
	Tidal Stream Energy	-	-	-

woodland / forests etc) where they contribute to landscape and townscape quality?	

7.2.4: AoS Objective 8: Protect and enhance air quality

7.2.4.1: Anticipated effects

As detailed in AoS-1, energy infrastructure projects have the potential for a number of generic adverse effects on air quality during construction, operation and decommissioning which 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
- emissions from plant, machinery and vehicles during the decommissioning of projects (including transport to and from site).

Specific effects on air quality are only expected to occur with biomass and energy from waste infrastructure projects.

EN-3 states that the pollutants of concern arising from the combustion of waste and biomass may include NOx, SOx, NMVOCs and particulates. In addition, emissions of heavy metals, dioxins and furans are a consideration for waste combustion generating stations but limited by the Industrial Emissions Directive (IED) and waste incineration BAT conclusions and regulated by the EA. Changes in air quality could affect both sensitive human health and ecological receptors, however, EN-3 notes that where the proposed plant meets the requirements of the IED and BAT conclusions and will not exceed the local air quality standards the Secretary of State should not regard the proposed plant as having adverse impacts on health.

EN-1 notes that a particular effect of NOx from some energy infrastructure may be eutrophication, which is the excessive enrichment of nutrients in the environment. The main emissions from energy infrastructure are from generating stations. Eutrophication can affect plant growth and functioning, altering the competitive balance of species and thereby damaging biodiversity. In aquatic ecosystems it can cause changes to algal composition and lead to algal blooms, which remove oxygen from the water, adversely affecting plants and fish. The effects on ecosystems can be short term or irreversible and can have a large impact on ecosystem services such as pollination, aesthetic services and water supply.

7.2.4.2: Approach to development and mitigation in EN-1 and EN-3

The approach is the same as noted in EN-1, with the added requirement to ensure that the proposed plant meets the requirements of the IED and BAT conclusions. The significance of effects will depend upon local site-specific factors, such as transport routes and proximity to sensitive receptors and these will be dealt with during the project level EIA.

EN-3 notes that abatement technologies should be those set out in the relevant sector guidance notes as produced by the EA. The Secretary of State does not need to consider equipment section in its determination process.

7.2.4.3: Assessment made in respect of EN-3

Specific effects on local air quality are only expected to occur with biomass and energy from waste infrastructure projects.

EN-1 notes that adverse effects may occur at all stages of the project, as a result of emissions released during construction, operation, and decommissioning. The significance of these effects will be determined during EIA and appropriate mitigation measures in accordance identified to minimise any adverse effects. The effects on air quality from biomass and energy from waste projects are therefore considered to be minor negative over all timeframes.

EN-3 notes which pollutants should be considered within an assessment but is clear that where a proposed project meets the requirements of the IED and BAT conclusions and does not exceed local air quality objectives then there should not be any adverse effects on human health. There may, however, be effects on sensitive ecological receptors which are not specifically mentioned in EN-3, although these effects are included in EN-1.

Table 7-5 – Protect and enhance air quality Objective Summary

AoS Objective	Technology	Assessment of non-generic effects (by timescale)		
		S	M	L
Protect and enhance air quality Guide questions: • Minimise emissions of dust and other air pollutants that affect human health or biodiversity? • Improve air quality within AQMAs and avoid the need for new AQMAs? • Promote enhancements to green infrastructure networks to help improve air quality?	Biomass and Waste combustion	-	-	-

7.2.5: AoS Objective 11: Improve health and well-being and safety for all citizens and reduce inequalities in health

7.2.5.1: Anticipated effects

EN-3 identifies specific effects from biomass and waste combustion on air pollution, as noted in the section above, on noise and vibration, and on odour, insect and vermin infestation. Sources of noise and vibration may include: delivery and movement of fuel and materials; processing waste for fuel at generating stations; the gas and steam turbines that will operate continuously; and external noise sources such as externally-sited air-cooled condensers that also operate continuously during normal operation. Insect and vermin infestation may be a particular issue with regard to storage of fuels for energy from waste generating stations as they may be attracted to biodegradable waste stored and processed at the facility. Odour is also likely to arise during the storage, handling and processing of biodegradable waste.

Specific effects are also identified from pumped hydro storage on noise and vibration as a result of the noise from the turbines and other power generation equipment during operation, and during construction, in particular if blasting is required to create new reservoirs.

Solar Photovoltaic generation is also identified as specifically causing glint and glare which could affect residents or motorists, and noise and vibration associated with traffic during the construction phase. This is considered specifically for solar farms, given their likely location in rural areas where a large number of vehicles may be necessary to transport necessary infrastructure along minor roads.

7.2.5.2: Approach to development and mitigation in EN-1 and EN-3

For biomass and waste combustion projects, the applicant should include a noise assessment of the impacts on amenity in case of excessive noise in accordance with EN-1. In addition to mitigation measures set out in EN-1, noise from gas turbines should be mitigated by attenuation of exhausts to reduce any risk of low-frequency noise transmission. The applicant should also assess the potential for insect infestation and emissions of odour as set out in EN-1. There are no further specific mitigation measures to those identified in EN-1.

For pumped hydro storage projects, a noise assessment of the impacts on amenity in the case of excessive noise should be undertaken in accordance with EN-1. In addition to the mitigation measures identified in EN-1, it is noted that noise from the operation of the pumped hydro storage generating stations and from the apparatus external to the main generating station may be unavoidable. Mitigation will be through careful plant selection. Noise during blasting will also be unavoidable. Careful consideration should be given to mitigating the impact of this on noise sensitive receptors.

For solar farms, it may be necessary in some instances for the applicant to undertake a glint and glare assessment as part of the application. This would need to take into account tracking panels which can cause differential diurnal and/or seasonal impacts. Solar PV panels are designed to absorb, not reflect, irradiation. However, the Secretary of State should assess the potential impact of glint and glare on nearby homes and on motorists. Consideration should be given to the use of non-glare/ non-reflective solar panels, and to ensure the front face of the panels is comprised with a non-reflective coating for the lifetime of the project.

The applicant should also consider any impact from noise resulting from construction traffic associated with solar farm proposals. Cumulative effects on the local road network should also be considered and disruption to local residents minimised through a transport delivery plan. Mitigation measures other than those specified in EN-1 may include temporary road widening.

7.2.5.3: Assessment made in respect of EN-3

The specific effects on health from renewable technologies identified in EN-3 could have negative effects on the activities identified such as on air quality, noise, odour, insect and vermin infestation and from glint and glare from solar panels. These effects could occur over all timeframes, with some effects such as those on noise being unavoidable. For all of the specific effects identified, mitigation measures should be considered where possible. The assessment has shown that minor negative impacts are expected from biomass and energy from waste plants, and solar farms over all timescales, while those for pumped hydro storage are likely to be significant negative, as some of the effects may be unavoidable.

Table 7-6 – Improve health and well-being Objective Summary

AoS Objective	Technology	Assessment of non-generic effects (by timescale)		
		S	M	L
Improve health and well-being and safety for all citizens and reduce inequalities in health Guide questions: • Protect the health of communities through prevention of accidental pollutant discharges, exposure to electric and magnetic fields, shadow flicker or radiation? • Minimise nuisance on communities and their facilities including air, noise and light pollution? • Provide for facilities that can promote more social interaction and a more active lifestyle and enjoyment of the countryside and coasts? • Promote initiatives that enhance safety and personal security for all?	Biomass and waste combustion	-	-	-
	Pumped hydro storage	--	--	-
	Solar photovoltaic generation	-	-	-

7.2.6: AoS Objective 14: Promote a strong economy with opportunities for local communities

7.2.6.1: Anticipated effects

While implementation of the NPS through EN-1 is expected to result in long term overall economic benefits, EN-3 identifies specific effects from offshore wind farms on commercial fisheries and fishing, and on navigation and shipping. EN-3 notes that certain types of commercial fishing activity such as trawling and long-lining, other fishing activities may be able to take place without being unduly disrupted. Establishment of a wind farm can also increase the potential for some fishing activities such as potting. Offshore wind farms could potentially affect fish that is of both commercial interest and ecological value.

Offshore wind farms will also impact on navigation and shipping in and around the area of the site, affecting both commercial and recreational users of the sea who may be affected by disruption or economic loss. Consent may not be given to projects which pose unacceptable risks to navigational safety after all mitigation measures have been adopted.

In addition, the siting of offshore infrastructure associated with offshore wind farms will often occur in or close to areas where other offshore infrastructure such as telecommunication cables, oil or gas pipelines, and carbon dioxide pipelines, is located, thus affecting economic activity.

EN-3 also identifies specific effects from pumped hydro storage on recreational activities such as water sports and fishing.

Potential effects on navigation and shipping may also occur with tidal array projects, although there is not yet sufficient evidence for these types of projects. Effects may be similar to those associated with offshore wind farms.

7.2.6.2: Approach to development and mitigation in EN-1 and EN-3

Regarding offshore wind farms, EN-3 states that the Secretary of State should be satisfied that the site selection process has been undertaken in a way that reasonably minimises adverse effects on fish stocks. Where the Secretary of State considers the wind farm would significantly impede the protection of sustainable fisheries or fishing activity at recognised important fishing grounds, this should be attributed a correspondingly significant weight. The Secretary of State should also consider adverse or beneficial impacts on different types of commercial fishing on a case by case basis. The Secretary of State should be satisfied that the applicant has sought to design the proposal with relevant consultees and tried to minimise the loss of any fishing activities. The Secretary of State will need to consider the extent to which disruption to the fishing industry has been mitigated where reasonably possible. Mitigation proposals should result from detailed consultation with relevant consultees, and mitigation should be designed to enhance where reasonably possible any potential medium and long-term positive benefits to the fishing industry.

Applicants should establish stakeholder engagement with interested parties in the navigation sector early in the development phase of the proposed offshore wind farm and continue to ensure that solutions are sought that allow offshore wind farms and navigation uses of the sea to successfully co-exist. Assessment should be underpinned by consultation with relevant representatives. Applicants should also undertake a Navigational Risk Assessment in accordance with relevant Government guidance. The Secretary of State should not grant development consent in relation to the construction or extension of an offshore wind farm if it considers that interference with the use of recognised sea lanes essential to international navigation is likely to be caused by the development. The Secretary of State should be satisfied that the site selection has been made with a view to avoiding or minimising disruption or economic loss to the shipping and navigation industries with particular regard to approaches to ports and to strategic routes essential to regional, national and international trade, lifeline ferries and recreational users of the sea. Where the proposed development is likely to adversely affect major commercial navigational routes, the Secretary of State should give these adverse effects substantial weight in its decision making. Mitigation measures should be identified following proactive engagement with key sector representatives. Where less strategically important shipping routes are likely to be affected, a pragmatic approach should be adopted, with negative impacts minimised as low as reasonably practicable.

Regarding the impact on offshore infrastructure, where the proposed wind farm is in close proximity to this infrastructure, the applicant should undertake an assessment of the potential effects of the proposed development on such infrastructure in accordance with EN-1. Early consultation between the applicant, the interested parties and the Secretary of State where relevant, should be held as early as possible in the process and continue throughout the lifetime of the project. Where a proposed offshore wind farm potentially affects other offshore infrastructure, the Secretary of State should expect the applicant to minimise negative impacts and reduce risks to as low as reasonably practicable. The Secretary of State should be satisfied that the site selection and site design of the offshore wind farm has been made with a view to avoiding or minimising disruption or economic loss or any adverse effect on safety to other offshore industries. Where a proposed development is likely to affect the future viability or safety of an existing or approved/ licensed offshore infrastructure or activity, the Secretary of State should give these adverse effects substantial weight in its decision making. Providing proposed schemes have been carefully designed, and that the necessary consultation with relevant bodies has been undertaken at an early stage, mitigation measures may be possible to negate or reduce effects on other offshore infrastructure to a level sufficient to enable the Secretary of State to grant consent.

Where a pumped hydro storage project is likely to have impacts on recreational activities the applicant should undertake a full assessment, accounting for the views of relevant representational bodies and taking measures to minimise adverse impacts. The Secretary of State should be satisfied that the applicant has demonstrated measures to minimise adverse impacts on recreational activities. These projects should be designed to minimise impacts on existing recreational activities, and where possible designed in such a way to enhance recreational activities.

7.6.2.3: Assessment made in respect of EN-3

The specific effects on economic activity from renewable technologies identified in EN-3 could have negative effects on the activities identified such as commercial fishing, navigation, on recreational activities, and on offshore infrastructure over all timeframes, of which some effects could carry substantial weight. For all of the specific effects identified, mitigation measures identified in consultation with relevant bodies should be adopted, and where possible specific effects should be taken into account in the design of the project. The assessment has shown that minor negative impacts are expected over all timescales, given that the majority of adverse effects should be able to be mitigated.

Table 7-7 – Promote a strong economy Objective Summary

AoS Objective	**Technology**	**Assessment of non-generic effects (by timescale)**		
		S	**M**	**L**
Promote a strong economy with opportunities for local communities Guide questions: • Support enhanced security, reliability and affordability of the national energy supply? • Support creation of both temporary and permanent jobs and increase skills, particularly in areas of need? • Have wider socio-economic effects such as changes to the demographics, community services or house prices?	Offshore Wind	-	-	-
	Pumped hydro storage	-	-	-

7.2.7: AoS Objective 15: Promote sustainable use of resources and natural assets

7.2.7.1: Anticipated effects

EN-3 identifies specific effects from biomass and waste combustion plants on waste management and residue management. EN-3 notes that waste combustion generating stations need not disadvantage reuse or recycling initiatives where the proposed development accords with the waste hierarchy. EN-3 identifies specific considerations regarding residue management. It notes that all waste/ biomass combustion generating stations will produce residues that require further management, much of which can be used for commercial purposes.

Generating stations that burn waste produce two types of residues: combustion residue- inert material from the combustion chamber; and fly ash, a residue from flue gas emission abatement technology. These two residues cannot be mixed.

Residues from biomass combustion generating stations will also produce both combustion and flue gas treatment residues, however, these can be mixed and managed as one product for disposal.

7.2.7.2: Approach to development and mitigation in EN-3

The applicant should undertake an assessment of the proposed waste combustion generating station that examines the conformity of the scheme with the waste hierarchy, and the effect on the relevant waste plan or plans. The applicant should set out the extent to which the generating station and capacity proposed is compatible with and supports the long-term recycling targets. If appropriate, reference should be made to the waste authorities annual monitoring reports. The Secretary of State should be satisfied that the proposed waste combustion generating station is in accordance with the waste hierarchy and of an appropriate type and scale so as not to prejudice the achievement of local or national waste management targets.

The applicant should include the production and disposal of residues as part of the ES. In addition, applicants should set out the consideration they have given to the existence of accessible capacity in waste management sites for dealing with residues for the planned life of the power station. The Secretary of State should consult the Environment Agency on the suitability of the proposals. The Secretary of State should be satisfied that management plans for residue disposal satisfactorily minimise the amount that cannot be used for commercial purposes. The Secretary of State should give substantial positive weight to development proposals that have a realistic prospect of recovering residues. The Secretary of State should consider what requirements it may be appropriate to impose following consultation with the Environment Agency. In terms of mitigation, the environmental burdens associated with the management of combustion residues can be mitigated through recovery of secondary products, for example aggregate or fertiliser, rather than disposal to landfill. The Secretary of State should give substantial positive weight to proposals that have a realistic prospect of recovering these materials.

7.2.7.3: Assessment made in respect of EN-3

Biomass and combustion from waste could have a positive effect where it is in accordance with the waste hierarchy and is of an appropriate scale. A positive effect could also occur where the applicant is planning to recover much of the residual component. However, there could also be negative effects in terms of the residues that are produced from burning waste.

Table 7-8 – Resources and natural assets Objective Summary

AoS Objective	**Technology**	**Assessment of non-generic effects (by timescale)**					
		S		**M**		**L**	
Promote sustainable use of resources and natural assets Guide questions: • Reduce consumption of materials, energy and resources?	Biomass and waste combustion	**-**	**+**	**-**	**+**	**-**	**+**

• Promote sustainable waste management practices in line with the waste hierarchy? • Encourage the use of recycled and / or secondary materials? • Promote the use of low carbon materials and technologies? • Produce waste by-products that require appropriate management? • Provide for safe and secure interim storage of waste, where necessary? • Promote the use of local suppliers that use sustainably-sourced and locally produced materials?	

7.3: Cumulative effects associated with adoption of EN-3

Offshore wind will have a hugely important role in supplying renewable energy. It is therefore likely that a number of offshore wind farms could be proposed in areas with good wind resources. Multiple offshore wind facilities could, 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).

It is possible that biomass facilities may be located in clusters near ports too, 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 regulatory emissions limits 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;
- 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.

7.4: Summary of Key Findings of Appraisal of EN-3

Renewable energy infrastructure development would have similar generic strategic effects to other types of energy infrastructure. These result from impacts associated with large facilities at single sites. For the majority of the AoS objectives, the generic strategic effects of EN-3 are considered to be aligned with those identified in AoS-1.

There are a number of specific effects associated in particular with eight AoS objectives: Carbon emissions, Biodiversity; Landscape/ Seascape; Water Quality; Air Quality; Health; Economy; and Resources. These effects have been found to be generally negative across short, medium and long terms.

Consistency with the national target of reducing carbon emissions to Net Zero by 2050 is considered significantly negative over the short, medium and long terms reflecting residual emissions from unabated waste combustion plants, in particular if negative emissions technologies are not used.

Significant effects from renewable technologies can potentially affect biodiversity, landscape/ seascape, noise, commercial fishing, and commercial navigation routes. However, the effects are uncertain at this level of appraisal, as the actual effects are dependent on the sensitivity of the environment and the location and design of infrastructure.

There are, however, a few positive specific effects associated with the technologies. Positive effects may occur on the fishing industry from offshore wind farms; on biodiversity from solar farms, where land is no longer managed intensively; on biodiversity from pumped hydro storage schemes, as a result of habitat creation and fish re-stocking; and on resources where residues from biomass or energy from plants can be recovered and re-used rather than being sent to landfill. Again, there is uncertainty associated with these effects at this level of appraisal.

EN-1 (informed by AoS-1) includes extensive mitigations to ensure these effects are considered by applicants and the Planning Inspectorate when preparing and determining

applications. EN-3 (informed by AoS-3) contains a range of specific mitigation measures, along with those proposed in EN-1, which seek to address the range of non-generic negative effects identified. In some cases, such as for noise impacts, which are included under the Health AoS objective, it is recognised that the effect may not be able to be mitigated completely. Overall, it is considered that residual negative but uncertain effects will remain for the AoS objectives considered.

It should be noted, however, that these technologies have an important role to play in meeting the UK's energy needs and supporting delivery towards the UK's net zero target, and EN-3 notes that the benefits of meeting this target may outweigh some negative effects.

A summary of the likely non-generic effects arising specifically from renewable energy infrastructure is set out in the following Tables 7-9 to 7-13.

Table 7-9 - Summary of Key AoS Findings Specific to Biomass and Waste Combustion

AoS Objective	Assessment of non-generic effects (by timescale)					
	S		M		L	
1. Consistent with the national target of reducing carbon emissions to Net Zero by 2050	--		--		--	
6. Protect and enhance the character and quality of the landscapes and townscapes, protect and enhance visual amenity	-		-		-	
8. Protect and enhance air quality	-		-		-	
11. Improve health and well-being and safety for all citizens and reduce inequalities in health	-		-		-	
15. Promote sustainable use of resources and natural assets	-	+	-	+	-	+

Table 7-10 - Summary of Key AoS Findings Specific to Offshore Wind

AoS Objective	Assessment of non-generic effects (by timescale					
	S		M		L	
3. Enhance biodiversity, promoting net gain, and supporting ecosystem resilience and functionality	--		--		--	
6. Protect and enhance the character and quality of the landscapes and townscapes, protect and enhance visual amenity	-		-		-	
14. Promote a strong economy with opportunities for local communities	-	+	-	+	-	+

Table 7-11 - Summary of Key AoS Findings Specific to Pumped Hydro

AoS Objective	Assessment of non-generic effects (by timescale		
	S	M	L
3. Enhance biodiversity, promoting net gain, and supporting ecosystem resilience and functionality	-	- +	- +
6. Protect and enhance the character and quality of the landscapes and townscapes, protect and enhance visual amenity	-	-	-
11. Improve health and well-being and safety for all citizens and reduce inequalities in health	--	--	-
14. Promote a strong economy with opportunities for local communities	-	-	-

Table 7-12 - Summary of Key AoS Findings Specific to Solar Photovoltaic

AoS Objective	**Assessment of non-generic effects (by timescale**		
	S	**M**	**L**
3. Enhance biodiversity, promoting net gain, and supporting ecosystem resilience and functionality	-	- +	- +
6. Protect and enhance the character and quality of the landscapes and townscapes, protect and enhance visual amenity	-	-	-
11. Improve health and well-being and safety for all citizens and reduce inequalities in health	-	-	-

Table 7-13 - Summary of Key AoS Findings Specific to Tidal Stream Energy

AoS Objective	**Assessment of non-generic effects (by timescale**		
	S	**M**	**L**
3. Enhance biodiversity, promoting net gain, and supporting ecosystem resilience and functionality	-	-	-
6. Protect and enhance the character and quality of the landscapes and townscapes, protect and enhance visual amenity	-	-	-

7.5: Alternatives Considered in respect of EN-3

As explained in Section 1 of this report, the AoS exercise for the energy NPSs also fulfils the requirements of the Strategic Environmental Assessment (SEA) Regulations 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 Regulations require 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".

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.

The reasonable alternatives considered in the AoS for the 2011 Renewable Energy Infrastructure NPS were the following:

> (a) adopting a policy that would be less tolerant of the adverse visual, noise and shadow flicker impacts of onshore wind farms; and
>
> (b) adopting a policy that would mean consents set more stringent criteria for the fuel for biomass / waste combustion facilities based on sustainability considerations.

Regarding alternative (a), the policy in revised EN-3 no longer includes onshore wind farms so this alternative is no longer appropriate.

For alternative (b), further relevant policy development in recent years that have strengthened criteria for fuel for biomass/ waste combustion facilities means that this is current policy and no longer an alternative. However, as for natural gas energy generation in EN-2, unabated biomass/ waste combustion facilities are encouraged to come forward under EN-3, so a reasonable alternative to EN-3 would be:

- EN3 (a): only consent biomass or waste combustion plant with Carbon Capture and Storage (CCS).

Broadly speaking, such an alternative would be aimed primarily at achieving the Net Zero aspects of overall NPS policy much quicker, as it could result in negative carbon emissions if employed at scale for biomass combustion plant.

7.6: Appraisal of Alternatives to EN-3

The preferred policy approach (EN-3) was appraised in detail using the AoS framework of objectives in Section 4. The summary of key appraisal findings is set out above.

The scope and methods of appraisal of alternatives are detailed in Section 2 of this report. The strategic alternative identified for renewable energy infrastructure was assessed using Sustainable Development themes that better keep the appraisal at the higher and strategic level. The results are set out below.

Note that in consideration of Alternatives, the assessment is undertaken in comparison to EN-3. As such, the findings of the AoS in respect of EN-3 broadly apply to the alternative – the key differentiator being the inclusion or absence of particular aspects related to the Technology and the relative outcomes of such inclusion or absence. To draw comparison between the alternative and EN-3 on a broad level, the following scale has been used.

Table 7-14 - Differentiator scale for Alternatives

Scale	Description
Large Positive	A materially different positive outcome is anticipated compared to EN-3
Positive	A more positive outcome is anticipated compared to EN-3
Neutral	This alternative is anticipated to have the same outcome as EN-3
Negative	A more adverse outcome is anticipated compared to EN-3
Large Negative	A materially different adverse outcome is anticipated compared to EN-3

7.7: Results of Appraisal of Alternatives to EN-3

The findings of the appraisal of the strategic alternative for EN-3 are set out below, arranged by Sustainable Development (SD) theme.

The alternative under consideration is:

- EN3 (a): only consent biomass or waste combustion plant with Carbon Capture and Storage (CCS).

7.7.1: Climate Change (Net Zero)

Alternative (a) only consenting biomass or waste combustion plant with CCS has the potential to further reduce CO_2 emissions from biomass or waste combustion plant compared with EN-3. However, the commercial viability will need to be demonstrated at a larger scale in the UK, although CCS in conjunction with biofuels is being deployed at small scale in Europe[13]. The need for scale increases the challenges in demonstrating economic viability but this alternative in conjunction with sustainable biomass could be beneficial in meeting Net Zero targets. However, this assessment is highly uncertain and would depend on what happens to the waste if not used within the power sector (as energy recovery from residual waste has a lower greenhouse gas impact than landfill) and the extent to which biomass may be more cost effective in decarbonising other sectors (such as heat and transport) over the long-term.

Headline SD themes	EN-3	Alternative (a)
Climate Change (Net Zero)		**Positive/Negative**

7.7.2: Security of Energy Supply

Alternative (a), only consenting biomass or waste combustion plant with CCS, may result in fewer proposals coming forward for such plant in the short term, given that developers will need to be confident of economic viability as CCS as yet to be proven at scale in the UK. This could have a negative effect on security of supply but given the relatively small capacity provided by these technologies may not be material.

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

[13] EBTP-ZEP-Report-Bio-CCS-The-Way-Forward.pdf (etipbioenergy.eu)

7.7.3: Health and Well-Being

Alternative (a), only consenting biomass or waste combustion plant with CCS, could potentially change effects on health and well-being compared with EN-3. There may be increases in emissions of air pollutants as a result of the CCS technology required to be used[14], although there are unlikely to be changes in noise associated with the plant. Alternative (a) may also increase negative effects on health and well-being on a wider regional and national scale if security of energy supply cannot be maintained, and this has impacts on employment opportunities and economic growth. However, if CCS is demonstrated to be economically viable on a larger scale, then impacts on health and well-being are likely to be more positive through increased employment opportunities associated with CCS technology.

Headline SD themes	EN-3	Alternative (a)
Health & Well-Being		**Positive / Negative**

7.7.4: The Economy

Alternative (a), only consenting biomass or waste combustion plant with CCS is likely to result in reduced benefits to the economy compared with EN-3 under current market conditions. Fewer proposals are likely to come forward, given that investors will need to be confident of the economic viability of CCS, unless incentives are provided. A reduced electricity generating capacity is also likely to increase reliance on more expensive energy generating technologies as nuclear in the transition to a low carbon economy or require an even faster expansion of renewables that may not be achievable within the required timescales, and therefore potentially increase energy bills to consumers. However, if CCS in conjunction with sustainable biomass plants and waste-to-energy plants are demonstrated to be economically viable on a larger scale, then the positive effects on the economy are likely to be greater than with the adoption of EN-3. This is related to greater employment opportunities in CCS and the likelihood that energy bills will be lower in the transition to a low carbon economy if there is more electricity generating capacity with CCS.

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

7.7.5: The Built Environment

Alternative (a), only consenting biomass or waste combustion plant with CCS, may result in reduced negative effects on the built environment compared with EN-3. This alternative is likely to result in fewer proposals for these types of plant and therefore likely to result in reduced negative effects on flood risk (plant tend to be located in coastal areas or estuarine sites where flood risk is elevated). There are also likely to be reduced negative effects on traffic and transport, although those that remain, as with EN-3, are likely to be localised and short term in duration associated with construction and decommissioning. Effects on archaeology and cultural heritage with adoption of alternative (a) are also likely to be less negative compared with EN-3, again associated with likely fewer generating stations,

[14] Air pollution impacts from carbon capture and storage (CCS) — European Environment Agency (europa.eu)

although those that remain are again likely to be local in extent. However, if CCS is demonstrated to be economically viable on a larger scale, then negative impacts on the built environment are likely to be larger compared with adoption of EN-3, because the footprint of plant with CCS is greater than that of plant without CCS.

Headline SD themes	EN-3	Alternative (a)
The Built Environment		**Positive / Negative**

7.7.6: The Natural Environment

Alternative (a), only consenting biomass or waste combustion plant with CCS, may result in reduced negative effects on the natural environment compared with EN-3. This alternative is likely to result in fewer proposals for such electricity generating stations and therefore likely to result in reduced negative effects on biodiversity as there will be less land take. Effects on landscape, townscape and visual character are also likely to be less than would be the case with EN-3, again because there will be less land take. Those effects that remain are likely to be local in extent. However, if CCS is demonstrated to be economically viable on a larger scale, then impacts on the natural environment are likely to be of greater negative magnitude compared with adoption of EN-3 as there will potentially be more land take.

Headline SD themes	EN-3	Alternative (a)
The Natural Environment		**Positive / Negative**

7.8: Summary of Alternatives Findings and Preferred Approach for the NPS

Table 7-15 - Summary of Alternatives Assessment

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

Alternative (a), only consenting biomass or waste combustion plant with CCS, could be beneficial in meeting Net Zero targets. However, there is uncertainty depending on what happens to the waste if not used within the power sector (as energy recovery from residual waste has a lower greenhouse gas impact than landfill) and the extent to which biomass may be more cost effective in decarbonising other sectors (such as heat and transport) over the long-term. The requirement to demonstrate the economic viability on a larger scale for CCS than required under EN-3 may result in fewer applications for development consent which could in turn negatively impact Security of Supply and affordability of energy but given the

relatively small capacity provided by these technologies may not be material. Widening the CCS requirement to all biomass or waste combustion plant could carry significant risks while (as at present) the technology remains unproven at large scale and it is unclear how much it will cost to install and operate and may also present economic barriers to developers. There may be even more uncertainty associated with waste combustion plant. Alternative (a) could also have greater positive effects on the Economy than EN-3 associated with the greater potential for employment with CCS and a positive impact in lowering energy prices. However, there are uncertainties associated with these positive effects from alternative (a).

Across the remaining sustainable development themes (Health & Well-Being, Built Environment and Natural Environment), the adoption of alternative (a) compared with EN-3 could therefore result in either greater positive or negative effects. Where CCS economic viability is not demonstrated on a wider basis, then there are likely to be smaller negative effects compared with EN-3. This is related to reduced land use as well as reduced footprint on health and well-being resulting from the narrower application of sustainable biomass/ waste plant with CCS. Where CCS viability is demonstrated on a wider basis for electricity generating capacity, then there are likely to be greater negative effects on these same topics.

The key difference between this alternative and EN-3 would seem to be a benefit for the achievement of Net Zero due to reduction of emissions from energy from waste and negative emissions through BECCS. This assessment is highly uncertain and would depend on what happens to the waste if not used within the power sector (as energy recovery from residual waste has a lower greenhouse gas impact than landfill) and the extent to which biomass may be more cost effective in decarbonising other sectors (such as heat and transport) over the long-term.

However, the use of CCS with biomass and energy from waste could present a more sustainable alternative than the policies set out in EN-1 and EN-3, if implemented in a way which minimises unintended consequences. As set out in the Energy White Paper, published in December 2020, the government is committed to consult on proposals to update the Carbon Capture Readiness requirements to reflect technological advances, such as conversion to low carbon hydrogen and apply them more broadly, by removing the 300MW threshold and including all combustion technologies within scope. If that consultation leads to changes in the relevant legal or policy framework then those new requirements will apply and this NPS will be updated to reflect any revised requirements ahead of designation.

8: Assessment for Gas Supply Infrastructure and Gas and Oil Pipelines Infrastructure EN-4 (AoS-4)

8.1: The NPS for Gas Supply Infrastructure and Gas and Oil Pipelines

The NPS for Gas Supply Infrastructure and Gas and Oil Pipelines (EN-4) in conjunction with the Overarching NPS for Energy (EN-1) sets out the relevant planning factors that should be considered by the Secretary of State when determining whether development consent should be granted for a proposed scheme.

As for EN-1, EN-4 has been developed via an iterative process, taking account of the appraisal of the predicted sustainability effects both for EN-4 preferred polices and reasonable alternatives.

8.2: Appraisal Findings for EN-4

Gas Supply Infrastructure and Gas and Oil Pipelines may have various impacts on communities and the environment depending on the nature of the development and its location. As noted in EN-4, all of the generic impacts detailed in EN-1 are likely to be relevant to energy infrastructure, even if only during specific stages of the development (such as construction), or at one specific part of the development (such as a pipeline).

While reference should be made to AoS-1 for consideration of all effects in full, this AoS-2 focuses on those potentially significant sustainability effects associated with the technologies set out in EN-4. The effects considered relate to:

- Carbon Emissions (Methane);
- Biodiversity;
- Landscape and Visual;
- Water Quality and Resources;
- Air Quality;
- Soil Resources and contamination; and
- Noise and Vibration.

The likely significant effects of the technology specific policies, requirements and guidance in EN-4 have been appraised against the corresponding objectives in the AoS framework as set out in Section 4.

Section 2.3 of this report explains how the significance of likely effects is shown. For ease of reference, the table is reproduced below.

Table 8-1 - Key to Appraising Significance of Predicted Effects

Significant positive effect likely	++	Policy is expected to address an existing sustainability problem or deliver sustainability enhancements, such as substantial environmental net gain above existing/emerging policy.
Minor positive effect likely	+	Policy is expected to lead to environmental net gain in line with existing or emerging Government policy OR result in

		protection and conservation of a sustainability asset (for example, a designated biodiversity site or designated heritage asset).
No effect likely or not applicable	0	No perceptible effects expected, or the objective is not relevant to the part of the NPS being assessed.
Minor negative effect likely	-	Policy is expected to result in adverse effects of a lower magnitude or smaller scale, which can be mitigated through standard measures and best practice.
Significant negative effect likely	--	Policy is expected to result in adverse effects of a greater magnitude or larger scale, which cannot be mitigated OR will require extensive and bespoke mitigation solutions (further studies may be required to identify appropriate solutions).

The appraisal focused on the identification of technology specific effects (non-generic) with consideration of mitigation measures as set out in AoS-1, in order to establish whether additional mitigation would be required as part of AoS-4. It is noted that an initial assessment was undertaken on a draft EN-4 document dated April 2021 and that this resulted in suggestions of additional mitigation (in the form of recommendations, see Appendix E) to be considered in the drafting of EN-4 for public consultation.

An assessment of residual non-generic effects is provided for the EN-4 document as presented for public consultation in the following sections. The likely non-generic effects arising specifically from Gas Supply Infrastructure and Gas and Oil Pipelines are presented together with a summary of the residual non-generic effects for each AoS objective over the short, medium and long term. In this context, for the purposes of the appraisal, the “short term” has been defined as the effects arising generally during the infrastructure construction period typically 2-7 years (different technologies have different construction times); the “medium term” as typically between 5 and 30 years (operational lifetimes vary with the characteristics of different technologies); and the “long term” as beyond 30 years (and including decommissioning where relevant).

In addition, consideration is given to the cumulative effects associated with the adoption of EN-4.

8.2.1: AoS Objective 1: Consistent with the national target of reducing carbon emissions to Net Zero by 2050

8.2.1.1: Anticipated effects

Gas Reception Facilities

EN-4 notes that there may be specific gas emission impacts which result from gas storage and supply infrastructure, for example due to the need to flare or vent gas. The most significant emissions are likely to come from gas reception facilities where flaring of gas is used to deal with a continuous stream of low volume waste gas from the processing. The venting of gas may be undertaken occasionally at facilities when there are relatively low volumes of hydrocarbon gas that need to be disposed of safely, usually associated with commissioning, decommissioning and maintenance operations.

The release of GHGs, including methane, through flaring or venting will negatively effect upon the climate change agenda.

Underground Natural Gas Storage

Methane, the main constituent of natural gas, is a greenhouse gas significantly more potent than CO_2. Releases of methane to the atmosphere from underground natural gas storage facilities are therefore not in alignment with the climate change agenda.

It is estimated that 70% of methane emissions from U.S. underground natural gas storage facilities come from fugitives[15].

Fugitive emission sources could include:

- Unintentional leaks caused by mechanical and thermal stresses in piping, valves, compressor seals, flanges, fittings and other components; and
- Methane leakage from improperly plugged and abandoned wells (and to a lesser extent from the geologic formation due to over-pressurising).

Vented emission sources could include:

- Vents from pneumatic devices
- Compressor startup
- Compressor shutdown
- Gas dehydration
- Condensate storage tank venting
- Equipment depressurisation

8.2.1.2: Approach to Development and Mitigation as set out in EN-1 and EN-4

Gas Reception Facilities

The flaring or venting of gas during the operation of a facility is regulated by the Environmental Permitting Regulations (EPR) which are administered by the EA. EN-1 provides guidance on the Environmental Permitting regime. Applicants are advised to make early contact with the EA to discuss the requirements at or before the pre-application stage.

EN-4 notes that the OGA is responsible for ensuring that the waste of a national resource (hydrocarbons) through flaring or venting is minimised and applicants should contact the OGA to check if flaring and venting consents are required.

EN-4 notes that mitigation measures to minimise the production of waste gas include:

- The use of emission control measures;
- The recovery and re-use of gas; and
- Combusting the processed gas to reduce GHG emissions by converting the methane to the less harmful carbon dioxide.

Underground Natural Gas Storage

EN-4 notes that there could be specific gas emission impacts which result from gas storage and supply infrastructure. The most significant emissions are likely to come from gas reception facilities where flaring of gas is used to deal with a continuous stream of low volume waste gas from the processing. There may also be emissions from underground gas storage. It is noted that the applicant's assessment should include an assessment of gas emissions and any adverse effects. The ES should include an assessment of the effects of

[15] Reducing Methane Emissions from Underground Natural Gas Storage Operations (epa.gov)

gas emissions on air quality in accordance with EN-1 and on greenhouse gas emissions in accordance with section 5.3 of EN-1. In addition, EN-1 notes that the Secretary of State should follow the principles for decision making as set out in the relevant sections of Parts 4 and 5 of EN-1. It is further noted that underground storage operators must demonstrate that they have taken all reasonable actions in collaboration with underground storage owners to prevent or reduce the leakage of gas within underground storage facilities through their infrastructure and from operation. Measures could include periodic leak inspection and repair work or using work practices and new equipment types to minimise leakage and venting.

8.2.1.3: Assessment made in respect of EN-4

Despite the development of gas reception facilities and underground natural gas storage sites aiding transition to a low carbon economy, in line with the AoS objective, the releases of methane from venting and flaring could lead to a direct increase in GHG emissions throughout all time scales (commissioning, decommissioning and maintenance operations). With mitigation in place, as described above, it is likely that effect will be reduced to minor negative in line with the target of reducing carbon emissions to Net Zero by 2050.

Taking this into account, Table 8-2 provides the assessment of EN-4 with minor negative effects predicted in the short, medium and long term reflecting the residual emissions from underground natural gas storage and natural gas facilities.

Table 8-2 - Reducing Carbon emissions to Net Zero Objective Summary

AoS Objective	**Technology**	**Assessment of non-generic effects (by timescale)**		
		S	**M**	**L**
Consistent with the national target of reducing carbon emissions to Net Zero by 2050 Guide questions: • Reduce carbon emissions of the national portfolio of major energy infrastructure? • Reduce direct and indirect emissions of all greenhouse gases, including carbon dioxide, during construction, operation and decommissioning? • Maximise supply of energy from low carbon/renewable energy sources / use of low carbon/renewable energy? • Maximise opportunities for making use of waste heat? • Use negative carbon emissions to offset residual emissions from energy such as Bioenergy with Carbon Capture & Storage (BECCS) and Nature Based Solutions? • Create new carbon sinks/removals through natural sequestration including that provided by green Infrastructure and soils and protection of key habitats which contribute to carbon sequestration?	**Gas Reception Facilities**	-	-	-
	Underground Natural Gas Storage	-	-	-

8.2.2: AoS Objective 3: Enhance biodiversity, promoting net gain, and supporting ecosystem resilience and functionality

8.2.2.1: Anticipated Effects

Underground Natural Gas Storage (Disposal of Brine)

Underground storage of gas within salt strata is identified within EN-4 as having the potential for aquatic ecological impacts from the disposal of large quantities of brine (water with a high saturation level of salt) to the sea/estuary. Gas is stored within specially created caverns, created through the solution mining of the salt using water. The resulting saltwater must be disposed of to a suitable location with enough energy to ensure effective mixing and dilution. Brine is denser than seawater and freshwater, and will sink to the bottom, impacting on benthic communities and bottom feeding fish and other species. Whilst fish can avoid these areas, benthic communities may not be able to due to limited mobility, and exposure to plumes of highly saline water could lead to death or injury16. The saltwater plume may also act as a physical barrier to fish migration. These effects will be temporary (short-term), occurring throughout the duration of the solution mining activity although recovery of the benthic communities is likely to take longer.

LNG Import Facilities (Dredging)

EN-4 identifies that dredging, required to maintain declared depths and to deepen waters to accommodate large LNG tanker deliveries, may have specific effects on the biodiversity of local marine, coastal and estuarine environments, particularly fish and bird life. EN-4 also recognises that the deposition of the dredging spoil must be undertaken responsibly.

The specific effects of dredging identified within EN-4 include the smothering of nearby habitats and benthic communities, increased suspended solids and contaminant release. Aquatic vegetation and invertebrates provide valuable food sources for fish and birds. If these sources are affected, impacts to the populations of the species that feed on them are also likely. Increases in suspended solids within the water have the potential to impact on fisheries, leading to the migration of fish. Disturbed sediments may also release contaminants into the water, which can also impact on biodiversity.

The cessation of dredging operation in the long-term may also affect the local coastal environment, and the ecology it supports, with either positive or negative effects on ecosystems which have become accustomed to the influences of dredging operations.

Gas and Oil Pipelines

EN-4 notes that the construction of pipelines can effect the ecology, with regard the effect on upon habitats within and adjacent to the pipeline route, such as grasslands, field boundaries (hedgerows, hedgebanks, drystone walls, fences), trees, woodlands, and watercourses.

The working width of the pipeline will vary depending on the surrounding terrain. Temporary impacts could include large excavations where deep pits are needed for boring beneath rivers, roads, and sensitive features.

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[16] *Appendix N of the King Street Gas Storage Project (Pipelines) - Addendum to the Statement to Inform an Appropriate Assessment (Appendix N), July 2008.*

8.2.2.2: Approach to Development and Mitigation in EN-1 and EN-4

Underground Natural Gas Storage (Disposal of Brine)

EN-1 notes the requirement for an ES. The ES should include measures to dispose of brine which mitigate its potential adverse environmental effects. Where pipelines are required to carry the brine away, these should be located outside of source protection zones 1 and 2. If it is not possible to avoid these zones, the applicant will need to demonstrate the use of best available techniques for pollution prevention (details of pollution control regimes are set out in EN-1).

EN-4 notes that, wherever possible, measures should include disposing of the brine for commercial use by industry so that mineral resources are used sustainably. Applicants should only propose disposing of brine to an underground reservoir (for example, a disused salt mine) or to the sea as a last resort where there is no practical option for re-use.

Where the proposed development involves any discharges to water bodies, including to groundwater or to the sea, the EA should be contacted early in the process, at or before the pre-application consultation stage, to discuss the requirements (including the information required from the applicant).

EN-1 notes that issues relating to discharges or emissions from a proposed project and which lead to other direct or indirect impacts on terrestrial, freshwater, marine, onshore and offshore environments, or which include noise and vibration may be subject to separate regulation under the pollution control framework or other consenting and licensing regimes. EN-4 notes that measures to discharge brine into an underground reservoir or the sea, where either is an appropriate course of action, will need to be covered by environmental permits or discharge consents.

Taking account of these and any EA advice, the Secretary of State should consider whether any mitigation measures are necessary by way of requirements in the development consent order. Where the brine is discharged to the sea, for example, these could relate to the siting offshore of the outflow pipe (to reduce impact on sensitive flora and/or fauna) and the rate of discharge (to reduce saline concentration levels).

LNG Import Facilities (Dredging)

EN-4 notes that the applicant should include an assessment in the ES (see Section 4.2 of EN-1) of the dredging required (a) to construct the LNG import facility and (b) to maintain an access channel or berth integral to the facility. The assessment should take into account the magnitude and frequency of dredging and the method selected.

The ES is required to set out any effects on designated sites, protected species and on other biodiversity afforded conservation priority. Where relevant, applicants are required to undertake sediment transfer modelling to predict and understand impacts and help identify relevant mitigating or compensatory measures. The assessment should include the effects on water quality and resources, and on coastal change.

EN-4 requires the applicant to assess the scope for mitigating impacts such as by avoiding dredging at certain times of the year or using methods to reduce sediment suspension and uncoordinated dispersal.

In addition, it is noted that the applicant should be careful to identify the effects on Marine Conservation Zones and designated protected areas. Applicants should consult the Marine Management Organisation (MMO) at an early stage about this.

EN-4 identifies that the applicant should propose appropriate mitigation measures to address the adverse effects of dredging, including the demonstration that best practices will be

followed during construction and operation to avoid or minimise risk of disturbance or damage to species and habitats.

Gas and Oil Pipelines

EN-1 recognises that careful siting and use of appropriate technologies can help to mitigate adverse impacts on the environment. Applicants are required to demonstrate how the design process was conducted and how it evolved. Where several different designs were considered, the applicant should explain why the favoured choice was selected. This may offer scope for avoidance and mitigation of impacts on biodiversity assets at the design stage. EN-1 suggests that that development proposals provide opportunities for building in beneficial biodiversity features as part of good design, which can offer opportunities to deliver biodiversity net gain. To aid this, EN-1 requires that the Secretary of State should maximise opportunities for biodiversity within developments, using planning obligations.

EN-1 ensures that any proposals for energy generating infrastructure are subject to robust consideration by requiring that they are accompanied by and Environmental Statement (ES) (under the Infrastructure Planning Regulations 2017), which describes the significant likely effects of the proposal on the environment, including specific reference to biodiversity. Through this requirement, EN-1 ensures that the direct, indirect, secondary, transboundary and short to long term effects of the development on biodiversity will be considered, as these are requirements in The EIA Regulations. EN-1 suggests that consideration of potential effects should include potential benefits, which include biodiversity net gain.

EN-1 sets out an overarching principle in relation to protecting biodiversity, which is that development should at the very least aim to avoid significant harm to biodiversity interests, including through mitigation and consideration of reasonable alternatives. It is suggested that in cases where significant harm is unavoidable, then appropriate compensation measures should be sought. Where this is not possible, it is suggested that the Secretary of State gives significant weight to any residual harm.

In terms of designations, EN-1 notes that the Secretary of State should ensure that appropriate weight is given to designated sites of international, national and local importance, protected species, habitats and other species of importance for the conservation of biodiversity. At the regional and local scale, EN-1 suggests that Local Nature Reserves and Local Wildlife Sites require due consideration, but given the need for new energy generating infrastructure, these designations should not be used as the sole reason to refuse development consent.

In addition, EN-4 notes that mitigation measures to protect ecology could include reducing the working width required for the installation of the pipeline to reduce the impact biodiversity where it will not be possible to fully reinstate the route. In circumstances where the habitat to be crossed contains ancient woodland, trees subject to a Tree Preservation Order, or hedgerows subject to the Hedgerows Regulations 1997, the applicant should consider whether it would be feasible to use horizontal direct drilling under the ancient woodland or thrust bore under the protected tree or hedgerow and the Secretary of State should consider requiring this, where not included in the proposal.

8.2.2.3: Assessment made in respect of EN-4

Underground Natural Gas Storage (Disposal of Brine)

The creation of underground gas storage caverns within salt strata has the potential for aquatic ecological impacts from the disposal of large quantities of brine. This saltwater is denser than seawater and freshwater and will sink to the bottom impacting on benthic

communities and bottom feeding fish and other species. The saltwater plume may also act as a physical barrier to fish migration. Measures to discharge brine into an underground reservoir or the sea, where either is an appropriate course of action, will need to be covered by environmental permits or discharge consents. Mitigation, such as siting offshore of the outflow pipe and reducing the rate of discharge will reduce the effects. These effects will be temporary (short-term), occurring throughout the duration of the solution mining activity, although recovery of the benthic communities is likely to take longer. However, the application of the discussed mitigation measures will help to reduce the effect.

LNG Import Facilities (Dredging)

The dredging requirements of LNG facilities, to facilitate navigation by large LNG tankers, may have adverse effects on the biodiversity of local marine, coastal and estuarine environments, including the smothering of nearby habitats and benthic communities, increased suspended solids and contaminant release. Even with the use of appropriate mitigation e.g. avoiding dredging at certain times of the year, or using methods to reduce sediment suspension and uncoordinated dispersal, it is likely the dredging activities will have short term adverse impacts on the biodiversity of the aquatic ecology.

The cessation of dredging operation in the long-term may also affect the local coastal environment, and the ecology it supports, with either positive or negative effects on ecosystems which have become accustomed to the influences of dredging operations.

Gas and Oil Pipelines

EN-4 notes that the construction of pipelines can adversely impact on ecology in the short term, with regard the effect upon habitats within and adjacent to the pipeline route, such as grasslands, field boundaries, trees, woodlands, and watercourses. EN-4 notes that mitigation measures to protect ecology could include reducing the working width required for the installation of the pipeline to reduce the impact biodiversity where it will not be possible to fully reinstate the route.

Table 8-3 – Enhancing biodiversity Objective Summary

AoS Objective	**Technology**	**Assessment of non-generic effects (by timescale)**		
		S	**M**	**L**
Enhance biodiversity, promoting net gain, and supporting ecosystem resilience and functionality Guide questions: • Protect and enhance nationally designated sites such as SSSIs and National Nature Reserves, including those of potential or candidate designation? • Protect and enhance valued habitat and populations of protected/scarce species on locally designated sites, including Key Wildlife Sites, Local Wildlife Sites and Local Nature Reserves? • Protect the structure and function/ecosystem processes, including in the marine environment?	**Underground Natural Gas Storage**	-	-	0
	LNG Import Facilities (Dredging)	-	0	0

• Protect and enhance the Nature Recovery Network? • Protect and enhance priority habitats, and the habitat of priority species? • Promote new habitat creation or restoration and linkages with existing habitats? • Protect and enhance the wider green infrastructure network? • Increase the resilience of biodiversity to the potential effects of climate change? • Promote a net gain in biodiversity for any new major infrastructure development?	**Gas and Oil Pipelines**	-	-	0

8.2.3: AoS Objective 6: Protect and enhance the character and quality of the landscapes and townscapes, protect and enhance visual amenity

8.2.3.1: Anticipated Effects

LNG Import Facilities

Effects that are specific to EN-4 include negative landscape and visual effects from permanent above ground infrastructure associated with each element. This is particularly pertinent to LNG facilities that include large scale structures, such as storage tanks.

These effects occur during construction (short-term) and operation (medium-term) but can be reversed in the long-term if decommissioned. The magnitude of these effects will be dependent on the sensitivity of the receiving environment, for example, the negative effects caused by development in AONBs or National Parks are likely to be considered more strategically significant than in a local landscape designation (although this will be an important local consideration for the Secretary of State).

Gas and Oil Pipelines

EN-4 identifies the temporary (short-term) construction effects to specific elements of the landscape within or adjacent to pipeline routes, such as grasslands, field boundaries (hedgerows, hedgebanks, drystone walls, fences), trees, woodlands and watercourses. Medium-term effects are likely with specific elements of the landscape, such as hedgerows and woodlands, as the landscape recovers and the vegetation re-establishes.

EN-4 also identifies limited longer-term effects to landscape from planting restrictions over and immediately adjacent to the pipelines. Other longer-term effects of pipelines include the small structures and indication points necessary to identify the pipeline route and provide it with service access.

8.2.3.2: Approach to Development and Mitigation in EN-1 and EN-4

LNG Import Facilities

EN-1 sets out the generic considerations to be given to landscape and visual impacts. EN-1 suggests that one way to mitigate the landscape and visual effects is to reduce the scale of a development but recognises that this may result in significant operational constraint and

reduction in function, making the development unfeasible. The appearance of some large gas supply infrastructure, such as the large storage tanks required at LNG import facilities, can be improved through countersinking or the use of squat tanks, without any significant operational constraint or reduction in function.

Gas and Oil Pipelines

EN-1 requires the ES to include an assessment of the landscape and visual effects of the proposed route and of the main alternative routes considered.

EN-4 identifies that reducing the working width required for the installation of a pipeline should be considered, where feasible, to reduce effects to the landscape particularly where it is not possible to fully reinstate the route.

EN-4 also identifies that where protected trees and hedgerows are to be crossed, e.g. ancient woodlands, trees subject to Tree Preservation Orders and hedgerows subject to the Hedgerow Regulations 1997, alternative construction methods, such as horizontal directional drilling or thrust bore should be considered.

EN-4 further notes that where it is unlikely to be possible to restore landscape to its original state, the applicant should set out measures to avoid, mitigate, or employ other landscape measures to compensate for, any adverse effect on the landscape.

8.2.3.3: Assessment made in respect of EN-4

Through promoting the expansion of the gas supply infrastructure and gas and oil pipeline infrastructure, EN-4 with EN-1 has the potential for increased strategic negative visual effects on landscape across England and Wales. Although both EN-1 and EN-4 include robust mitigations which will help to minimise negative effects, it is considered that the overall effects are likely to be of minor negative significance for the short and medium-term and unknown for the longer-term, as effects will be dependent on decommissioning and remediation.

LNG Import Facilities

Negative landscape and visual effects from permanent above ground infrastructure are associated to LNG facilities. Whilst mitigation measures are available to reduce the effects, full mitigation of large scale structures can be difficult. Increased negative landscape and visual effects are associated with the construction and operation of LNG import facilities however application of the mitigation discussed within EN-1 and EN-4 will help to minimise negative effects. It is considered that the overall effects are likely to be of minor negative significance for the short and medium-term and unknown for the longer-term, as effects will be dependent on decommissioning and remediation.

It is noted that the conditions that have been set out in EN-4 only provide further context rather than additional conditions to those contained in EN-1.

Gas and Oil Pipelines

Short-term construction effects to specific elements of the landscape within or adjacent to pipeline routes, such as grasslands, field boundaries, trees, woodlands and watercourses have been identified. In most instances it is possible to fully mitigate for these effects. Medium-term effects are likely with specific elements of the landscape, such as hedgerows and woodlands, as the landscape recovers and the vegetation re-establishes. Long term impacts upon the landscape for pipelines are likely to be limited, as once operational the main infrastructure is usually buried.

Table 8-4 – Protect and enhance landscapes Objective Summary

AoS Objective	Technology	Assessment of non-generic effects (by timescale)		
		S	M	L
Protect and enhance the character and quality of the landscapes and townscapes, protect and enhance visual amenity Guide questions: • Support the integrity of any areas designated for landscape value, including in conjunction with the provisions of any relevant Management Plan (e.g. AONB and local landscape designations)? • Conserve and enhance the intrinsic character or setting of local landscapes or townscapes or waterscapes? • Minimise noise and light pollution from construction and operational activities on residential amenity and on sensitive locations, receptors and views? • Conserve, protect and enhance natural environmental assets (e.g. parks and green spaces, common land, woodland / forests etc) where they contribute to landscape and townscape quality?	**LNG Import Facilities**	-	-	0
	Gas and Oil Pipelines	-	-	0

8.2.4: AoS Objective 7: Protect and enhance the water environment

8.2.4.1: Anticipated Effects

Underground Natural Gas Storage

EN-4 identifies that during the construction of an underground gas storage facility in a salt bed or in an aquifer there could be effects on the water environment. The effects depend on the type of storage facility:

- In a salt bed storage construction, there will be a large demand for water. The specific issue to be considered is the abstraction of water to leach the salt caverns. The Secretary of State needs an accurate picture of this to understand the environmental impacts of the proposed underground storage project.
- In the case of aquifer storage, the issue is likely to be the displacement of groundwater. In addition, following solution mining of underground storage caverns, large volumes of 'brine', or water with a high saturation level of salt, require disposal. EN-4 recognises that a more sustainable and practical use should be found for the brine wherever possible, with disposal to underground reservoir (e.g. disused salt mines) or to the sea only as a last resort.

LNG Import Facilities (Dredging)

EN-4 recognises that dredging and the disposal of dredging spoil in coastal and estuarine locations, as required for the operation of LNG facilities, can result in local increases in suspended sediments and the disturbance of potentially contaminated sediments. Impacts on water quality and resource subsequently lead to effects on to fisheries, fish migration and important biodiversity.

No details are provided on the specific effects of disturbing contaminated sediments within EN-4. Direct impacts on water quality tend to rise when sediments are disturbed in the dredge location. The release of heavy metals, hydrocarbons, organo-halogen compounds etc from the sediment into the water column, either by solution or re-suspension of particulate matter can cause toxic effects on aquatic biota. The release of organic wastes can cause localised oxygen depletion of the water, again creating stressful conditions for aquatic biodiversity.

Gas and Oil Pipelines

EN-4 states that constructing pipelines creates corridors of surface clearance and excavation that can potentially affect watercourses, aquifers, water abstraction and discharge points, areas prone to flooding and ecological receptors. Pipeline impacts could include:

- inadequate or excessive drainage;
- interference with groundwater flow pathways;
- mobilisation of contaminants already in the ground;
- the introduction of new pollutants;
- flooding;
- disturbance to water ecology;
- pollution due to silt from construction; and
- disturbance to species and their habitats.

One further specific effect associated with pipelines that is not discussed within EN-4 concerns the abstraction and disposal of water used for hydrostatic testing during commissioning. Although this water can be moved along the pipeline to test different sections, it will often require considerable volumes.

8.2.4.2: Approach to Development and Mitigation in EN-1 and EN-4

Underground Natural Gas Storage

EN-4 refers the applicant to section 5.16 of EN-1 which sets out generic policy on the protection of the water environment during the construction, operation and decommissioning of a project. EN-1 also sets out considerations on the pollution control framework. EN-1 emphasises the need for good design and planning to ensure the efficient use of water, including water recycling.

EN-4 notes that in a salt cavity development, the applicant should provide an assessment of the effect of abstracting water for solution mining on groundwater resources, the natural environment, and the public water supply. The applicant should assess whether water abstraction for the new development is likely to result in the loss or reduction of water available to any licensed or unlicensed groundwater abstractions or ecological receptors such as rivers and wetlands dependent upon groundwater. The applicant should also assess the impact of the mobilisation of salt and other pollutants, with respect to groundwater quality within the ES.

In the case of aquifer storage, EN-4 states the applicant should assess the impact of the displacement of groundwater with respect to its potential interference with groundwater flow pathways, mobilisation of contaminants, flood risk, and potential effects on groundwater dependant ecosystems.

EN-4 confirms that measures to control abstractions and discharges of water are covered by abstraction licences and environmental permits, including appropriate conditions, issued by the Environment Agency.

With regard the removal of brine water, a by-product of the salt cavern gas storage construction, EN-4 notes that where pipelines are required to carry brine away, these should be located outside of source protection zones 1 and 2. If it is not possible to avoid these zones, the applicant will need to demonstrate the use of best available techniques for pollution prevention (details of pollution control regimes are set out in Section 4.12 of EN-1). Wherever possible, measures should include disposing of the brine for commercial use by industry so that mineral resources are used sustainably. Applicants should only propose disposing of brine to an underground reservoir (for example, a disused salt mine) or to the sea as a last resort where there is no practical option for re-use. Where the proposed development involves any discharges to water bodies, including to groundwater or to the sea, the EA should be contacted early in the process, at or before the pre-application consultation stage, to discuss the requirements (including the information required from the applicant).

Similarly, EN-4 confirms that measures to discharge brine into an underground reservoir or the sea, where either is an appropriate course of action, are also required to be covered by Environment Agency permits or discharge consents, and in some cases abstraction licences.

EN-4 suggests specific mitigation measures to reduce the effects of brine discharge to the sea including the siting of the offshore outflow pipe, adjustments to the rate of discharge and reductions in the saline concentration levels.

LNG Import Facilities (Dredging)

EN-4 notes dredging is a licensable activity under Part 4 of the Marine and Coastal Access Act.

EN-4 notes mitigation measures for dredging include the undertaking of sediment transfer modelling to predict and understand the impacts and assist with the identification of further mitigation and compensatory measures. EN-4 further notes avoiding dredging at certain times of the year, using methods to reduce sediment suspension and uncoordinated dispersal and following best practice during construction and operation to avoid or minimise any effects.

The applicant should be careful to identify the effects on Marine Conservation Zones and designated protected areas. Applicants are required to consult the Marine Management Organisation (MMO) at an early stage about this.

Gas and Oil Pipelines

EN-4 notes that impacts during construction should be avoided as far as possible through route selection or mitigated if unavoidable and ground should be reinstated after construction.

EN-4 notes that abstraction and disposal of large volumes of water through hydrostatic testing of pipelines during commissioning may also impact on water quality. Abstraction and discharges are regulated by the Environment Agency, under an abstraction licence and Environmental Permit respectively.

EN-4 notes that where the project is likely to give rise to effects on water quality, for example through siltation or spillages, discharges from maintenance activities or the discharge of disposals such as wastewater or solvents, the applicant should provide an assessment of the impacts within the ES.

The Secretary of State should liaise with the EA over the potential for the new development to result in loss or reduction of supply to any licensed abstraction or unlicensed groundwater abstraction, or any potential interference with current legitimate uses of groundwater or surface waters, taking account of the terms of any relevant environmental permits or any negative effect on a groundwater dependent ecosystem.

Mitigation measures to protect the water environment may include techniques for crossing rivers and managing surface water before and after construction, including restoring vegetation and using sustainable drainage systems to control run-off.

Mitigation measures to protect water quality may include:

- the avoidance of vulnerable groundwater areas or appropriate use of above ground pipeline facilities;
- use of the highest specification pipework and best practice in the storage and handling of pollutants to prevent spillage;
- careful storage of excavated material away from watercourses and facilities for the disposal of sewage and waste;
- use of sustainable drainage systems; and
- careful reinstatement of riverbanks and reed beds.

8.2.4.3: Assessment made in respect of EN-4

There are a number of generic effects on the water environment that are applicable to all energy infrastructure development, including gas supply infrastructure and gas and oil pipelines. The significance of the effects and effectiveness of mitigation depends on the location of development and will need to be evaluated during studies for project level EIAs. The mitigation measures outlined in EN-1 with regard to water quality and resources, including the requirement for an assessment of the impacts of new development on the water environment, should help to minimise negative effects on the water environment.

Underground Natural Gas Storage

Salt cavity development has the potential to negatively effect groundwater resources in the short term (construction). The mobilisation of salt and other pollutants can affect groundwater quality and in the case of aquifer storage, the potential displacement of groundwater can interfere with groundwater flow pathways, mobilisation of contaminants, flood risk, and potential effects on groundwater dependant ecosystems. Measures to control abstractions and discharges of water are covered by abstraction licences and environmental permits,

The disposal of brine water to an underground reservoir or the sea has the potential to impact on water quality. The measures to discharge brine are also required to be covered by Environment Agency permits or discharge consents, and in some cases abstraction licences. In addition, specific mitigation measures to reduce the effects of brine discharge to the sea including the siting of the offshore outflow pipe, adjustments to the rate of discharge and reductions in the saline concentration levels will help to reduce the effect.

With mitigation in place it is likely the potential adverse effects associated with salt cavity development and disposal of brine will be reduced to an acceptable level.

LNG Import Facilities (Dredging)

Dredging and the disposal of dredging spoil in coastal and estuarine locations throughout the operational period of an LNG facility, can result in local increases in suspended sediments and the disturbance of potentially contaminated sediments. Such dredging activities will be licensed under the Marine and Coastal Act. The Marine Licence will recommend mitigation such as avoiding dredging at certain times of the year, using methods to reduce sediment suspension and uncoordinated dispersal and following best practice during construction and operation to avoid or minimise these effects.

With the cessation of dredging operations, after decommissioning, it is likely that water quality will return.

Gas and Oil Pipelines

Constructing pipelines create corridors of surface clearance and excavation that can potentially affect watercourses, aquifers, water abstraction and discharge points and areas prone to flooding during construction (short term). In addition, the abstraction and disposal of large volumes of water through hydrostatic testing of pipelines during commissioning may also impact on water quality. Mitigation measures to protect the water environment may include techniques for crossing rivers and managing surface water before and after construction, including restoring vegetation and using sustainable drainage systems to control run-off, in addition to the mitigation contained within the abstraction licence and Environmental Permit for abstraction and discharges. With the mitigation in place, as detailed in EN-4, it is likely that any short term effects are reduced to minor adverse.

Table 8-5 – Protect and enhance water environment Objective Summary

AoS Objective	**Technology**	**Assessment of non-generic effects (by timescale)**		
		S	M	L
Protect and enhance the water environment Guide questions: Protect ground, surface, estuarine and coastal water quality? Safeguard the availability of water resources (surface and groundwater)? Minimise the use of water resources / water consumption?	Underground Natural Gas Storage	**-**	**0**	**0**
	LNG Import Facilities (dredging)	**-**	**-**	**0**
	Gas and Oil Pipelines	**-**	**0**	**0**

8.2.5: AoS Objective 8: Protect and enhance air quality

8.2.5.1: Anticipated Effects

Gas Reception Facilities

EN-4 notes that there could be specific gas emission impacts associated with gas reception facilities where flaring of gas is used to deal with a continuous stream of low volume waste gas from the processing. The venting of gas may also be undertaken occasionally when there are relatively low volumes of hydrocarbon gas that need to be disposed of safely, usually associated with commissioning, decommissioning and maintenance operations.

8.2.5.2: Approach to Development and Mitigation in EN-1 and EN-4

Gas Reception Facilities

EN-4 notes that the flaring or venting of gas during the operation of a facility is regulated by the Environmental Permitting Regulations (EPR) which are administered by the EA. In addition, it is noted that BEIS is responsible for ensuring that the waste of a national resource (hydrocarbons) through flaring or venting is minimised and applicants should therefore contact BEIS to check if flaring and venting consents are required from that Department.

The ES should include an assessment of the effects of gas emissions on air quality in accordance with EN-1.

EN-4 states that the routine or periodic release of natural gas should be avoided as far as possible, and, where it takes place, its impacts should be minimised, flaring is one way to do this.

EN-4 further notes mitigation measures to minimise the production of waste gas and effects on air quality as including use of emission control measures, the recovery and re-use of waste gas (for example at an LNG facility by exporting it to the low pressure gas network) or by combusting the process gas to reduce greenhouse gas emissions by converting the methane to the less harmful carbon dioxide (flaring). Mitigation measures to reduce the hazards of gas flares to birds could include reducing or shielding light from the flare and/or site during high risk periods.

8.2.5.3: Assessment made in respect of EN-4

Gas Reception Facilities

EN-4 identifies the potential for some adverse effects with regard to air quality due to the need to flare gas at some facilities to deal with a continuous stream of low volume waste gas from processing. The venting of gas may also take place on a less frequent basis. These activities are generally subject to environmental controls to ensure they do not exceed acceptable levels. With mitigation in place e.g. the recovery and re-use of waste gas or flaring, it is likely negative effects will be reduced to acceptable levels, particularly on a local to regional scale.

No specific air quality effects are identified in the short (construction) or long-term (decommissioning).

Table 8-6 – Protect and enhance air quality Objective Summary

AoS Objective	Technology	Assessment of non-generic effects (by timescale)		
		S	M	L
Protect and enhance air quality Guide questions: Minimise emissions of dust and other air pollutants that affect human health or biodiversity? Improve air quality within AQMAs and avoid the need for new AQMAs? Promote enhancements to green infrastructure networks to help improve air quality?	**Gas Reception Facilities**	**0**	**-**	**0**

8.2.6: AoS Objective 9: Protect soil resources and avoid land contamination

8.2.6.1: Anticipated Effects

Gas and Oil Pipelines

New pipelines will be installed in a variety of geological conditions. It will be important for applicants to understand the soil types and the nature of the underlying strata. Underground cavities and unstable ground conditions may present particular risks to pipeline projects. Impacts could include sterilisation of mineral resources or loss of soil quality.

8.2.6.2: Approach to Development and Mitigation in EN-1 and EN-4

Gas and Oil Pipelines

EN-4 states that the applicants should assess the stability of the ground conditions associated with the pipeline route and incorporate the findings of that assessment in the ES as appropriate. Desktop studies, which include known geology and previous borehole data, can form the basis of the applicant's assessment. In addition, sinking new boreholes if necessary to better understand the ground conditions present. The assessment should cover the options considered for installing the pipeline and weigh up the impacts of the means of installation. Where the applicant proposes to use horizontal directional drilling (HDD) as the means of installing a pipeline under a National or European Site and mitigating the impacts, the assessment should cover whether the geological conditions are suitable for HDD.

EN-4 notes that when considering any application where the pipeline goes under a designated area of geological or geomorphological interest, the applicant should submit details of alternative routes, which either bypass the designated area or reduce the length of pipeline through the designated area to the minimum possible, and the reasons why they were discounted.

Applicants are required to consult with the relevant statutory consultees at an early stage.

The Secretary of State should take into account the impact on and from geology and soils when considering a pipeline project. A proposal will be acceptable from the point of view of

soil and geology if the applicant has proposed a route and other measures (if applicable) that either eliminates any adverse impacts on soil and geology or reduces them to an acceptable level, and that the route chosen does not adversely affect the integrity of the pipeline, for example, by increasing materially the risk of fracture or impact on areas of high population. The HSE can advise on the suitability of the pipeline route and on the design of the pipeline.

EN-4 notes that mitigation measures to minimise any adverse effects on soil and geology should include measures to ensure that residual impacts on the surface are minor, for example some differential vegetation growth. Further mitigation measures identified include the appropriate treatment of soil (and in particular topsoil) during site construction and other infrastructure activity) and appropriate soil storage and reinstatement in line with the principles and practices outlined in the Code of Practice for the Sustainable Management of Soils on Construction Sites and the Agricultural Land Classification which provides guidelines on soil handling and restoration criteria and land quality. The Secretary of State may also attach appropriate conditions to the consent.

Other mitigation measures noted include the use of alternative techniques to open-cut trenching, including horizontal directional drilling and other methods of trenchless installation.

8.2.6.3: Assessment made in respect of EN-4

Gas and Oil Pipelines

Through promoting the expansion of the gas supply infrastructure and gas and oil pipeline infrastructure, EN-4 has the potential for specific limited negative effects identified associated with long distance pipelines and the effects on and of the underlying ground conditions.

However, EN-4 includes robust mitigation which will help to reduce negative effects, principally through avoidance of sensitive areas, areas of high risk, areas of mineral resources etc. However, in some instances it may be difficult or impossible to avoid these areas, although alternative mitigation measures are available to address the issues. It is, therefore, considered that the overall effects of EN-4 are likely to be of neutral significance in the short, medium and long-term, throughout all stages of the development. As the significance is dependent on the location of the development and the sensitivity of the receiving environment, some uncertainty exists with regard to the overall significance.

EN-4 also recognises that effects to soils may result in some minor residual effects at the surface, such as differential vegetation growth in the short-term.

Table 8-7 – Protect soil resources and avoid land contamination Objective Summary

AoS Objective	Technology	Assessment of non-generic effects (by timescale)		
		S	M	L
Protect soil resources and avoid land contamination Guide questions: • Assist in facilitating the re-use of previously developed land? • Avoid development upon the best and most versatile agricultural land? • Ensure the protection of soil resources and reduce soil quality degradation? • Seek to remediate contaminated land?	**Gas and Oil Pipelines**	**0**	**0**	**0**

8.3: Cumulative Effects associated with adoption of EN-4

Cumulative effects of construction (e.g. air quality, dust, noise, visual, traffic, socio-economic etc.) may arise with the development of the elements within EN-4 as most will not be developed in isolation, i.e. LNG facility + pipeline, gas receptor facility + pipeline, underground storage facility + pipeline. It is likely that both elements would be constructed within the same timeframe and connecting to each other, resulting in cumulative effects of a temporal and spatial nature.

Similarly, cumulative effects of construction may arise in conjunction with the development of other energy technologies, particularly those contained in EN-2 where pipeline connections may be required to supply new natural gas power stations.

Cumulative effects may also arise due to location/proximity. LNG facilities and gas reception facilities within EN-4 require coastal locations, as may other energy technologies within EN-2, EN-3 and EN-5. Cumulative effects on coastal landscapes and coastal change may arise should energy developments be concentrated in areas that provide the specific requirements of that development. Such effects would be permanent and long-term (until decommissioned), and also difficult to mitigate due to the scale of the energy developments, particularly where LNG facilities are involved.

Cumulative effects of location/proximity may also arise with the underground storage of gas, particularly those within solution mined salt caverns. The presence of suitable rocksalt strata is restricted to a small number of areas within England and Wales and, as such, underground gas storage facilities may be concentrated in specific locations.

8.4: Summary of Key Findings of Appraisal of EN-4

Generally, the development of oil and gas supply infrastructure and gas and oil pipelines has similar effects to other types of energy infrastructure, although due to the linear nature of cross-country, long distance pipelines, effects are often more dispersed and spread across a wider area. For the majority of the AoS objectives, the strategic effects of EN-4 are considered to match those identified in AoS-1.

However, associated with additional detail provided about the technologies in EN-4, non-generic effects were further considered for six AoS objectives (Carbon Emissions,

Biodiversity, Water Environment, Landscape and Townscape, Soil and Air Quality). The non-generic effects have been found to be generally negative across short and medium terms, neutral in the long term.

With regards to GHG emissions minor negative effects are predicted in the short, medium and long term reflecting the residual emissions from underground natural gas storage and natural gas facilities. Biodiversity non-generic negative effects due to disposal of brine from Underground Gas Storage, dredging from LNG Import Facilities and construction of Gas and Oil Pipelines. Large scale structures for LNG Import Facilities may give rise to non-generic negative impacts on Landscape/Townscape. Dredging and disposal of spoils for LNG Import Facilities in coastal and estuarine locations may negatively affect water quality in such locations and Oil and Gas Pipeline construction may negatively affect watercourses, aquifers etc. Air quality may get be negatively affected by venting of gas from Gas Reception Facilities and sterilisation of mineral resources or soil pollution may occur as a result of Gas Pipelines construction and operation.

Uncertainty is associated with this assessment, as at this level of appraisal, actual effects are dependent on the sensitivity of the environment and the location and design of infrastructure.

EN-1 (informed by AoS-1) includes extensive mitigations to ensure these effects are considered by applicants and the Planning Inspectorate when preparing and determining applications. EN-4 (informed by AoS-4) contains a range of technology specific mitigation measures, along with those proposed in EN-1, which seek to address the range of negative effects identified. Nevertheless, it is considered that residual negative, but uncertain, effects will remain in most cases for the six AoS objectives considered.

A summary of the likely non-generic effects arising specifically from gas and oil infrastructure is set out in Tables 8-8 to 8-11:

Table 8-8 - Summary of Key AoS Findings Specific to Underground Natural Gas Storage

AoS Objective	Assessment of non-generic effects (by timescale)		
	S	M	L
1. Consistent with the national target of reducing carbon emissions to Net Zero by 2050	-	-	-
3. Enhance biodiversity, promoting net gain, and supporting ecosystem resilience and functionality	-	-	0
6. Protect and enhance the character and quality of the landscapes and townscapes, protect and enhance visual amenity	-	-	0
7. Protect and enhance the water environment	-	0	0

Table 8-9 - Summary of Key AoS Findings Specific to LNG Import Facilities

AoS Objective	Assessment of non-generic effects (by timescale		
	S	M	L
3. Enhance biodiversity, promoting net gain, and supporting ecosystem resilience and functionality	-	0	0
6. Protect and enhance the character and quality of the landscapes and townscapes, protect and enhance visual amenity	-	-	0
7. Protect and enhance the water environment	-	-	0

Table 8-10 - Summary of Key AoS Findings Specific to Gas Reception Facilities

AoS Objective	Assessment of non-generic effects (by timescale		
	S	M	L
8. Protect and enhance air quality	0	-	0

Table 8-11 - Summary of Key AoS Findings Specific to Gas and Oil Pipelines

AoS Objective	Assessment of non-generic effects (by timescale		
	S	M	L
3. Enhance biodiversity, promoting net gain, and supporting ecosystem resilience and functionality	-	-	0
6. Protect and enhance the character and quality of the landscapes and townscapes, protect and enhance visual amenity	-	-	0
7. Protect and enhance the water environment	-	0	0
9. Protect soil resources and avoid land contamination	0	0	0

8.5: Alternatives Considered in respect of EN-4

As explained in Section 1 of this report, the AoS exercise for the energy NPSs also fulfils the requirements of the Strategic Environmental Assessment (SEA) Regulations (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 Regulations 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”.

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-4 is concerned with the analysis of alternatives to those policies in the NPS suite which are of most relevance directly to new oil and gas infrastructure. Although, as noted above, EN-4 contains information on the new oil and gas infrastructure 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 concentrates on different approaches to reducing or eliminating particular impacts of the technology concerned.

The reasonable alternative considered in the AoS for the 2011 Gas Supply Infrastructure and Gas and Oil Pipeline Infrastructure NPS was:

> (a): the Government would take a strategic view on locations where it is best to develop new oil and gas infrastructure (based on geology, cost, etc) and limit consenting to those areas.

Given the increased complexity of the energy system as proposed in EN-1 with several energy production locations yet unknown, storage facility locations unknown and demand patterns and magnitudes across the country unknown, taking a strategic view on locations to develop and consent new oil and gas infrastructure as set out in EN-4, alternative (a) is no longer considered a reasonable alternative. New oil and gas infrastructure will need to be provided at appropriate locations to connect planned energy production with planned sources of demand where such sources of demand arise. In addition, an attempt to adequately predict the evolution of such a complex and interdependent system could risk security of supply, and also the national target of reducing carbon emissions to Net Zero by 2050 by not allowing optimal connection between production and demand.

Under current conditions, a reasonable alternative to EN-4 would be to only consent new gas infrastructure (gas pipelines and underground gas storage) which can demonstrate that it can convert to a low carbon alternative in future. Broadly speaking, such an alternative would also contribute to achieving the Net Zero aspects of overall NPS policy earlier.

Thus, the reasonable alternative for consideration in the AoS for the Gas Supply Infrastructure and Gas and Oil Pipeline Infrastructure NPS is:

- EN-4 (a): only consent new gas infrastructure (gas pipelines and underground gas storage) which can demonstrate that it can convert to a low carbon alternative in future.

8.6: Appraisal of Alternatives to EN-4

The preferred policy approach (EN-4) was appraised in detail using the AoS framework of objectives in Section 4. The summary of key appraisal findings is set out above.

The scope and methods of appraisal of alternatives are detailed in Section 2 of this report. The strategic alternative identified for Gas Supply Infrastructure and Gas and Oil Pipelines was assessed using Sustainable Development themes that better keep the appraisal at the higher and strategic level. The results are set out below.

Note that in consideration of Alternatives, the assessment is undertaken in comparison to EN-4 and not to each other alternative. As such, the findings of the AoS in respect of EN-4 broadly apply to the alternative identified – the key differentiator being the inclusion or absence of particular aspects related to the Technology and the relative outcomes of such

inclusion or absence. To draw comparison between the alternative and EN-4 on a broad level, the following scale has been used.

Table 8-12 - Differentiator scale for Alternatives

Scale	Description
Large Positive	A materially different positive outcome is anticipated compared to EN-4
Positive	A more positive outcome is anticipated compared to EN-4
Neutral	This alternative is anticipated to have the same outcome as EN-4
Negative	A more adverse outcome is anticipated compared to EN-4
Large Negative	A materially different adverse outcome is anticipated compared to EN-4

8.7: Results of Appraisal of Alternatives to EN-4

The findings of the appraisal of the strategic alternatives for EN-4 are set out below, arranged by Sustainable Development (SD) theme.

The alternative under consideration is:

- EN-4 (a): only consent new gas infrastructure (gas pipelines and underground gas storage) which can demonstrate that it can convert to a low carbon alternative in future.

8.7.1: Climate Change (Net Zero)

Alternative (a), only consenting new gas infrastructure (gas pipelines and underground gas storage) which can demonstrate that it can convert to a low carbon alternative in future, will be beneficial in the medium to longer term from a Net Zero point of view as the facilities switch to store and carry hydrogen instead of natural gas and allow the transition to net zero quicker than that of EN-4.

Headline SD themes	EN-4	Alternative (a)
Climate Change (Net Zero)		**Positive**

8.7.2: Security of Energy Supply

Alternative (a), only consent new gas infrastructure (gas pipelines and underground gas storage) which can demonstrate that it can convert to a low carbon alternative in future, may reduce the number of proposals submitted to the Planning Inspectorate and Secretary of State for gas pipelines and underground gas storage facilities. This is because natural gas pipelines need adaptations to transport hydrogen, in particular to compress the hydrogen to the operating pressure of the pipeline, compressor stations are required along the way. A complete switch to a 100 percent hydrogen pipeline requires installing new and more turbines or motors and more powerful compressors to deliver the three-times higher volume flow of hydrogen compared to natural gas[17]. In addition, with regards to underground storage not all depleted oil or gas fields or man-made salt caverns that are suitable for natural gas are suitable for low carbon alternatives such as hydrogen (for example hydrogen has a

[17] https://www.siemens-energy.com/global/en/news/magazine/2020/repurposing-natural-gas-infrastructure-for-hydrogen.html

smaller molecular size and diffusion rate than that of natural gas and it may therefore leak from depleted oil and gas field storage reservoirs more readily and rapidly than natural gas, in addition not all salt mines and salt caverns are suitable for the storage of hydrogen[18]) As such, the opportunities to develop both gas pipelines and storage facilities will be reduced and likely to result in approval of a smaller total natural gas transport and storage capacity than would be the case with EN-4. This may therefore increase the risk of insufficient natural gas being available to provide energy supply through the transition to a low carbon economy.

Headline SD themes	EN-4	Alternative (a)
Security of Energy Supply		**Large Negative**

8.7.3: Health and Well-Being

Alternative (a), only consent new gas infrastructure (gas pipelines and underground gas storage) which can demonstrate that it can convert to a low carbon alternative in future, will likely have positive effects on health and well-being from decreased air emissions (for example through the need to vent), as there will be less underground natural gas facilities operational due to the incompatibility of some potential natural storage sites to hydrogen1.

Levels of noise at underground natural gas storage facilities during construction and operation will remain, but these are likely to be felt at a smaller number of localities as the number of proposals submitted to the Planning Inspectorate will likely reduce. In addition, landscape and visual effects from pipelines are likely to reduce due to the lesser number of pipelines required.

However, alternative (a) may also increase indirect negative effects on health and well-being on a wider regional and national scale if security of energy supply cannot be maintained, and this has impacts on employment opportunities and economic growth.

Headline SD themes	EN-4	Alternative (a)
Health & Well-Being		**Positive / Negative**

8.7.4: The Economy

Alternative (a), only consent new gas infrastructure (gas pipelines and underground gas storage) which can demonstrate that it can convert to a low carbon alternative in future, may lead to the Planning Inspectorate approving a smaller total of natural gas storage capacity than would be the case with EN-4 (due to incompatibility of some sites to storing hydrogen). This is likely to increase negative effects on the economy if security of energy supply cannot be maintained, and this has impacts on employment opportunities and economic growth.

A reduced natural gas storage capacity is also likely to increase reliance on more expensive energy generating technologies such as nuclear in the transition to a low carbon economy, or require an even faster expansion of renewables that may not be achievable within the required timescales, and therefore potentially increase energy bills to consumers.

Lower potential uptake of decarbonised gas storage is also likely to result in reduced employment opportunities compared with EN-4.

[18] Stone, Veldhuis, Richardson_2009_Underground hydrogen storage in the UK.pdf

Headline SD themes	EN-4	Alternative (a)
The Economy		**Negative**

8.7.5: The Built Environment

Alternative (a), only consent new gas infrastructure (gas pipelines and underground gas storage) which can demonstrate that it can convert to a low carbon alternative in future, is likely to result in fewer applications for both storage sites and the gas pipelines serving them, due to a lower number of suitable sites for both natural gas and hydrogen storage1. As such, there is likely a more positive effect on the built environment as the number of pipelines being constructed is reduced, than would be the case with EN-4.

Headline SD themes	EN-4	Alternative (a)
The Built Environment		**Positive**

8.7.6: The Natural Environment

Alternative (a), only consent new gas infrastructure (gas pipelines and underground gas storage) which can demonstrate that it can convert to a low carbon alternative in future, is likely to result in fewer applications for both storage sites and the gas pipelines serving them, due to a lower number of suitable sites for both natural gas and hydrogen storage1. As such, whilst the effects from construction and operation of pipelines and storage facilities on the natural environment will remain (for example habitat fragmentation, deterioration in soil quality, water quality impacts) they will be felt at a smaller number of localities.

. Headline SD themes	EN-4	Alternative (a)
The Natural Environment		**Positive**

8.8: Summary of Alternatives Findings and Preferred Approach for the NPS

Table 8-13 - Summary of Alternatives Assessment

Headline SD themes	EN-4	Alternative (a)
Climate Change (Net Zero)		**Positive**
Security of Energy Supply		**Large Negative**
Health & Well-Being		**Positive / Negative**
The Economy		**Negative**
The Built Environment		**Positive**
The Natural Environment		**Positive**

Alternative policy (a), only consent new gas infrastructure (gas pipelines and underground gas storage) which can demonstrate that it can convert to a low carbon alternative in future, may lead to fewer applications being presented than would be the case with EN-4. This may therefore reduce employment opportunities and affect the Economy in this part of the energy sector. In addition, alternative (a) is likely to result in approval of a smaller total natural gas transmission and storage capacity than would be the case with EN-4. This may therefore increase the risk of insufficient storage being available to provide electricity supply through the transition to a low carbon economy.

However, the impacts of this alternative on the contribution to Net Zero in comparison with EN-4, could be more positive, where later storing low carbon alternatives, such as hydrogen, occurs.

Because the opportunities to develop storage facilities will be reduced (not all depleted oil or gas fields or man-made salt caverns that are suitable for natural gas are suitable for low carbon alternatives such as hydrogen[19]) it is likely that, alternative (a) will result in positive effects on the build and natural environment. There are also positive effects with regard to air quality from alternative policy (a).

The key difference is that EN-4 is more likely to give confidence to developers to come forward with planning applications which if approved will contribute to security of supply and affordability, whereas alternative (a) may compromise security of supply and affordability and lead to adverse economic effects. Accordingly, the policies set out in the revised EN-4 are preferred.

[19] Stone, Veldhuis, Richardson_2009_Underground hydrogen storage in the UK.pdf

9: Assessment for Electricity Networks Infrastructure EN-5 (AoS-5)

9.1: The NPS for Electricity Networks Infrastructure

The NPS for Electricity Network Infrastructure (EN-5) in conjunction with the Overarching NPS for Energy (EN-1) sets out the relevant planning factors that should be considered by the Secretary of State when determining whether development consent should be granted for a proposed scheme.

As for EN-1, EN-5 has been developed via an iterative process, taking account of the appraisal of the predicted sustainability effects both for EN-5 preferred polices and reasonable alternatives.

9.2: Appraisal Findings for EN-5

Electricity networks infrastructure may have various impacts on communities and the environment depending on the nature of the development and its location. As noted in EN-5, all of the generic impacts detailed in EN-1 are likely to be relevant to electricity network infrastructure, even if only during specific stages of the development (such as construction), or at one specific part of the development (such as a substation).

While reference should be made to AoS-1 for consideration of all effects in full, this AoS-5 focuses on those potentially significant sustainability effects associated with the technologies set out in EN-5. The effects considered relate to:

- Reducing Carbon to Net Zero (with regard SF6);
- Biodiversity and Geological Conservation;
- Landscape and Visual;
- Noise and Vibration; and
- Health and Well Being and Safety of all Citizens (including Electro-magnetic fields).

The likely significant effects of the technology specific policies, requirements and guidance in EN-5 have been appraised against the corresponding objectives in the AoS framework as set out in AoS-1.

Section 2.3 of this report explains how the results of the assessment of likely significant effects are shown. For ease of reference, the table is reproduced below.

Table 9-1 - Key to Appraising Significance of Predicted Effects

Likely Significance of Effects		
Significant positive effect likely	**++**	Policy is expected to address an existing sustainability problem or deliver sustainability enhancements, such as substantial environmental net gain above existing/emerging policy.
Minor positive effect likely	**+**	Policy is expected to lead to environmental net gain in line with existing or emerging Government policy OR result in protection and conservation of a sustainability asset (for example, a designated biodiversity site or designated heritage asset).

No effect likely or not applicable	0	No perceptible effects expected, or the objective is not relevant to the part of the NPS being assessed.
Minor negative effect likely	-	Policy is expected to result in adverse effects of a lower magnitude or smaller scale, which can be mitigated through standard measures and best practice.
Significant negative effect likely	--	Policy is expected to result in adverse effects of a greater magnitude or larger scale, which cannot be mitigated OR will require extensive and bespoke mitigation solutions (further studies may be required to identify appropriate solutions).

The appraisal focused on the identification of technology specific effects (non-generic) with consideration of mitigation measures as set out in AoS-1, in order to establish whether additional mitigation would be required as part of AoS-5. It is noted that the initial assessments were undertaken on a draft EN-5 document dated April 2021 and that this resulted in suggestions of additional mitigation (in the form of recommendations, see Appendix E) to be considered in the drafting of EN-5 for public consultation.

An assessment of residual non-generic effects is provided for the EN-5 document as presented for public consultation in the following sections. The likely non-generic effects arising specifically from electricity network infrastructure are presented together with a summary of the residual non-generic effects for each AoS objective over the short, medium and long term. In this context, for the purposes of the appraisal, the “short term” has been defined as the effects arising generally during the infrastructure construction period typically 2-7 years (different technologies have different construction times); the “medium term” as typically between 5 and 30 years (operational lifetimes vary with the characteristics of different technologies); and the “long term” as beyond 30 years (and including decommissioning where relevant).

In addition, consideration is given to the cumulative effects associated with the adoption of EN-5.

9.2.1: AoS Objective 1: Consistent with the national target of reducing carbon emissions to Net Zero by 2050

9.2.1.1: Anticipated effects

In order to decarbonise electricity generation, it is essential that physical infrastructure of the energy system and networks are fit for the low carbon transition. Electricity networks are needed to connect the output of other types of electricity infrastructure with consumers and with each other. Therefore, as new generation, storage and interconnection facilities are built, the need to build the electricity networks that connect these sources of electricity with each other, and with centres of consumer demand will increase.

Due to the significant number of additional connections to the electricity grid that are required with this transition to Net Zero, there is also a rise in the number of electrical switches and circuit breakers that are needed to prevent serious accidents. Collectively, these safety devices are called switchgear. The vast majority use Sulphur Hexafluoride (SF6) gas to quench arcs and stop short circuits.

EN-5 notes that SF6 is an extremely potent and persistent greenhouse gas that is primarily utilised as an electrical insulator. SF6 has the highest global warming potential (GWP) of any known substance. It is 22,800 times more warming than CO_2.

Across the entire UK network of power lines and substations, there are around one million kilograms of SF6 installed. A study from the University of Cardiff found that across all transmission and distribution networks, the amount used was increasing by 30-40 tonnes per year.

This rise was also reflected across Europe with total emissions from the 28 member states in 2017 equivalent to 6.73 million tonnes of CO_2. That's the same as the emissions from 1.3 million extra cars on the road for a year.

The most important means by which SF6 gets into the atmosphere is from leaks in the electricity industry.Whilst it is difficult to quantify the levels of SF6 that enter the atmosphere through leaks from the electricity industry, studies suggests that the UK's use of SF6 has risen in recent years, and leakage levels are over 1%[20].

Unlike CO_2, SF6 emissions can't be sequestered from the atmosphere, so the only option is to eliminate the use of SF6 altogether. Whilst there are other options available, for example G3, Airplus or Clean Air, depending on the circumstance, their use may not be considered appropriate. SF6 may therefore to be required to be replaced, when necessary, on a like for like basis.

EN-5 notes that fugitive emissions from electricity networks infrastructure are an object of increasing environmental concern, especially in light of the UK's commitment to net zero by 2050.

9.2.1.2: Approach to Development and Mitigation as set out in EN-1 and EN-5

EN-5 details that the climate-warming potential of SF6 is such that applicants should, as a rule, avoid the use of SF6 in new developments. However, where no proven SF6-free alternative is commercially available, and where the cost of procuring a bespoke alternative is grossly disproportionate, the continued use of SF6 is acceptable, provided that emissions monitoring and control measures compliant with the F-gas regulations or their successors are in place.

EN-5 notes that the Secretary of State should grant consent for an electricity networks development only if the applicant has demonstrated either that i) the development will not use SF6; or iia) that there is no proven commercially available alternative to the use of SF6, and iib) that a bespoke alternative would be grossly disproportionate in terms of cost, and iic) that emissions monitoring and control measures compliant with the F-gas regulations or their successors are in place.

9.2.1.3: Assessment made in respect of EN-5

In light of the policy in EN-5, the non-generic effects of EN-5 are considered minor negative reflecting residual SF6 emissions from continued use of SF6 where no proven SF6-free alternative is considered appropriate.

Table 9-2 – Reducing Carbon emissions to Net Zero Objective Summary

AoS Objective	Technology	Assessment of non-generic effects (by timescale)		
		S	M	L

[20] Energies | Free Full-Text | Evaluation of SF6 Leakage from Gas Insulated Equipment on Electricity Networks in Great Britain | HTML (mdpi.com)

Consistent with the national target of reducing carbon emissions to Net Zero by 2050 Guide questions: • Reduce carbon emissions of the national portfolio of major energy infrastructure? • Reduce direct and indirect emissions of all greenhouse gases, including carbon dioxide, during construction, operation and decommissioning? • Maximise supply of energy from low carbon/renewable energy sources / use of low carbon/renewable energy? • Maximise opportunities for making use of waste heat? • Use negative carbon emissions to offset residual emissions from energy such as Bioenergy with Carbon Capture & Storage (BECCS) and Nature Based Solutions? • Create new carbon sinks/removals through natural sequestration including that provided by green Infrastructure and soils and protection of key habitats which contribute to carbon sequestration?	Electricity Networks	-	-	-

9.2.2: AoS Objective 3: Enhance biodiversity, promoting net gain, and supporting ecosystem resilience and functionality

9.2.2.1: Anticipated Effects

EN-5 notes that overhead lines are linear in nature and can cover significant distances. As a result, electricity networks infrastructure has the potential to affect designated and non-designated ecology over a large area through, for example, disturbance and habitat loss and fragmentation. When lines are placed underground, to match overhead line performance for a 400kV double circuit as many as twelve separate cables in four separate trenches may be needed, resulting in a cable swathe of up to 40 metres. The volume of spoil excavated for an underground cable where two cables per phase are installed can be some 14 times more than for an equivalent overhead line route21. Vegetation also needs to be cleared along and to the side of trenches to allow for construction and associated access for vehicles. Where electricity lines cross rivers, cables may be placed in ducts on river beds, and any necessary river diversions may result in significant local impacts for aquatic life (fish, otters etc). As a result, the effects of laying underground cables on biodiversity are likely to be more significant than overhead lines, through increased disturbance and habitat loss and fragmentation, issues considered in detail through EN-1.

EN-5 identifies the potential for electricity networks infrastructure to have specific negative effects on biodiversity through bird collisions with overhead transmission lines. This can be a particular issue for large bird species such as swans and geese which sometimes collide with overhead line conductors in poor visibility, resulting in their injury or death. This risk is greater when overhead power lines intersect migration routes and/or the breeding and feeding grounds of bird species. Large raptors sometimes use power lines and pylons as vantage points for hunting, which can also result in electrocution if they touch more than one

[21] National Grid (2009) Undergrounding high voltage electricity transmission: The technical issues.

line at once. Perching birds can be killed as soon as their wings touch energised parts of the infrastructure.

EN-5 also identifies that high voltage lines can generate noise under certain conditions, which could have negative effects on ecology.

9.2.2.2: Approach to Development and Mitigation as set out in EN-1 and EN-5

EN-5 notes that the applicant will need to consider whether the proposed line will cause such problems at any point along its length and take this into consideration in the preparation of the ES. Particular consideration is required to be given to feeding and hunting grounds, migration corridors and breeding grounds, where they are functionally linked to sites designated or allocated under the 'national site network' provisions of the Conservation of Habitats and Species Regulations.

Mitigation has been listed in EN-5 and includes:

- Careful siting of a line away from, or parallel to, but not across, known flight paths can reduce the numbers of birds colliding with overhead lines considerably.
- Making lines more visible by methods such as the fitting of bird flappers and diverters to the earth wire, which swivel in the wind, glow in the dark and use fluorescent colours designed specifically for bird vision can also reduce the number of deaths. The design and colour of the diverters will be specific to the conditions – the line and pylon/transmission tower specifications and the species at risk.
- Electrocution risks can be reduced through the design of crossarms, insulators and the construction of other parts of high voltage power lines so that birds find no opportunity to perch near energised power lines on which they might electrocute themselves.

9.2.2.3: Assessment made in respect of EN-5

EN-5 identifies that birds sometimes collide with overhead line conductors in poor visibility, resulting in their injury or death. Large raptors can also be accidently electrocuted when using power lines and pylons as vantage points to hunt. Mitigation measures for these technology-specific effects include the careful planning and design of overhead power lines so that they avoid migration routes and feeding/ breeding areas as well as providing alternative areas for large raptors to perch.

The significance of the effects identified and the effectiveness of mitigation depend upon the specific sensitivities of the sites together with details of design and site layout. This will be addressed alongside wider effects on ecology during the project level HRA and EIA assessments. There are opportunities to mitigate certain potential negative effects on ecology, for example, project design to avoid sensitive areas, and habitat retention and species protection measures on site. As the nature and significance of effects is dependent on the location of electricity network infrastructure, it is appraised that the non-generic effect of enabling the development of new electricity networks infrastructure on ecology in the short term is minor negative and uncertain. In the medium and long term, the non-generic effects of enabling the development of electricity networks infrastructure as envisaged in EN-5 on biodiversity are appraised as neutral given the mitigation measures available and the detailed policy set out in this respect in EN-1.

Table 9-3 – Enhancing biodiversity Objective Summary

AoS Objective	Technology	Assessment of non-generic

		effects (by timescale)		
		S	M	L
Enhance biodiversity, promoting net gain, and supporting ecosystem resilience and functionality Guide questions: • Protect and enhance nationally designated sites such as SSSIs and National Nature Reserves, including those of potential or candidate designation? • Protect and enhance valued habitat and populations of protected/scarce species on locally designated sites, including Key Wildlife Sites, Local Wildlife Sites and Local Nature Reserves? • Protect the structure and function/ecosystem processes, including in the marine environment? • Protect and enhance the Nature Recovery Network? • Protect and enhance priority habitats, and the habitat of priority species? • Promote new habitat creation or restoration and linkages with existing habitats? • Protect and enhance the wider green infrastructure network? • Increase the resilience of biodiversity to the potential effects of climate change? • Promote a net gain in biodiversity for any new major infrastructure development?	Electricity Networks	-	0	0

9.2.3: AoS Objective 6: Protect and enhance the character and quality of the landscapes and townscapes, protect and enhance visual amenity

9.2.3.1: Anticipated Effects

EN-5 notes that new overhead lines, whether supported by lattice steel towers or monopole structures, can give rise to adverse landscape and visual impacts. These impacts depend on the type, scale, siting, and degree of screening of the lines, as well as the characteristics of the landscape and local environment through which they are routed.

New substations, sealing end compounds, and other above-ground installations that serve as connection, switching, and voltage transformation points on the electricity network may also give rise to adverse landscape and visual impacts.

EN-5 details that cumulative adverse landscape and visual impacts may arise where new overhead lines are required along with other related developments such as substations, wind farms, and/or other new sources of generation

These effects occur during construction for overhead lines (short-term) and with ongoing effects during operation (medium-term). These effects may be reversed in the long term if the infrastructure is decommissioned. For underground lines, negative effects are likely during construction and are therefore short-term.

It is likely that the need to connect sources of supply in remote or otherwise rural areas (notably wind farms) will result in a need for many new transmission and distribution lines to cross open country. The magnitude of the effects noted above in this and other contexts is dependent on the sensitivity of the receiving environment, for example, the effects caused by development in AONBs or National Parks are likely to be considered more strategically significant than effects on a non-designated agricultural area. The development of overhead transmission systems in particular (which unlike overhead lines of 132kV and below generally require to be supported on steel towers) adds an industrial element to the landscape. Natural, unspoilt environments and landscape have been identified as primary drivers of tourism. In areas where employment and the economy relies on tourism from the natural environment and its scenery, there is a concern that negative impacts may occur that are considered to be of local and wider, regional significance. Overhead towers may also impact on scenic waterways and cumulative landscape and townscape effects can occur where new overhead lines are required alongside energy infrastructure and related developments, such as substations.

9.2.3.2: Approach to Development and Mitigation as set out in EN-1 and EN-5

The existing planning regime for electricity networks infrastructure includes requirements under EIA regulations for assessment of visual impacts and use of the Guidelines for the Routeing of new overhead lines (The Holford Rules) and the Guidelines for the design and siting of substations (The Horlock Rules) which tend towards mitigation of adverse visual impacts.

While it is the position of EN-5 that overhead lines should be the default option for electricity networks development, in certain cases overhead lines will be unacceptable in planning terms. Specifically, where a route crosses part of a nationally designated landscape (a National Park or AONB), and mitigation or re-routing to avoid harm to that landscape is not feasible, then the starting point will be that a developer should underground that section of the line. However, undergrounding will not be required where doing so is not reasonably feasible in engineering terms, or where the harm caused by undergrounding is not outweighed by the visual impact/landscape benefits.

In addition to good design in accordance with the Holford and Horlock rules, EN-5 notes the consideration of undergrounding or rerouting the line, the principal opportunities for mitigating adverse landscape and visual impacts of electricity networks infrastructure are:

- consideration of network reinforcement options (where alternatives exist) which may allow improvements and/or extensions to an existing line rather than the building of an entirely new line; and
- selection of the most suitable type and design of support structure in order to minimise the overall visual impact on the landscape. In particular, ensuring that lattice steel towers are of the smallest possible footprint and internal volume.
- The rationalisation, reconfiguration, and/or undergrounding of existing electricity networks infrastructure in the vicinity of the proposed development.

Additionally, there are more specific measures that might be taken, and which the Secretary of State could mandate through DCO requirements if appropriate, as follows:

- Landscape schemes, comprising off-site tree and hedgerow planting, are sometimes used for larger new overhead line projects to mitigate potential landscape and visual impacts, softening the effect of a new above ground line whilst providing some screening from important visual receptors. These may be implemented with the agreement of the relevant landowner(s), or the developer may compulsorily acquire the land in question. Advice from the relevant statutory authority may also be needed.

- Screening, comprising localised planting in the immediate vicinity of residential properties and principal viewpoints can also help to screen or soften the effect of the line, reducing the visual impact from a particular receptor.

EN-5 notes where landscape schemes and/or screening mitigation of the kind described above is required, rights over the land necessary for such measures may be compulsorily acquired as part of the development's consent order. In addition, EN-5 recognises that since long-term management of the selected mitigation schemes is essential to their mitigating function, a management plan, developed at least in outline at the conclusion of the examination, should secure the integrity and benefit of these schemes and uphold the landscape commitments made to achieve consent, alongside any pertinent commitments to environmental and biodiversity net gain.

9.2.3.3: Assessment made in respect of EN-5

Through facilitating the expansion of the electricity grid, EN-1 has the potential for increased strategic negative visual effects on landscape and townscape across England and Wales. However, even if some undergrounding takes place on a case by case basis, and/or overhead line routes otherwise avoid nationally designated landscapes, the development of transmission networks through EN-5 is likely to have significant negative non-generic effects for landscape, potentially including indirect impacts on the tourist economy at local and regional scales. Therefore, the overall non-generic effect is likely to be major negative in the short, medium and longer term, despite the inclusion of robust mitigations which will help to minimise negative effects in both EN-1 and EN-5.

Table 9-4 – Protect and enhance landscapes Objective Summary

AoS Objective	Technology	Assessment of non-generic effects (by timescale)		
		S	M	L
Protect and enhance the character and quality of the landscapes and townscapes, protect and enhance visual amenity Guide questions: • Support the integrity of any areas designated for landscape value, including in conjunction with the provisions of any relevant Management Plan (e.g. AONB and local landscape designations)? • Conserve and enhance the intrinsic character or setting of local landscapes or townscapes or waterscapes? • Minimise noise and light pollution from construction and operational activities on residential amenity and on sensitive locations, receptors and views? • Conserve, protect and enhance natural environmental assets (e.g. parks and green spaces, common land, woodland / forests etc) where they contribute to landscape and townscape quality?	Electricity Networks	--	--	--

9.2.4: AoS Objective 11: Improve health and well-being and safety for all citizens and reduce inequalities in health

9.2.4.1: Anticipated Effects

EMFs are produced by overhead power lines and these can have direct and indirect effects on human health. The direct effects occur in terms of impacts on the central nervous system resulting in its normal functioning being affected. Indirect effects occur through electric charges building up on the surface of the body producing a microshock on contact with a grounded object, or vice versa.

There is also a history of concern around the negative health effects of human exposure to EMFs, which can potentially lead to anxiety for some members of the population. However, as discussed in EN-5, the balance of scientific evidence over several decades of research has not proven a causal link between EMFs and cancer or any other disease.

EN-5 notes that the Department of Health and Social Care's Medicines and Healthcare Products Regulatory Agency (MHRA) does not consider that transmission line EMFs constitute a significant hazard to the operation of pacemakers.

In addition, EN-5 notes the potential for noise effects from high voltage transmission lines. The highest noise levels generated by a line generally occur during rain. Water droplets may collect on the surface of the conductor and initiate corona discharges with noise levels being dependent on the level of rainfall.

Audible noise effects can also arise from substation equipment such as transformers, quadrature boosters and mechanically switched capacitors. Transformers are installed at many substations and generate low frequency hum.

9.2.4.2: Approach to Development and Mitigation as set out in EN-1 and EN-5

To prevent the known effects of EMFs, the International Commission on Non-Ionizing Radiation Protection (ICNIRP) developed health protection guidelines in 1998 for both public and occupational exposure. Government policy is that exposure of the public should comply with the ICNIRP (1998) guidelines. The electricity industry has agreed to follow this policy. EN-5 states that applications should show evidence of this compliance.

The Applicant should have considered the following factors:

- height, position, insulation and protection (electrical or mechanical as appropriate) measures subject to ensuring compliance with the Electricity Safety, Quality and Continuity Regulations 2002;
- that optimal phasing of high voltage overhead power lines is introduced wherever possible and practicable in accordance with the Code of Practice to minimise effects of EMFs; and
- any new advice emerging from the Department of Health and Social Care relating to Government policy for EMF exposure guidelines.

However, where it can be shown that the line will comply with the current public exposure guidelines and the policy on phasing, no further mitigation should be necessary.

EN-5 notes that where EMF exposure is within the relevant public exposure guidelines, re-routeing a proposed overhead line purely on the basis of EMF exposure, or undergrounding a line solely to further reduce the level of EMF exposure are unlikely to be proportionate mitigation measures.

With regard noise, EN-5 notes that the assessment of noise from substations, standard methods of assessment and interpretation using the principles of the relevant British Standards are satisfactory.

For the assessment of noise from overhead lines, the Applicant must use an appropriate method to determine the sound level produced by the line in both dry and wet weather conditions, in addition to assessing the impact on noise-sensitive receptors. For instance, the Applicant may use an appropriate noise modelling tool or tools for the prediction of overhead line noise and its propagation over distance. When assessing the impact of noise generated by overhead lines in wet weather relative to existing background sound levels, the Applicant should consider the effect of varying background sound levels due to rainfall. The Secretary of State is likely to regard it as acceptable for the Applicant to use a methodology that demonstrably addresses these criteria.

Typical mitigation measures are noted as being:

- the positioning of lines to help mitigate noise;
- ensuring that the appropriately sized conductor arrangement is used to minimise potential noise;
- quality assurance through manufacturing and transportation to avoid damage to overhead line conductors which can increase potential noise effects;
- ensuring that conductors are kept clean and free of surface contaminants during stringing/installation; and
- the selection of the quietest cost-effective plant available.

In addition, the ES should include information on planned maintenance arrangements. Where detail is not included, the Secretary of State should consider stipulating appropriate maintenance arrangements by way of requirements attached to any grant of development consent.

9.2.4.3: Assessment made in respect of EN-5

The effect of EMFs on health and wellbeing is considered to be neutral across the short, medium and long term as mitigations are provided in EN-5, including requiring the application of international guidelines on non-ionizing radiation (ICNIRP).

Noise from overhead lines is unlikely to lead to the Secretary of State refusing an application, but it may need to consider the use of appropriate requirements in the DCO to ensure noise is minimised as far as is practicable as set out in EN-1. As such, noise from overhead lines is considered to have a neutral non-generic effect on the health and well-being of citizens.

Table 9-5 – Improve health and well-being objective Summary

AoS Objective	**Technology**	**Assessment of non-generic effects (by timescale)**		
		S	**M**	**L**
Improve health and well-being and safety for all citizens and reduce inequalities in health Guide questions:	Electricity Networks	**0**	**0**	**0**

• Protect the health of communities through prevention of accidental pollutant discharges, exposure to electric and magnetic fields, shadow flicker or radiation? • Minimise nuisance on communities and their facilities including air, noise and light pollution? • Provide for facilities that can promote more social interaction and a more active lifestyle and enjoyment of the countryside and coasts? • Promote initiatives that enhance safety and personal security for all?				

9.3: Cumulative Effects associated with adoption of EN-5

Cumulative effects have been considered during the AoS-5 appraisal and noted where relevant under each topic. The following summarises the cumulative effects identified for EN-5:

- **Climate change (Net Zero) effects**: Through helping to facilitate the delivery of low carbon energy, EN-5 will contribute to the UK meeting its renewables targets and minimising greenhouse gas emissions. This is a cumulative effect already considered in AoS-1.
- **Economic effects**: EN-5 is likely to contribute cumulatively to the overall positive effect of the Energy NPS documents for the UK Economy through ensuring a secure supply of energy required by industry and business and in supporting the transition to a low carbon economy. This is a cumulative effect already considered in AoS-1.
- **Landscape, townscape and visual effects**: Negative cumulative landscape and townscape effects, potentially indirectly affecting tourist-dependent economies, can occur where new overhead lines are required alongside energy infrastructure, such as generating stations and related developments, such as substations. These are specific cumulative effects arising from EN-5.

9.4: Summary of Key Findings of Appraisal of EN-5

Generally, electricity networks infrastructure development has similar generic strategic effects to other types of energy infrastructure, although due to the linear nature of electricity lines, effects are often more dispersed and spread across a wider area. For the majority of the AoS objectives, the generic strategic effects of EN-5 are considered to match those generic effects identified in AoS-1.

EN-1 (as informed by AoS-1) includes extensive mitigations to ensure these effects are considered by applicants and the Planning Inspectorate when preparing and determining applications. EN-5 (as informed by AoS-5) contains a range of technology specific mitigation measures, along with those proposed in EN-1, which seek to address the range of non-generic negative effects identified. Nevertheless, it is considered that residual non-generic negative, but uncertain, effects will remain in most cases for the three AoS objectives considered (Carbon Emissions, Biodiversity, Landscapes and Townscapes. Health and Well-being effects are considered neutral.

The non-generic effects have been found to be generally negative across short, medium and long terms for all four AoS objectives, with the exception of Biodiversity where non-generic effects were identified only in the short term due to construction activities.

In relation to the national target of reducing carbon emissions to Net Zero by 2050, technology specific effects have been found negative across the short, medium and long term, due to the potentially unavoidable use of SF6 in switchgear.

Significant and ongoing negative technology effects across the short medium and long term are expected in terms of landscape and townscape / visual amenity due to overhead lines.

Regarding health and well-being, negative technology specific effects expected to arise across short, medium of long term, due to potential EMF exposure.

Uncertainty is associated with this assessment, as at this level of appraisal, actual effects are dependent on the sensitivity of the environment and the location and design of infrastructure.

A summary of the likely non-generic effects arising specifically from electricity networks infrastructure is set out in the following Table 9-6.

Table 9-6 - Summary of Key AoS Findings Specific to Electricity Networks

AoS Objective	Assessment of non-generic effects (by timescale)		
	S	M	L
1. Consistent with the national target of reducing carbon emissions to Net Zero by 2050	-	-	-
3. Enhance biodiversity, promoting net gain, and supporting ecosystem resilience and functionality	-	0	0
6. Protect and enhance the character and quality of the landscapes and townscapes, protect and enhance visual amenity	--	--	--
11. Improve health and well-being and safety for all citizens and reduce inequalities in health	0	0	0

9.5: Alternatives Considered in respect of EN-5

As explained in Section 1 to this report, the AoS exercise for the energy NPSs also fulfils the requirements of the Strategic Environmental Assessment (SEA) Regulations 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 Regulations require 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".

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.

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-5 is concerned with the analysis of alternatives to those policies in the NPS suite which are of

most relevance directly to electricity networks infrastructure. Although, as noted above, EN-5 contains information on the electricity networks-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 concentrates on different approaches to reducing or eliminating a particular impact of the technology concerned that experience shows are most objectionable for EN-5, namely adverse landscape and visual impacts.

The reasonable alternatives considered in the AoS for the 2011 Electricity Networks Infrastructure NPS were the following:

> (a): the Government would take a strategic view on locations where it is best to develop electricity network infrastructure and limit consenting to those areas.
>
> (b): adopt a presumption that electricity lines should be put underground (generally, or in particular locations, such as Areas of Outstanding Natural Beauty (AONBs).

Regarding alternative (a) given the increased complexity of the energy system as outlined in EN-1, with several energy production locations yet unknown, storage facility locations unknown and demand patterns and magnitudes across the country unknown, taking a strategic view on locations to develop and consent electricity network as set out in EN-5, alternative (a) is no longer considered a reasonable alternative. Electricity network infrastructure will need to be provided at appropriate locations to connect energy production with sources of demand where such sources of demand arise. In addition, an attempt to adequately predict the evolution of such a complex and interdependent system could risk security of supply, and the national target of reducing carbon emissions to Net Zero by 2050. There is no reasonable alternative in this regard.

Regarding alternative (b), where revised EN-5 policy establishes a strong presumption in favour of electricity networks to be put underground in AONBs and National Parks. Outside of these areas, there is still a strong presumption in favour of overhead lines, with decisions on undergrounding being taken on a case by case basis. A reasonable alternative to EN-5 in this regard would be to adopt a blanket presumption that all electricity lines should be put underground. Broadly speaking, such an alternative would be aimed at eliminating landscape and visual impacts of overhead lines through a presumption of undergrounding.

Thus, the reasonable alternative for consideration in the AoS for the Electricity Networks Infrastructure NPS is:

- EN-5 (a): adopt a blanket presumption that all electricity lines should be put underground.

9.6: Appraisal of Alternatives to EN-5

The preferred policy approach (EN-5) was appraised in detail using the AoS framework of objectives in Section 4. The summary of key appraisal findings is set out above.

The scope and methods of appraisal of alternatives are detailed in Section 2 of this report. The strategic alternative identified for Electricity Network infrastructure was assessed using Sustainable Development themes that better keep the appraisal at the higher and strategic level. The results are set out below.

Note that in consideration of Alternatives, the assessment is undertaken in comparison to EN-5 and not to each other alternative. As such, the findings of the AoS in respect of EN-5 broadly apply to the alternative identified – the key differentiator being the inclusion or absence of particular aspects related to the Technology and the relative outcomes of such inclusion or absence. To draw comparison between the alternative and EN-5 on a broad level, the following scale has been used.

Table 9-7 - Differentiator scale for Alternatives

Scale	Description
Large Positive	A materially different positive outcome is anticipated compared to EN-5
Positive	A more positive outcome is anticipated compared to EN-5
Neutral	This alternative is anticipated to have the same outcome as EN-5
Negative	A more adverse outcome is anticipated compared to EN-5
Large Negative	A materially different adverse outcome is anticipated compared to EN-5

9.7: Results of Appraisal of Alternatives to EN-5

The findings of the appraisal of the strategic alternatives for EN-5 are set out below, arranged by Sustainable Development (SD) theme.

The alternative under consideration is:

- EN-5 (a): adopt a blanket presume ption that all electricity lines should be put underground.

9.7.1: Climate Change (Net Zero)

The provision of an improved/ upgraded electricity network infrastructure would facilitate the distribution of energy, including from low carbon energy sources. There are potential long term, positive impacts from improving clean energy distribution. These effects are shared by the preferred option, discussed in Section 2.1. However, alternative EN-5 (a) adopting a presumption that all electricity lines should be put underground, would likely result in additional carbon emissions associated with energy intensive excavation and/or tunnelling technologies, with negative long term effects as compared to a preferred approach of selective undergrounding on a case by case basis. As for overhead power transmission, there will also be embodied energy (and carbon) in the material used for construction underground but this is not appraised as significant.

Headline SD themes	EN-5	Alternative (a)
Climate Change (Net Zero)		**Negative**

9.7.2: Security of Energy Supply

Alternative EN-5 (a), adopting a presumption that all electricity lines should be put underground, will facilitate the transmission of energy, including from low carbon sources, and contribute overall to the delivery of secure, clean, affordable energy, with positive long term effects, in line with EN-5. Construction will require the use of raw materials for cabling, tunnelling and supporting infrastructure. Undergrounding will lead to significantly higher material costs given the additional structural requirements when compared with overhead power transmission. Where repairs are required to be undertaken on the underground lines, these can be costly and disruptive, and this can affect the security of supply through lines being out of service for longer periods. These higher financial costs are potentially negative effects against security of supply objectives.

A presumption in favour of undergrounding for all electricity lines is also likely to result in higher generation of waste products from excavation (soil, rocks etc) which will have

accompanying transport and disposal demands. Minor negative effects are possible over all timescales dependent on the location and scope of the transmission requirements.

Headline SD themes	EN-5	Alternative (a)
Security of Energy Supply		**Negative**

9.7.3: Health and Well-Being

Alternative EN-5 (a), adopting a presumption that all electricity lines should be put underground, will lead to minor negative effects for noise objectives throughout the construction phase for electricity line undergrounding. The period of disruption would typically be longer than for equivalent overhead construction given the greater infrastructure demands.

However, noise effects during operation and in the long term are appraised as project level/ local issues. Minor negative effects on air quality are also possible during the construction periods but are appraised as neutral in the medium to long term.

Potential electromagnetic field (EMF) effects arising from overhead lines require appropriate planning and mitigation. For underground lines EMFs are typically more concentrated close to transmission lines but fall away rapidly at a distance from source1. EN-5 requires that the Secretary of State seek evidence of compliance with the International Commission on Non-Ionizing Radiation Protection's guidelines for electric, magnetic and electromagnetic fields. Taking account of the required mitigation, the effects of this option are appraised as neutral in the short, medium and long term.

The option will facilitate the transmission of energy, contributing to the overall security and affordability of supply for all population groups. However, the increased cost of undergrounding is likely to have negative impacts for affordability of electricity supply, especially on the part of the fuel poor. There is potential for the negative impacts of the development/construction phases to be more significant for populations in rural/remote areas, which are forecast to receive additional/new infrastructure to meet the demands of emergent (for example, offshore) technology types. The impacts for equality issues in the context of wider health and safety objectives are therefore appraised as uncertain, due to the negative effects on affordability.

Headline SD themes	EN-5	Alternative (a)
Health & Well-Being		**Positive / Negative**

9.7.4: Economy

Alternative EN-5 (a), adopting a presumption that all electricity lines should be put underground, may contribute positively to economic objectives during the construction and development phases, in line with the preferred approach (EN-5). The is also likely the potential for enhanced employment in the short term through the acceleration of energy infrastructure development.

There is a potential for negative effects on land use and property values and this is likely to be greater where there is a presumption in favour of undergrounding given the higher land take demands and construction footprint (when compared to EN-5). Negative effects will be

most significant during the construction period, particularly given the substantially higher financial costs of undergrounding which may affect deliverability. Undergrounding can also lead to degradation of the quality agricultural land even after mitigation measures are applied, therefore medium to long term effects are likely to be greater than for overhead lines.

Headline SD themes	EN-5	Alternative (a)
The Economy		**Negative**

9.7.5: Built Environment

Alternative EN-5 (a), adopting a presumption that all electricity lines should be put underground, may in the short-term, have significant negative effects for electricity networks through disruption given the higher footprint requirement than overhead power. This may be more significant in rural areas where networks are less extensive, although these effects are appraised as localised and short term. Mitigation at a local level in line with requirements set out in EN-5 would be necessary.

The effect of the excavation for underground lines on soil and surface characteristics is considered under the Natural Environment. A potential consequence of the excavation is that it could alter surface and ground water flows leading to increased risk of both localised and wider regional flood events. The impacts of excavation on surface and groundwater flows may be mitigated by suitable design and construction. Any residual impacts on flood risk could be mitigated through Flood Risk Assessment (FRA) and would be necessary for developments in sensitive locations. Where mitigation is effectively incorporated, long term effects are likely to be neutral.

The effects of undergrounding on archaeology are potentially significant and will depend on the sensitivities of the receiving location. Excavation requirements, and the associated financial costs, are substantially higher than for overhead lines and any negative effects are likely to be long term given the permanence of the structures.

Mitigation measures set out in EN-5, including survey, Environmental Statement and avoidance of designated areas, should address negative impacts. In the long term, however, overall effects are location dependent and therefore uncertain.

A presumption in favour of undergrounding may provide some resilience to the predicted effects of climate change (overhead power lines are more at risk from extreme weather events, Section 2.1), however, undergrounding may also exacerbate localised vulnerabilities to the effects of climate change, for example by altering soil properties and drainage characteristics in flood prone areas. Mitigation measures would be necessary to ensure that undergrounding power lines does not contribute to greater flood risk in the long term.

Overall this alternative supports the distribution of energy, including from low carbon sources with potentially positive effects for climate change objectives in the long term. There is uncertainty given that the overall mix of energy types is not known.

Headline SD themes	EN-5	Alternative (a)
The Built Environment		**Negative**

9.7.6: The Natural Environment

Alternative EN-5 (a), adopting a presumption that all electricity lines should be put underground, has potentially significant negative impacts and effects for ecology in the short, medium and long term, due to direct habitat loss, disturbance and fragmentation. Undergrounding requires a substantially larger footprint than overhead power lines and its effects, for example on the soil and water environment, may have additional indirect negative effects on habitats and species integrity and survival. The disturbance and removal of soil (including when maintenance work is required) will require specific mitigation to prevent overall loss of quality in the long term. The negative effects for ecology are likely for the terrestrial and possibly fluvial environments. In the long term, the effects on mobile species (for example birds) from undergrounding may be less than occur from overhead lines, which can act as obstructions/barriers to migration routes.

The effect of excavation on soil and surface characteristics may also produce effects on surface and ground water flow leading to negative impacts on water quality and resources. Where mitigation is effectively incorporated, long term effects are likely to be neutral. The potential for changes in surface and ground water flow to affect flood risk is considered under the Built Environment theme.

Significant negative effects on both landscape and townscape are possible in the short term during the construction phases for undergrounding. The larger footprint required by undergrounding may enhance these short term negative effects.

A presumption in favour of undergrounding for all electricity lines will have significant positive effects for landscape receptors in the medium to long term by removing long term visual impacts associated with overhead lines. However, the short-term effects from undergrounding on the landscape may be more significant due to the larger construction footprint and disruption of soil.

The effects on the natural environment of undergrounding, or of undergrounding in particular locations (for example AONBs) are therefore considered to be significant and positive for landscape in the medium to longer term, but more likely to lead to negative impacts on ecology, soil and the water environment.

Headline SD themes	EN-5	Alternative (a)
The Natural Environment		**Positive / Negative**

9.8: Summary of Alternatives Findings and Preferred Approach for NPS

Table 9-8 - Summary of Alternatives Assessment

Headline SD themes	EN-5	Alternative (a)
Climate Change		**Negative**
Security of Energy Supply		**Negative**
Health & Well-Being		**Positive / Negative**

The Economy		**Negative**
The Built Environment		**Negative**
The Natural Environment		**Positive / Negative**

Alternative EN-5 (a), adopting a presumption that all electricity lines should be put underground, would likely have minor negative effects compared to the EN-5 policy in relation to the AoS objective for climate change (Net Zero) due to the additional emissions associated with energy intensive tunnelling technologies.

Undergrounding electricity network infrastructure has significantly higher costs than the installation of overhead power lines and this aspect is appraised as having negative effects, which may be cumulative, for security of supply and economic objectives. The increased disruption caused by maintenance and repair can also have effects on security of supply. On affordability and longer term security of supply issues, the preferred option is, therefore, more likely to ensure that the plan is delivered in the timescales necessary to support the transmission of energy supplied.

Undergrounding also demands a substantially higher footprint than overhead lines, and effects on soil, water, and archaeology are all likely to be negative in the short term and will require appropriate mitigation. There is some uncertainty as to the long term effects which will depend on the specific location and the sensitivity of the receiving environment. Significant negative effects in the short term are also appraised for biodiversity objectives, as direct loss and disturbance from extensive linear excavations are likely and will require extensive mitigation measures as detailed in EN-1 and EN-5. In common with the appraisal findings for other elements of the natural environment, the exact nature of the effects and their duration will depend on the specific location and the sensitivity of the receiving environment.

Negative effects of undergrounding all electricity lines on landscape are appraised as short term (construction phase). In the long term, landscape, townscape and visual impacts will be positive given the removal of electricity lines from local and wider population receptors.

Given that underground lines are not without a range of adverse impacts of their own, and that they are significantly more expensive, it is considered better to adopt the policies set out in the revised draft EN-1 and EN-5 and not to prefer presumption in favour of undergrounding for all electricity lines. This is because the range of factors to be taken into account means that any decision to underground is best taken within a more flexible policy framework that follows a case by case evaluation of all of the impacts of a particular project and supports the use of both undergrounding and overhead lines as appropriate, in line with the appraisal findings.

10: Appraisal of Sustainability - Summary of key findings for EN-1 to EN-5

The following section sets out the key findings of the AoS of the draft Overarching Energy NPS (EN-1). As noted previously, recommendations for clarifying and strengthening of the NPS were discussed with BEIS in an iterative fashion. Key findings for the technology specific sustainability effects (relating to EN-2 to EN-5) are also provided in turn.

Note that for all assessments there is uncertainty as to the precise level of effect as this will be dependent upon the precise nature of the energy infrastructure and the area within which it is to be located.

10.1: Overall Summary of AoS Findings for EN-1

The following sets out some key findings from the AoS for EN-1.

- The energy NPSs will be transformational in enabling England and Wales to transition to a low carbon economy and thus help to realise UK climate change commitments sooner than continuation under the current planning system. However, there is also some uncertainty as it is difficult to predict the mix of technology that will be delivered by the market against the framework set by the Government.
- It is important to recognise that EN-1 will still generate residual carbon emissions which will need to be addressed if the Government target of Net Zero by 2050 is to be met. It should also be recognised that some climate change is inevitable and as such, there is a need for energy infrastructure to be resilient to climate change – the NPS sets out a clear and robust approach for ensuring this is done.
- The energy NPSs are likely to contribute positively towards improving the vitality and competitiveness of the UK energy market by providing greater clarity for developers. This should improve the UK's security of supply and, less directly through increased economic opportunities for local communities, have positive effects for health and well-being in the medium to longer term through helping to secure affordable supplies of energy and minimising fuel poverty. However, it is to be recognised that in health terms there is the potential for effects to be distributed disproportionally at a local level, with vulnerable groups being potentially susceptible to effects, though these issues can be addressed when details of schemes and their location are known.
- The development of new energy infrastructure, at the scale and speed required to meet the current and future need, is likely to have some minor negative effects on cultural heritage, the water environment, air quality, soils and potentially geodiversity. This is an inevitable reflection of the nature of this largescale infrastructure, the 'footprint', material and resource requirements as well as the construction activities involved to develop these assets. However, the significance of these effects and the effectiveness of mitigation possibilities is largely uncertain at the strategic and non-locationally specific level at which EN-1 to EN-5 are pitched.
- Short-term construction impacts are likely through an increased use of raw materials and resources and negative effects on the economy due to impacts on existing land and sea uses. In general, it should be possible to mitigate satisfactorily the most significant potential negative effects of new energy infrastructure consented in accordance with the energy NPSs, and they explain ways in which this can be done.

- Due to the nature and size of potential schemes (as well as likely potential locations in areas such as coastal areas), opportunities for landscape mitigation will be limited and while EN-1 sets out a robust approach to addressing impacts on landscape, townscape and seascape across the short, medium and long timeframes, significant adverse effects are likely to remain.
- There is potential from construction and operation activities for significant negative effects on biodiversity as a result of EN-1 implementation in the short, medium and long term. However, due to the possibility of enhancement of the natural environment and biodiversity net gains, there is also potential for minor positive effects in the medium to long term.
- The AoS process has provided a series of recommendations which update the approaches outlined in the NPS to ensure that the NPS remains in line with current considerations of sustainability. These recommendations have been addressed where appropriate and incorporated to the NPS.

There may also be cumulative negative effects on biodiversity, landscape, water and air quality, water resources, flood risk, coastal change and health at the regional or sub-regional levels depending upon location and the extent of clustering of new energy and other infrastructure. Proposed energy developments will still be subject to project level assessments, including Environmental Impact Assessment, and this will address locationally specific effects. The energy NPSs set out mitigation for cumulative negative effects by requiring the Secretary of State to consider accumulation of effects as a whole in their decision-making on individual applications for development consent.

Table 10-1 - Summary of key AoS findings for EN-1

AoS Objective	Timescales		
	S	M	L
1. Consistent with the national target of reducing carbon emissions to Net Zero by 2050	+	++	++
2. Maximise adaptation and resilience to climate change	+	++	++
3. Enhance biodiversity, promoting net gain, and supporting ecosystem resilience and functionality	--	-- / +	-- / +
4. Protect and enhance sites designated for their international importance for nature conservation purposes	--	-- / +	-- / +
5. Protect and enhance cultural heritage assets and their settings, and the wider historic environment	-	-	-
6. Protect and enhance the character and quality of the landscapes and townscapes, protect and enhance visual amenity	--	--	--
7. Protect and enhance the water environment	-	-	-
8. Protect and enhance air quality	-	-	-
9. Protect soil resources and avoid land contamination	-	-	-
10. Protect, enhance and promote geodiversity	-	- / +	- / +
11. Improve health and well-being and safety for all citizens and reduce inequalities in health	+	+	+
12. Promote sustainable transport and minimise detrimental impacts on strategic transport network and disruption to basic services and infrastructure	-	+	+
13. Promote a strong economy with opportunities for local communities	- / ++	++	++
14. Promote sustainable use of resources and natural assets	-	0	0 / +

10.2: Summary of AoS findings for each technology specific NPS

The AoS for EN-2 to EN-5 noted additional specific non-generic adverse effects related to individual technologies, over and above those noted within EN-1 as summarised above. For example, in relation to EN-2 it was noted that natural gas electricity generating infrastructure development will have additional considerations in respect of air quality, the water environment, carbon and biodiversity. Similar additional considerations are noted in respect of EN-3, EN-4 and EN-5 (which also noted issues in relation to landscape and health and wellbeing). In all cases, each technology specific EN (2 – 5) notes a range of mitigation measures, which will act to bolster the approaches outlined in EN-1, to reduce the adverse effects of these technology specific issues.

10.2.1: EN-2 Natural Gas Electricity Generating Infrastructure

A summary of the likely non-generic effects arising specifically from natural gas electricity generating infrastructure is set out in the following table.

Table 10-2 - Summary of Key AoS Findings Specific to Natural Gas Electricity Generating Infrastructure

AoS Objective	Assessment of non-generic effects (by timescale)		
	S	M	L
1. Consistent with the national target of reducing carbon emissions to Net Zero by 2050	-	-	-
3. Enhance biodiversity, promoting net gain, and supporting ecosystem resilience and functionality	-	-	0
7. Protect and enhance the water environment	-	-	0
8. Protect and enhance air quality	-	-	0

Key points from the AoS for EN-2 (AoS-2) are:

- Natural gas generating infrastructure development has similar effects to other types of energy infrastructure, resulting from impacts associated with large facilities at single sites; as well as those associated with linear features linked with potential development of CCS infrastructure. Therefore, for the majority AoS objectives, the strategic effects of EN-2 are considered to match those identified in AoS-1.
- However, associated with additional detail provided about the Technologies in EN-2, non-generic effects were considered for four AoS objectives (Carbon Emissions, Biodiversity, Water Environment and Air Quality). The non-generic effects have been found to be negative across short, medium and long terms for all four AoS Objectives linked to construction and operation activities of natural gas generating infrastructure.
- Consistency with the national target of reducing carbon emissions to net zero by 2050 is also considered negative in the long term, reflecting the residual emissions from unabated natural gas plants, unless balanced by negative emissions.
- In the long term, following decommissioning, as discharges and emissions to the air and water would cease, the effect would be neutral for Water Environment and Air Quality.

- It is important to note there is uncertainty over actual effects as this would be dependent upon location and sensitivity of the receiving environment.

EN-1 (informed by AoS-1) includes extensive mitigations to ensure these effects are considered by applicants and the Planning Inspectorate when preparing and determining applications. EN-2 (informed by AoS-2) contains a range of technology specific mitigation measures, along with those proposed in EN-1, which seek to address the range of negative effects identified.

As required by the SEA Regulations, an assessment of reasonable alternatives has also been carried out in respect of EN-2. The two alternatives assessed against EN-2 were:

Plan	Overview
EN-2	EN-2 covers natural gas-fired electricity generating infrastructure over 50 MW electricity generating capacity in England and over 350 MW electricity generating capacity in Wales. EN-1 provides that consent will only be given to new and refurbishing combustion generating stations with a generating capacity at or over 300 MW that are CCR. As a result, EN-2 will consent natural gas-fired electricity generating infrastructure over 50 MW in England that is not CCR, with the CCR requirements only applying at or over 300MW.
Alternative (a)	Only consent low carbon gas plant (i.e. natural gas with CCS or hydrogen-fired)
Alternative (b)	Only consent combustion generation plants which can demonstrate that they are capable of converting to low carbon alternatives in future

The key differences between alternative (a) and EN-2 are:

- materially beneficial for the achievement of Net Zero due to no emissions from unabated gas.
- materially adverse on Security of Supply as reliant on technologies still under development such as Hydrogen and Energy Storage at scale to ensure peak supply and maintain the stability and security of the electricity system.

The key differences between alternative (b) and EN-2 are:

- beneficial for the achievement of Net Zero due by ensuring that no new unabated gas plant is ‘locked-in’ without the capability to convert to low carbon alternatives when ready.
- adverse on Security of Supply, as although it would be less likely to be reliant (than alternative (a)) on yet to be fully proven technologies such as Hydrogen and Energy Storage at scale, there may still be a need for them to ensure peak supply and maintain the stability and security of the electricity system.

It is recognised that alternative (b) could present a more sustainable alternative than the policies set out in EN-1 and EN-2, if implemented in a way which minimises the potential impact on security of supply. As set out in the Energy White Paper, published in December 2020, the government is committed to consult on proposals to update the Carbon Capture Readiness requirements to reflect technological advances, such as conversion to low carbon hydrogen and apply them more broadly, by removing the 300MW threshold and including all combustion technologies within scope. If that consultation leads to changes in the relevant

legal or policy framework then those new requirements will apply and this NPS will be updated to reflect any revised requirements ahead of designation.

10.2.2: EN-3 Renewable Energy Infrastructure

A summary of the likely non-generic effects arising specifically from Renewable Energy infrastructure is set out below.

Table 10-3 - Summary of Key AoS Findings Specific to Biomass and Waste Combustion

AoS Objective	Assessment of non-generic effects (by timescale)		
	S	M	L
1. Consistent with the national target of reducing carbon emissions to Net Zero by 2050	--	--	--
6. Protect and enhance the character and quality of the landscapes and townscapes, protect and enhance visual amenity	-	-	-
8. Protect and enhance air quality	-	-	-
11. Improve health and well-being and safety for all citizens and reduce inequalities in health	-	-	-
15. Promote sustainable use of resources and natural assets	-/+	-/+	-/+

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Table 10-4 - Summary of Key AoS Findings Specific to Offshore Wind

AoS Objective	Assessment of non-generic effects (by timescale		
	S	M	L
3. Enhance biodiversity, promoting net gain, and supporting ecosystem resilience and functionality	--	--	--
6. Protect and enhance the character and quality of the landscapes and townscapes, protect and enhance visual amenity	-	-	-
14. Promote a strong economy with opportunities for local communities	-	-	-

Table 10-5 - Summary of Key AoS Findings Specific to Pumped Hydro

AoS Objective	Assessment of non-generic effects (by timescale		
	S	M	L
3. Enhance biodiversity, promoting net gain, and supporting ecosystem resilience and functionality	-	-	-
6. Protect and enhance the character and quality of the landscapes and townscapes, protect and enhance visual amenity	-	-	-
11. Improve health and well-being and safety for all citizens and reduce inequalities in health	--	--	-
14. Promote a strong economy with opportunities for local communities	-	-	-

Table 10-6 - Summary of Key AoS Findings Specific to Solar Photovoltaic

AoS Objective	**Assessment of non-generic effects (by timescale**		
	S	**M**	**L**
3. Enhance biodiversity, promoting net gain, and supporting ecosystem resilience and functionality	-	-	-
6. Protect and enhance the character and quality of the landscapes and townscapes, protect and enhance visual amenity	-	-	-
11. Improve health and well-being and safety for all citizens and reduce inequalities in health	-	-	-

Table 10-7 - Summary of Key AoS Findings Specific to Tidal Stream Energy

AoS Objective	Assessment of non-generic effects (by timescale		
	S	M	L
3. Enhance biodiversity, promoting net gain, and supporting ecosystem resilience and functionality	-	-	-
6. Protect and enhance the character and quality of the landscapes and townscapes, protect and enhance visual amenity	-	-	-

Key points from the AoS for EN-3 (AoS-3) are:

- Renewable energy infrastructure development has similar effects to other types of energy infrastructure. Solar, biomass or energy from waste facilities will occupy land and as such potentially result in a whole range of terrestrial impacts. Offshore wind will, conversely, have impacts on marine and coastal environments.

- For the majority AoS objectives, the strategic effects of EN-3 are considered to match those identified in AoS-1.
- However, associated with additional detail provided about the Technologies in EN-3, non-generic effects were considered for eight AoS objectives (Carbon Emissions, Biodiversity, Water Environment, Landscape / Seascape, Air Quality, Health, Economy and Resources). The non-generic effects have been found to be generally negative across short, medium and long terms, though there are some elements of positivity in respect of the need to promote sustainable use of resources and natural assets.
- Consistency with the national target of reducing carbon emissions to Net Zero by 2050 is considered significantly negative over the short, medium and long terms reflecting residual emissions from unabated waste combustion plants, in particular if negative emissions technologies are not used.
- Significant effects from renewable technologies can potentially affect biodiversity, landscape/ seascape, noise, commercial fishing, and commercial navigation routes. However, the effects are uncertain at this level of appraisal, as the actual effects are dependent on the sensitivity of the environment and the location and design of infrastructure.
- There are, however, a few positive specific effects associated with the technologies. Positive effects may occur on the fishing industry from offshore wind farms; on biodiversity from solar farms, where land is no longer managed intensively; on biodiversity from pumped hydro storage schemes, as a result of habitat creation and fish re-stocking; and on resources where residues from biomass or energy from plants can be recovered and re-used rather than being sent to landfill.
- Uncertainty is associated with this assessment, as at this level of appraisal, actual effects are dependent on the sensitivity of the environment and the location and design of infrastructure.

As required by the SEA Regulations, an assessment of reasonable alternatives has also been carried out in respect of EN-3. The alternative assessed against EN-3 was: only consent biomass/ waste combustion plant with Combined Capture and Storage (CCS).

The key difference between this alternative and EN-3 would seem to be a beneficial for the achievement of net zero due to reduction of emissions from energy from waste and negative emissions through BECCS. This assessment is highly uncertain and would depend on what happens to the waste if not used within the power sector (as energy recovery from residual waste has a lower greenhouse gas impact than landfill) and the extent to which biomass may be more cost effective in decarbonising other sectors (such as heat and transport) over the long-term.

However, the use of carbon capture and storage with biomass and energy from waste could present a more sustainable alternative than the policies set out in EN-1 and EN-3, if implemented in a way which minimises unintended consequences. As set out in the Energy White Paper, published in December 2020, the government is committed to consult on proposals to update the Carbon Capture Readiness requirements to reflect technological advances, such as conversion to low carbon hydrogen and apply them more broadly, by removing the 300MW threshold and including all combustion technologies within scope. If that consultation leads to changes in the relevant legal or policy framework then those new requirements will apply and this NPS will be updated to reflect any revised requirements ahead of designation.

10.2.3: EN-4 Gas Supply Infrastructure and Gas and Oil Pipelines Infrastructure

A summary of the likely non-generic effects arising specifically from gas and oil infrastructure is set out below.

Table 10-8 - Summary of Key AoS Findings Specific to Underground Natural Gas Storage

AoS Objective	Assessment of non-generic effects (by timescale)		
	S	M	L
1. Consistent with the national target of reducing carbon emissions to Net Zero by 2050	-	-	-
3. Enhance biodiversity, promoting net gain, and supporting ecosystem resilience and functionality	-	-	0
6. Protect and enhance the character and quality of the landscapes and townscapes, protect and enhance visual amenity	-	-	0
7. Protect and enhance the water environment	-	0	0

Table 10-9 - Summary of Key AoS Findings Specific to LNG Import Facilities

AoS Objective	Assessment of non-generic effects (by timescale		
	S	M	L
3. Enhance biodiversity, promoting net gain, and supporting ecosystem resilience and functionality	-	0	0
6. Protect and enhance the character and quality of the landscapes and townscapes, protect and enhance visual amenity	-	-	0
7. Protect and enhance the water environment	-	-	0

Table 10-10 - Summary of Key AoS Findings Specific to Gas Reception Facilities

AoS Objective	Assessment of non-generic effects (by timescale		
	S	M	L
8. Protect and enhance air quality	0	-	0

Table 10-11 - Summary of Key AoS Findings Specific to Gas and Oil Pipelines

AoS Objective	Assessment of non-generic effects (by timescale		
	S	M	L
3. Enhance biodiversity, promoting net gain, and supporting ecosystem resilience and functionality	-	-	0
6. Protect and enhance the character and quality of the landscapes and townscapes, protect and enhance visual amenity	-	-	0
7. Protect and enhance the water environment	-	0	0
9. Protect soil resources and avoid land contamination	0	0	0

Key points from the AoS for EN-4 (AoS-4) are:

- Generally, the development of oil and gas supply infrastructure and gas and oil pipelines has similar effects to other types of energy infrastructure, although due to the linear nature of cross-country, long distance pipelines, effects are often more dispersed and spread across a wider area. For the majority of the AoS objectives, the strategic effects of EN-4 are considered to match those identified in AoS-1 as above.
- However, associated with additional detail provided about the technologies in EN-4, non-generic effects were further considered for six AoS objectives (Carbon Emissions, Biodiversity, Water Environment, Landscape and Townscape, Soil and Air Quality). The non-generic effects have been found to be generally negative across short, medium and long terms.
- With regards to GHG emissions minor negative effects are predicted in the short, medium and long term reflecting the residual emissions from underground natural gas storage and natural gas facilities. Biodiversity non-generic negative effects due to disposal of brine from Underground Gas Storage, dredging from LNG Import Facilities and construction of Gas and Oil Pipelines. Large scale structures for LNG Import]Facilities may give rise to non-generic negative impacts on Landscape/Townscape. Dredging and disposal of spoils for LNG Import Facilities in coastal and estuarine locations may negatively affect water quality in such locations and Oil and Gas Pipeline construction may negatively affect watercourses, aquifers etc. Air quality may be negatively affected by venting of gas from Gas Reception Facilities and sterilisation of mineral resources or soil pollution may occur as a result of Gas Pipelines construction and operation.
- However, the effects are uncertain at this level of appraisal, as the actual effects are dependent on the sensitivity of the environment and the location and design of infrastructure.
- EN-1 (informed by AoS-1) includes extensive mitigations to ensure these effects are considered by applicants and the Planning Inspectorate when preparing and determining applications. EN-4 (informed by AoS-4) contains a range of technology specific mitigation measures, along with those proposed in EN-1, which seek to address the range of negative effects identified. Nevertheless, it is considered that residual negative, but uncertain, effects will remain in most cases for the six AoS objectives considered.

As required by the SEA Regulations, an assessment of reasonable alternatives has also been carried out in respect of EN-4. The alternatives assessed against EN-4 was: only consent new gas infrastructure (gas pipelines and underground gas storage) which can demonstrate that it can convert to a low carbon alternative in future.

The key differences between this alternative and EN-4 are that EN-4 is more likely to give confidence to developers to come forward with planning applications which if approved will contribute to security of supply and affordability, whereas the alternative may compromise security of supply and affordability and lead to adverse economic effects. Accordingly, the policies set out in the revised draft EN-4 are preferred.

10.2.4: EN-5 Electricity Networks Infrastructure

A summary of the likely non-generic effects arising specifically from electricity networks infrastructure is set out in the following table.

Table 10-12 - Summary of Key AoS Findings Specific to Electricity Networks

AoS Objective	Assessment of non-generic effects (by timescale)		
	S	M	L
1. Consistent with the national target of reducing carbon emissions to Net Zero by 2050	-	-	-
3. Enhance biodiversity, promoting net gain, and supporting ecosystem resilience and functionality	-	0	0
6. Protect and enhance the character and quality of the landscapes and townscapes, protect and enhance visual amenity	--	--	--
11. Improve health and well-being and safety for all citizens and reduce inequalities in health	0	0	0

Key points from the AoS for EN-5 are:

- Electricity networks infrastructure development has similar effects to other types of energy infrastructure, although due to the linear nature of cross-country, long electricity lines, effects are often more dispersed and spread across a wider area. Therefore, for the majority of AoS objectives, the strategic effects of EN-5 are considered to match those identified in AoS-1.
- However, associated with additional detail provided about the Technologies in EN-5, non-generic effects were considered for four AoS objectives (Carbon Emissions, Biodiversity, Landscape and Townscape, as well as Health and Wellbeing). The non-generic effects have been found to be generally negative across short, medium and long terms for these AoS Objectives, other than health and wellbeing which is considered neutral.
- In relation to the national target of reducing carbon emissions to Net Zero by 2050, technology specific effects were considered to be negative across the short medium and long term, due to the potentially unavoidable use of SF6 in switchgear.
- Significant and ongoing negative effects across the short, medium and long term are expected in terms of landscape and townscape / visual amenity dur to overhead lines.

- Uncertainty is associated with this assessment, as at this level of appraisal, actual effects are dependent on the sensitivity of the environment and the location and design of infrastructure.

As required by the SEA Regulations, an assessment of reasonable alternatives has also been carried out in respect of EN-5. One alternative was identified and assessed: adopt a blanket presumption that all electricity lines should be put underground.

The key differences between this alternative and EN-5 are:

- adverse for the achievement of Net Zero due to the additional emissions associated with energy intensive tunnelling technologies.
- adverse for the Security of Energy Supply and the Economy due to higher costs and increased disruption for maintenance and repair.

Although undergrounding for all electricity lines will have significant positive effects for landscape receptors in the medium to long term by removing long term visual impacts associated with overhead lines the short-term effects from undergrounding on the landscape may be more significant due to the larger construction footprint and disruption of soil.

Given that underground lines are not without a range of adverse impacts of their own, and that they are significantly more expensive, it is considered better to adopt the policies set out in EN-1 and EN-5. This is because the range of factors to be taken into account means that any decision to underground is best taken within a more flexible policy framework that follows a case by case evaluation of all of the impacts of a particular project and supports the use of both undergrounding and overhead lines as appropriate, in line with the appraisal findings.

11: Cumulative and Transboundary Effects

11.1: Cumulative, Synergistic and Indirect Effects of energy NPSs

It is a requirement to consider cumulative, synergistic and indirect effects of implementation of the energy NPSs. Secondary and indirect effects are effects that are not a direct result of the NPSs, but which occur away from the original effect or as the result of a complex pathway. Cumulative effects arise where several proposals or elements of the NPSs, individually may or may not have significant effect but in-combination have a significant effect due to spatial crowding or temporal overlap. Synergistic effects occur when two or more effects act together to create an effect greater than the simple sum of the effects when acting alone.

As required by the SEA Regulations, cumulative, synergistic and indirect effects have also been considered during the AoS. The identification of these effects already takes into account the fact that earlier recommendations have taken on board to improve the sustainability performance of the NPSs.

Of particular note and a key element to the NPSs is the recognition of the need to reduce GHG emissions in order to help combat climate change. As such, there is a key focus within the NPSs for low or net zero carbon energy generation and transmission. In addition to reducing emissions at source, the NPSs provide for new technologies that will remove carbon emissions and store these (Carbon Capture and Storage). However, given the likely costs associated with the development of such infrastructure and the offshore location for the storage of the captured CO_2, there is likely to be a clustering of installations around strategically located land based transfer stations prior to onward pumping of the CO_2 to offshore head works.

Clustering of installations can have benefits, though also negatives and this is recognised within the NPSs. For example, it is noted in a number of areas that if development consent were to be granted for a number of projects within a region and these were developed in a similar timeframe, there could be short term negative effects. This could be on local economies through impacts of large scale construction activities leading to an influx of workers to an area driving up demand for housing and accommodation and local services. Similarly, this could lead to a shortage of skilled workers in the local area. On the other hand, beneficial cumulative effects could be accrued through increased spend in the local area, as well as increased opportunities for secure and well paid employment and development of skills / training, with potentially beneficial indirect effects on health. Such cumulative effects are more likely to be more pronounced in rural areas. Of course, overall, the NPSs provide a cumulative benefit to the population as a whole by helping to ensure certainty of investment and security of energy supplies that will help provide robust and low cost energy.

As well as cumulative effects on the local and wider population, there can also be effects experienced on environmental issues. Cumulatively this will again be most pronounced where infrastructure is clustered and it is to be noted that it does not all need to be of the same technology – combinations of technologies can act both cumulatively and synergistically together, with effects on landscape being of particular note. Particular significance of these effects would depend on the location of the infrastructure and the sensitivity of the area, but it is to be noted that many of the areas where it could be expected that large scale energy infrastructure may be developed (due for example to the need for large amounts of cooling water), are also frequently the most prized landscapes or seascapes.

Technological drivers are a key consideration in respect of the potential for cumulative effects and the NPSs do place careful emphasis on the need to analyse all such aspects. For example and as noted, many energy installations need availability of large amounts of water resources to meet process water demands and cooling water requirements, as well as suitable discharge locations. They may also require to be located close to ports to receive imported fuel stock and other raw materials and for outward transport of residues to export markets. Renewable technologies are not immune from such demands, which may also lead to clustering of such facilities.

Due to the potential for technological drivers leading to cumulative effects, each of the technology specific EN's were considered for the potential for cumulative effects. Across all technologies it was considered that cumulative effects of construction (e.g. air quality, dust, noise, visual, traffic, socio- economic etc.) may arise with the development of the specific technologies and it is to be recognised that these are not likely to be developed in isolation – for example, within EN-4 (Gas and Oil) an LNG facility will also require a pipeline, gas receptor facility and pipeline, underground storage facility and pipeline. It is likely that both elements would be constructed within the same timeframe and connecting to each other, resulting in cumulative effects of a temporal and spatial nature, though such effects would likely be temporary.

It is also to be recognised that even technologies that could be anticipated to be dispersed and spread across a wider area such as the linear electricity networks noted in EN-5, can have potential for cumulative effects. Such effects can include those relating to landscape and townscape including potentially within areas noted for tourist-dependent economies. Effects could occur where new overhead lines are required alongside energy infrastructure, such as generating stations and related developments, such as substations.

These potential cumulative effects will be felt across a number of AoS objectives in an adverse manner including air quality, water quality, resource use, biodiversity and traffic and transport amongst others. These would for the most part arise during construction and they may be difficult to mitigate. As such, the NPS places careful emphasis for decision makers to balance such competing issues. It also places a strong emphasis on the need for further consideration of all issues and effects (including cumulative effects) through applicable assessment types such as EIA, or through socio-economic assessment.

The NPSs also ensure consideration needs to be made of cumulative effects across the full timescale of the energy infrastructure, through to decommissioning and beyond. It is to be recognised that this could be many decades in respect of some technologies.

In short therefore, while the lack of clarity relating to location of infrastructure means it is not possible to be precise as to cumulative, synergistic and indirect effects, it is possible to conclude that the significance and nature of cumulative effects may vary with the mix of technology projects proposed and the sensitivity of the receiving communities and environment. The NPSs though set out a series of approaches that will address and manage these issues.

11.2: Cumulative effects in-combination with other plans and policies

Cumulative effects can also arise due to effects from the energy NPSs combining with effects from other plans and policies. However, due to the strategic and high level nature of the energy NPSs and the lack of any locational and specific detail on any infrastructure developments that are likely to be brought forward, as well as that inevitably there is going to be a delay between the adoption of the energy NPSs and any subsequent energy infrastructure development, it is not possible to know when (or indeed if) any subsequent

project proposal will come forward and it is not therefore possible to predict what other plans and projects will be relevant to future project assessments.

The type of PPPs that could have cumulative or in-combination effects with infrastructure developed under the NPSs are:

- Applications lodged but not yet determined;
- Projects subject to periodic review;
- Projects authorised but not yet started;
- Projects started but not yet completed;
- Known projects that do not require external authorisation;
- Proposals in adopted plans; and
- Proposals in draft plans formally published or submitted for final consultation, examination or adoption.

Typical types of effects that could lead to cumulative or in-combination effects include (but are not limited to):

- Noise, vibration and light disturbance;
- Air, land and water pollution;
- Changes to water quantity / flow and coastal change;
- Species injury and mortality; and
- Changes in habitat extent, composition and structure.

Such in-combination effects are more likely to arise when multiple projects have similar impacts; due to effects exceeding the limit of what the relevant sustainability parameters can tolerate and becoming significant effects. Note that projects that include non-energy infrastructure development and smaller scale development that is not an NSIP can also lead to cumulative or in-combination effects and should be considered at the appropriate point. In-combination effects can be by virtue of proximity, connectivity and/or timing. The most common combined effects include additive air quality, water quality/quantity and habitat/species disturbance impacts.

11.3: Transboundary effects

Potential transboundary effects from the NPSs have been approached in a similar way to other cumulative effects, only that the assessment looks at effects that originate within the UK but have the ability to extend across national borders. Transboundary effects are addressed through Regulation 14 of the SEA Regulations, which requires notification to Member States of the European Union of any Plan or Programme which is considered likely to have significant effect on the environment of that Member State.

Two types of technology have been considered in this assessment of transboundary effects: nuclear and offshore wind.

Transboundary effects from nuclear power stations are addressed in the AoS of EN-6[22]. Unintended release of radiation from nuclear power stations may result in transboundary effects. In the UK, the nuclear regulatory bodies will need to be satisfied that the radiological

[22] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/47778/1925-appl-of-sust-of-revised-draft-en6.pdf

and other risks to the public associated with accidental releases of radioactive substances are as low as reasonably practicable and within the relevant radiological risk limit. As part of the site licensing process, a potential operator will be required to demonstrate that the nuclear facility is designed and can be operated such that several levels of protection and defence are provided against significant faults or failures, that accident management and emergency preparedness strategies are in place and that all reasonably practicable steps have been taken to minimise the radiological consequences of an accident. The robustness of the regulatory regime surrounding these installations in the UK thus result in a low probability of an unintended release and therefore any significant transboundary effects.

Radioactive releases from nuclear power stations are strictly controlled in accordance with limits laid down in permits issued by the Nuclear Installations Inspectorate and the Environment Agency under the Environmental Permitting (England and Wales) Regulations 2016. This regulatory system ensures that permitted radioactive discharges are within authorised limits. These releases are likely to remain sufficiently localised so as not to impact significantly on neighbouring countries.

Transboundary effects of offshore wind farms have been identified in relation to marine mammals and birds as their movements are independent of national geographical boundaries. The biodiversity assessment for this technology concluded that there are likely significant transboundary effects on these receptors. The HRA concludes that there is potential for adverse effects on European Sites in other nations (transboundary), particularly as a result of offshore wind and coastal development. Therefore, it is considered that Ireland, France, Belgium, Germany, Denmark, Sweden and the Netherlands should be informed of the potential for significant environmental effect from implementation of the NPS. For the same reason there would also be potential effects on Norway and the Crown Dependencies of the Isle of Man and the Channel Islands.

The transboundary effects (if any) of individual proposals for both new nuclear and offshore wind farms will be considered at project-level as part of the development consent process. The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (‘the EIA Regulations’) set out the requirements governing statutory notification and consultation in respect of transboundary effects of projects on EEA States. Regulation 32 of the EIA Regulations establishes the procedural duties necessary where an NSIP is likely to have significant effects on the environment in an EEA State. The duties under Regulation 32 apply until the decision on the DCO is made. As such, identification of the relevant State will be made in light of the technology being developed and the location within which the development is to take place.

12: Monitoring

Monitoring helps to examine the effects predicted through the AoS process against the actual effects of the NPSs when they are implemented. It is also a requirement of the SEA Regulations to describe the measures envisaged concerning how significant effects of implementing the NPS will be monitored – Section 17 (1) notes "the responsible authority shall monitor the significant environmental effects of the implementation of each plan or programme with the purpose of identifying unforeseen adverse effects at an early stage and being able to undertake appropriate remedial action". As ODPM Guidance23 advises, it is not necessary to monitor everything, or monitor an effect indefinitely, but rather monitoring needs to be focused on significant sustainability effects. Monitoring should therefore focus upon significant effects that may give rise to irreversible damage, with a view to identifying trends before such damage is caused, and significant effects where there was uncertainty in the AoS and where monitoring would enable preventative or mitigation measures to be undertaken.

The sustainability effects of the energy NPSs may be monitored through the monitoring frameworks already carried out by the environmental regulators and the local authorities. Pollution control and environmental management monitoring, including status of water quality and resources, protected habitats and species, is carried out by the environmental agencies; human health protection is the responsibility of the health authorities and Public Health England; and the extent of nuclear generating activities will be monitored through the nuclear licensing procedures. Local Planning Authorities monitor the effectiveness of their spatial plans, including indicators such as employment and access to community facilities and services. Nationally, Government24 assesses and reports annually on progress against sustainable development indicators (including greenhouse gas and carbon dioxide emissions), energy use (including renewables), and resources (including water).

It is proposed that the effects that should be monitored overall for the energy NPSs are focused on the positive effects predicted for climate change, resources, and economy/skills; and the negative or uncertain effects predicted for landscape/visual amenity and biodiversity.

[23] Practical Guide to the Strategic Environmental Assessment Directive (ODPM, September 2005).
[24] Defra national SD indicators http://www.defra.gov.uk/sustainable/government/progress/national/index.htm

Table 12-1 - Proposed Monitoring

No.	AoS Objective against which a significant effect has been predicted	Monitoring Measure / Indicator	Target	Data Source	Suggested frequency of monitoring	Responsibility for undertaking monitoring
1	Consistent with the national target of reducing carbon emissions to net zero by 2050	CO_2 emissions from energy sector (by source)	Reduce to pathway consistent with Net Zero targets	BEIS: UK greenhouse gas emissions national statistics	Annual	BEIS
		% output from low carbon sources	To be consistent with Net Zero target	BEIS: Digest of UK Energy Statistics (DUKES)	Annual	BEIS
		electricity generation by technology	To be consistent with Net Zero target	BEIS: Digest of UK Energy Statistics (DUKES)	Annual	BEIS
2	Maximise adaptation and resilience to climate change	Area of flood risk (from all sources) constructed upon by new Energy Schemes	Zero	Environment Agency, Local Authorities and Energy Scheme developers (in respect of individual projects)	Annual	Energy Scheme developers (in respect of individual projects) – reporting to BEIS
		Number of new Energy Schemes designed for successful adaptation to climate change	All	Environment Agency, Local Authorities and Energy Scheme developers (in respect of individual projects)	Annual	Energy Scheme developers (in respect of individual projects) – reporting to BEIS
		Number of new Energy Schemes designed to include best practice SuDS (where	Increase	Environment Agency, Local Authorities and Energy Scheme	Annual	Energy Scheme developers (in respect of individual

No.	AoS Objective against which a significant effect has been predicted	Monitoring Measure / Indicator	Target	Data Source	Suggested frequency of monitoring	Responsibility for undertaking monitoring
		appropriate) and / or upstream Natural Flood Management		developers (in respect of individual projects)		projects) – reporting to BEIS
3	Enhance biodiversity, promoting net gain, and supporting ecosystem resilience and functionality	Net Gain in Biodiversity (using the DEFRA metric) due to Energy Schemes	Increase in Biodiversity Net Gain	Natural England, Local Authorities and Energy Scheme developers (in respect of individual projects)	Annual	Energy Scheme developers (in respect of individual projects) – reporting to BEIS
		Number of Energy Schemes with overall adverse impact on sites designated for nature conservation	Year on year decrease	Natural England, Local Authorities and Energy Scheme developers (in respect of individual projects)	Annual	Natural England, Local Authorities and Energy Scheme developers (in respect of individual projects)
		Changes in areas of biodiversity importance (priority habitats and species by type) and areas designated for their intrinsic environmental value including sites of national, regional or sub regional significance	Year on year increase in area (ha)	Natural England, Local Authorities and Energy Scheme developers (in respect of individual projects)	Annual	Natural England, Local Authorities and Energy Scheme developers (in respect of individual projects)
		Area of Green Infrastructure	Year on year increase in area (ha)	Natural England, Local Authorities and Energy Scheme developers (in respect of individual projects)	Annual	Natural England, Local Authorities and Energy Scheme developers (in respect of individual projects)

No.	AoS Objective against which a significant effect has been predicted	Monitoring Measure / Indicator	Target	Data Source	Suggested frequency of monitoring	Responsibility for undertaking monitoring
4	Protect and enhance sites designated for their international importance for nature conservation purposes (linked to separate HRA process for Energy NPS)	Condition of International and or European Sites	Year on year increase in improvement	Natural England, Local Authorities and Energy Scheme developers (in respect of individual projects)	Annual	Natural England, Local Authorities and Energy Scheme developers (in respect of individual projects)
5	Protect and enhance cultural heritage assets and their settings, and the wider historic environment	Number of Heritage assets impacted by new Energy schemes	Reduction in direct impacts	English Heritage, Local Authorities and Energy Scheme developers (in respect of individual projects)	Annual	BEIS
6	Protect and enhance the character and quality of the landscapes and townscapes, protect and enhance visual amenity	Change in the quality of character or status of a designated area	Reduction in direct impacts	Natural England, National Parks and AONB Management Groups, Environment Agency and Energy Scheme developers (in respect of individual projects)	Annual	BEIS
		Changes in settings and views	Reduction in direct impacts	Natural England, National Parks and AONB Management	Annual	BEIS

No.	AoS Objective against which a significant effect has been predicted	Monitoring Measure / Indicator	Target	Data Source	Suggested frequency of monitoring	Responsibility for undertaking monitoring
				Groups, Environment Agency and Energy Scheme developers (in respect of individual projects)		
7	Protect and enhance the water environment	Number of water pollution incidents attributable to the Energy Sector (across all waterbodies)	Zero	Environment Agency, Local Authorities and Energy Scheme developers (in respect of individual projects)	Annual	Energy Scheme developers and Operators (in respect of individual projects / facilities) – reporting to BEIS
8	Protect and enhance air quality	No exceedances of Air Quality Objectives or limit values	Zero	DEFRA / Environment Agency, Local Authorities and Energy Scheme developers and Operators (in respect of individual projects)	Annual	Energy Scheme developers and Operators (in respect of individual projects / facilities) – reporting to BEIS
		Meet Air Quality emission targets	Reduce to emissions consistent with aim to meet emissions targets to Ceiling Directive	BEIS and Energy Scheme developers and Operators (in respect of individual projects).	Annual	Energy Scheme developers and Operators (in respect of individual projects / facilities) – reporting to BEIS
9	Protect soil resources and avoid land contamination	Area (in hectares) of best and most versatile land (BVAL) (grades 1,2 or 3a) included	Year-on-year reduction in the area of BVAL within or impacted by new	Local Authorities and Energy Scheme developers (in respect of individual projects)	Annual	Energy Scheme developers and Operators (in respect of individual

No.	AoS Objective against which a significant effect has been predicted	Monitoring Measure / Indicator	Target	Data Source	Suggested frequency of monitoring	Responsibility for undertaking monitoring
		within or impacted by new Energy Schemes	Energy schemes subject to loss or degraded quality.			projects / facilities) – reporting to BEIS
		Area (in hectares) of previously contaminated land included within or impacted by new Energy Schemes	100% of previously contaminated land covered by new Energy Schemes subject to decontamination measures	Local Authorities and Energy Scheme developers (in respect of individual projects)	Annual	Energy Scheme developers and Operators (in respect of individual projects / facilities) – reporting to BEIS
10	Protect, enhance and promote geodiversity	Area (in hectares) of designated geodiversity sites (RIGS and / or SSSIs) included within or impacted by Energy schemes	100% of designated geodiversity sites retained at their current condition or subject to improvement in their condition Year-on-year deduction in the % of geodiversity sites within or impacted by Energy schemes subject to loss or degraded condition.	Local Authorities and Energy Scheme developers (in respect of individual projects)	Annual (subject to data availability)	BEIS
11	Improve health and well-being and safety for all citizens	Households living in fuel poverty	Year on year reduction in	Environment Agency, Public Health bodies including those in	Annual	BEIS supported by relevant authorities

No.	AoS Objective against which a significant effect has been predicted	Monitoring Measure / Indicator	Target	Data Source	Suggested frequency of monitoring	Responsibility for undertaking monitoring
	and reduce inequalities in health		numbers living in fuel poverty	Devolved Administrations and Agencies		
12	Promote sustainable transport and minimise detrimental impacts on strategic transport network and disruption to basic services and infrastructure	Proportion of new Energy Schemes with Transport Management Plans that emphasise sustainable transport modes including public and active travel	100% of new Energy schemes	Local Authorities and Energy Scheme developers (in respect of individual projects)	Annual	Energy Scheme developers and Operators (in respect of individual projects / facilities) – reporting to BEIS
13	Promote a strong economy with opportunities for local communities	GVA per capita and percentage change in employment in areas of proposed Energy Schemes	Increase	NOMIS / Office for National Statistics	Annual	BEIS supported by relevant authorities
14	Promote sustainable use of resources and natural assets	Proportion of construction materials used in new Energy schemes derived from alternative secondary and / or recycled sources.	100% of Energy schemes employing reuse, recovery and recycling practices during construction	Local Authorities and Energy Scheme developers (in respect of individual projects)	Annual	Energy Scheme developers and Operators (in respect of individual projects / facilities) – reporting to BEIS
		Proportion (by mass) of waste arising associated with new Energy schemes which is reused or recycled	Year-on-year increase in % of waste materials generated during	Local Authorities and Energy Scheme developers (in respect of individual projects)	Annual	Energy Scheme developers and Operators (in respect of individual

No.	AoS Objective against which a significant effect has been predicted	Monitoring Measure / Indicator	Target	Data Source	Suggested frequency of monitoring	Responsibility for undertaking monitoring
			construction being reused on-site			projects / facilities) – reporting to BEIS

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