Energy Bill – Offshore Wind Environmental Improvement Package Measures Impact Assessment

Key definitions of policy area

Environmental assessment and offsetting: Habitats Regulations Assessment (HRA) is a sequential assessment under the Habitats Regulations to test whether a plan or project could have a significant effect on a protected site (in the marine environment, these are designated as Special Areas of Conservation (SAC) or Special Protection Area (SPA) under the Habitats Regulations) or the integrity of the National Site Network. If the HRA concludes that it is not possible to rule out an adverse effect, the consenting authority must demonstrate that the plan or project has overriding public interest and that there are no alternative solutions to avoid, reduce or mitigate the effects of concern. If these tests are passed, compensatory measures must be secured for the plan or project to be approved. Compensatory measures can either be provided by developers at a project level or by plan promoters at plan level (the latter approach is currently being developed). The offshore wind (OFW) industry is subject to HRA processes but the current approach to assessment results in issues being raised and addressed late in the planning process, which is inefficient and results in delays to consent which could be avoided – see Section 3.1 of the IA.

There is a parallel process for assessing adverse effects to protected sites designated as Marine Conservation Zones (MCZ), as set out in the Marine and Coastal Access Act 2009 (MCAA), which tests whether the public benefit of a plan or project being taken forward clearly outweighs likely environmental damage. The plan or project promoter must then provide measures of equivalent environmental benefit (MEEB) to offset the predicted adverse effect, which is parallel to compensatory measures in HRA. Highly Protected Marine Areas (HPMAs)may also be designated under the MCAA, and the approach to compensation/offsetting for these sites is currently being developed.

Strategic compensatory measures: As per the summary above, if it is not possible to rule out an adverse effect on integrity to a SAC or SPA due to an offshore wind development, or a development causes a 'significant risk to the achievement of the conservation objectives' of a MCZ, the decision maker must secure compensatory measures or MEEB (hereafter referred to as compensatory measures) to approve the plan or project. The only current pathway is for developers to secure and pay for these measures on a project basis. These measures will need to fully offset the damage which will or could be caused to the site. Statutory Nature Conservation Bodies (SNCBs) provide advice on impacts and suitable compensation, and developers should work closely with them when identifying, designing and securing suitable compensatory measures.

Currently these compensatory measures are time consuming and difficult to deliver at an individual project or plan level, as discussed in Section 3.2 below, and therefore '**strategic**' compensatory measures are needed. The strategic element of these measures enables the pooling of resources to allow for compensatory measures to be carried out in a way that will secure environmental benefits greater than if they were attempted in silo (see Section 5.3 – 'non-monetised benefits' for two examples of this) and can be provided at distance from the development footprint.

In addition to industry or plan promoter led strategic compensation, the proposed legislation considered would allow developers and plan promoters to voluntarily discharge their compensation obligations through the **Marine Recovery Fund (MRF)**. This would be a financial vessel enabling Government to collect, hold and spend the money needed for the strategic compensatory measures. Government can provide additional strategic compensatory measures, as some measures have to be Government led (e.g. enabling enhanced protections of sites) or can be carried out more effectively by Government (e.g. commercial sensitivities limiting industry-led coordination). This Fund would carry out the strategic compensatory measures on behalf of industry or the plan promoter and would be managed by the Fund's administrator.

Title: Energy Bill – Defra's Offshore Wind Environmental Improvement Package measures IA **IA No:** - **RPC Reference No:** - **Lead department or agency:** Department for Environment, Food & Rural Affairs (Defra) **Other departments or agencies:** Department for Business, Energy, and Industrial Strategy (BEIS), Department for Levelling Up, Housing and Communities (DLUHC)	**Impact Assessment (IA)** **Date:** 24/11/2022 **Stage:** Formal **Source of intervention:** Domestic **Type of measure:** Primary legislation **Contact for enquiries:** Jessica.Bridgland@defra.gov.uk

Summary: Intervention and Options

RPC Opinion: Not applicable

Cost of Preferred (or more likely) Option (£ million)			
Total Net Present Social Value (2020 prices, 2022 present value)	**Business Net Present Value** (2019 prices, 2020 present value)	**Net cost to business per year** (2019 prices, 2020 present value)	**Business Impact Target Status** Qualifying provision
-3 – **-40** PV(costs) benefits not monetised	**-2** – **-40** PV(costs) benefits not monetised	**0.1** – **2**	

What is the problem under consideration? Why is government action or intervention necessary??

The British Energy Security Strategy (BESS) commits Government to an ambition to deploy up to 50 gigawatts (GW) of OFW by 2030. Increasing domestic energy supply and decarbonising the energy grid is vital to deliver domestic energy security (a quasi-public good) and net-zero (reducing negative externalities from greenhouse gas emissions). However, the scale and speed of OFW expansion risks having a significant negative impacts on the UK's environmental objectives and statutory commitments to marine protection.

The current regulatory consenting process for OFW development was designed to protect the marine environment whilst allowing the development of OFW projects. However, the HRA element of this is highly complex and over time has become disproportionate, resulting in time delays for construction and increased risk of refused or challenged consents. These cannot be resolved by industry as they need Government action to streamline requirements for OFW specific development consents. A review of the HRA processes is required. Compensatory measures have to be secured under the HRA process when there are 'Adverse Effects on Site Integrity' to a national network site from development, or under the processes for assessing impacts on MCZs. These are novel in the marine environment, generally untested, difficult to develop and time-consuming to deliver at an individual project or plan level. Carrying these measures out more 'strategically' could help to alleviate some of these issues. However, complexities in interpretation, commercial sensitivities and a lack of agreed delivery models stop industry doing this alone. Some compensatory measures, including those most supported by SNCBs, can also only be delivered through Government actions.

What are the policy objectives of the action or intervention and the intended effects?

The policy objectives of these Defra measures are to (1) speed up the consenting period for OFW to meet the twin objectives of managing climate change and ensuring energy security, and (2) protect and enhance the marine environment. The BESS' marine elements will deliver these objectives through a series of measures including the Offshore Wind Environmental Improvement Package (OWEIP). The measures from this package considered in the Energy Bill are strategic compensatory measures delivered through the MRF and the environmental assessment review.

What policy options have been considered, including any alternatives to regulation? Please justify preferred option (further details in Evidence Base)

This IA considers three main policy options:

- Option 1 **(preferred)**: Regulatory option - Primary legislation to (1) give Government the power to tailor the HRA in secondary legislation for OFW industry, and (2) allow developers and plan promoters to delegate their compensatory responsibilities to the MRF who will carry them out on industry or the plan promoter's behalf using strategic compensatory measures (further details provided in Section 3). *This is the preferred option as it ensures all environmental and shorter consenting time benefits are realised and is not expected to impose high costs on the OFW industry. For the HRA review, multiple aspects of the policy can only be delivered through legislation (which would not be subject to existing case law). For strategic compensatory measures, industry have proven unable to deliver them to date without Government coordination due to commercial sensitivities, and plan promoters are limited in their measures as some have to be provided by Government. This would be the situation even with guidance being provided.*

- Option 2: Non-regulatory option – Government provides guidance to the OFW industry on (1) the current HRA process to streamline and provide greater clarity on what must be assessed, and (2) how they could deliver some industry or plan promoter led strategic compensatory measures. *This is <u>not</u> the preferred option, as although guidance could be provided, it risks having little or no benefit. For example, for strategic compensatory measures, it does not solve the issue of commercial sensitivities or that only Government can deliver the most effective compensatory measures, and therefore guidance on industry or plan promoter led strategic compensatory measures may not be followed.*
- Option 3: Do nothing **-** OFW developers continue to (1) follow the current HRA process and, (2) deliver project or plan level compensatory measures. *This is <u>not</u> preferred as the problems under consideration would still compound and lead to stalled developments in the short-medium term. This is our baseline as this is the scenario that would occur without Government intervention.*

As per Regulatory Policy Committee (RPC) guidance, the IA summary tables at the front of the IA only focus on the part of the proposal that is brought in through primary legislation (i.e., strategic compensatory measures and the MRF) and not those that will be brought in through secondary legislation where the detail is currently not known (i.e., HRA Review). However potential impacts for the latter are included in the Evidence Base to show indicative impacts of the whole policy. The baseline to determine the impact of the policy options is Option 3 (do nothing), where Option 1 is the regulatory intervention and Option 2 is the non-regulatory intervention to deal with at least some of the issues presented if Government did not intervene.

Will the policy be reviewed? It will not be reviewed. **If applicable, set review date:** N/A				
Is this measure likely to impact on international trade and investment?		No		
Are any of these organisations in scope?	**Micro** No	**Small** No	**Medium** Yes	**Large** Yes
What is the CO_2 equivalent change in greenhouse gas emissions?		**Traded: N/A**		**Non-traded: N/A**

I have read the Impact Assessment and I am satisfied that, given the available evidence, it represents a reasonable view of the likely costs, benefits and impact of the leading options.

Signed by the responsible SELECT SIGNATORY: Matan Cable Date: 09/01/23

Summary: Analysis & Evidence - Policy Option 1 (preferred)

Description: This is the regulatory policy option. It involves introducing primary legislation to allow OFW developers and plan promoters to delegate compensatory responsibilities to the MRF and its administrator, who will carry these out on industry or the plan promoter's behalf using Secretary of State (SoS) agreed strategic compensatory measures. The Fund administrator will also be responsible for monitoring the effectiveness of these measures to ensure the compensatory requirements are met. This policy option aims to solve the difficulty industry, plan promoters and the SoS for BEIS are having with providing project or plan level compensatory measures by co-ordinating strategic compensatory measures (this is unlikely to be industry led due to lack of clarity on interpretation, access to effective government-led measures and commercial sensitivities). This will reduce the consenting time for OFW projects and give the opportunity to ensure the compensation provides the most ecologically beneficial outcome. Costs and benefits are determined through comparison with the baseline Policy Option 3 (i.e., 'do nothing'). *Note, this summary does not include the HRA review policy measure (see previous page for reason).*

FULL ECONOMIC ASSESSMENT

Price Base Year 2020	**PV Base Year** 2022	**Time Period Years** 20	**Net Benefit (Present Value (PV)) (£mn)**		
			Low: -3 PV(costs) (benefits not monetised)	**High:** -40 PV(costs) (benefits not monetised)	**Best Estimate:** Range as provided

COSTS (£m)	**Total Transition** (Constant Price) Years		**Average Annual (£m)** (excl. Transition) (Constant Price)	**Total Cost (£mn)** (Present Value)
Low	0	N/A	0.1	3
High	0		2	40
Best Estimate	0		Range as provided	Range as provided

Description and scale of key monetised costs by 'main affected groups'

There are two costs to the OFW industry that have been monetised for strategic compensatory measures and the MRF: familiarisation cost (i.e., cost of understanding the new legislation), and the cost of running the MRF to deliver i) strategic compensatory measures and ii) the monitoring of the strategic compensatory measures' effectiveness. Together, these provide a cost of £0.1 - 2 million annually for OFW developers in the UK in total, and £3 - 40 million over the appraisal period. This range captures the uncertainty around the value of strategic compensatory measures required in the future, and therefore the potential cost to industry. This cost is very small when compared against the OFW industry financials (i.e., £3.8 billion in UK revenue in 20201, equivalent to £3.6 billion in 2022 present value).

Other key non-monetised costs by 'main affected groups'

There are several non-monetised costs including Government resourcing to scope and agree the strategic compensatory measures with SoS in the short term.

BENEFITS (£m)	**Total Transition** (Constant Price) Years		**Average Annual** (excl. Transition) (Constant Price)	**Total Benefit** (Present Value)
Low	0	N/A	Not monetised	Not monetised
High	0		Not monetised	Not monetised
Best Estimate	0		Not monetised	Not monetised

Description and scale of key monetised benefits by 'main affected groups'

No benefits have been monetised for this policy option.

Other key non-monetised benefits by 'main affected groups'

Benefits to society include increasing the likelihood of delivering two possible net zero energy system carbon savings (£320 – 360 million worth of annual carbon savings to the energy system over our appraisal period) and protecting ecosystem services (see Annex 3) provided by the marine environment by ensuring a variety of compensatory measures can be delivered. Benefits to the OFW industry include possible increased revenue/cost savings from a shorter consenting process (e.g., no longer having to pay an option fee to secure the seabed rights for development for unnecessary time). There are also possible wider benefits as discussed in Section 7.

Key assumptions/sensitivities/risks	**Discount rate (%)**
We assume that 30 - 70% of compensatory requirements will take place through the MRF (i.e., assumed "take up" of the MRF by industry). We assume it costs 5 - 7% of the MRF's value to operate it and that this is fully passed on to industry (either directly for project-level assessments or indirectly through plan promoters for plan-level assessments). There is a risk that the requirement for, or cost of, strategic compensatory measures is greater than expected. This would impact the MRF size and its cost. There is a risk Government could fail to deliver the benefits and objectives of the policy.	3.5

[1] UK Government - LCREE data

BUSINESS ASSESSMENT (Option 1) – Price base 2019, Present Value 2020, 20-year appraisal period

Direct impact on business (Equivalent Annual) £mn:			**Score for Business Impact Target (qualifying provisions only) £mn:**
Costs: 0.1 – 2	**Benefits:** Not monetised	**Net: 0.1 – 2** PV(costs)	**0.5 – 10**

Summary: Analysis & Evidence - Policy Option 2

Description: This is the non-regulatory policy option. It involves Government providing industry and plan promoters with guidance on how they could deliver some strategic compensatory measures (i.e., what strategic compensatory measures could be accepted to gain development consent). They could choose to follow this guidance or continue with delivering project or plan-level compensatory measures. This policy option does not address the issues of industry not being able to access effective measures which can only be led by government and commercial sensitivities preventing industry join up, however, it could help join up across projects which are run by the same developer, if there are available measures which don't require government leadership. *Note, this summary does not include the HRA review policy measure (see first summary page for reason).*

FULL ECONOMIC ASSESSMENT

Price Base Year 2020	**PV Base Year** 2022	**Time Period Years** 20	**Net Benefit (Present Value (PV)) (£mn)**		
			Low: 0 – -3 PV(costs) benefits not monetised	**High:** 0 – -40 PV(costs) benefits not monetised	**Best Estimate:** Range as provided

COSTS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual (£mn)** (excl. Transition) (Constant Price)	**Total Cost (£mn)** (Present Value)
Low	0	N/A	0 – 0.1	0 – 3
High	0		0 – 2	0 – 40
Best Estimate	0		Range as provided	Range as provided

Description and scale of key monetised costs by 'main affected groups'

We would expect the OFW industry costs to be between Policy Options' 1 and 3 (i.e., between the 'do nothing' and the regulatory policy option). No analysis was done to determine where exactly between these costs Policy Option 2 would fall. However, we would expect costs to be closer to Policy Option 3 (i.e., 'do nothing') as the issue of commercial sensitivities would still remain, limiting join up across developers and therefore the take up of the guidance and associated coordination costs.

Other key non-monetised costs by 'main affected groups'

Government would need to fund the creation and distribution of the guidance. This would include scoping measures that industry could deliver strategically on their own, and that would be accepted to meet their legal compensatory requirements. This would be a short-term cost.

BENEFITS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Benefit** (Present Value)
Low	0	N/A	Not monetised	Not monetised
High	0		Not monetised	Not monetised
Best Estimate	0		Not monetised	Not monetised

Description and scale of key monetised benefits by 'main affected groups'

No benefits have been monetised for this policy option.

Other key non-monetised benefits by 'main affected groups'

Providing guidance could achieve a small amount of the benefits realised in Policy Option 1 (i.e., regulatory policy option). This would depend on the take-up of the guidance by industry which is likely to be low as issues such as commercial sensitivities, preventing industry join up, and lack of access to the most effective measures which can only be led by Government remain. However, it could help join up across projects that are run by the same developer. Providing guidance could therefore reduce the consenting time for some developers which have more than one project in the same region or plan promoters compared to our baseline Policy Option 3 (i.e., 'do nothing') and achieve the associated benefits, such as increasing the likelihood of delivering two possible net zero energy system carbon savings, possible increased revenue/cost savings for the OFW industry, and environmental benefits. Note even with a full take up of guidance, which is extremely unlikely, benefits would still be below Policy Option 1 as some effective strategic compensatory measures can only be delivered by Government.

Key assumptions/sensitivities/risks	**Discount rate (%)**	3.5

The main assumption for this policy option is that the upper bound of the costs would be the same as in Policy Option 1. This is a reasonable assumption to make, as industry and plan promoters would still have to carry out administration costs related to coordinating activities to achieve the strategic compensatory measures. We assume ant plan promoter costs would be passed on to industry. The main risk of this policy option is the take up of the guidance.

BUSINESS ASSESSMENT (Option 2) - Price base 2019, Present Value 2020, 20-year appraisal period

Direct impact on business (Equivalent Annual) £mn:			**Score for Business Impact Target (qualifying provisions only) £mn:**
Costs: 0 - 2	**Benefits:** not monetised	**Net:** 0 – 2 PV(costs)	0 - 10

Summary: Analysis & Evidence - Policy Option 3

Description: This is the 'do nothing' option where Government does not intervene through regulatory or non-regulatory policy. This is our baseline in which we compare the impacts of Policy Options 1 and 2, as this is the current scenario and the one without Government intervention. Industry and plan promoters would continue to provide project or plan level compensatory measures to meet their compensatory requirements to gain development consent. They could choose to deliver strategic compensatory measures but are unlikely to due to issues such as (1) commercial sensitivities preventing join up across developers, (2) uncertainty around what strategic compensatory measures might get accepted to gain development consent, and (3) lack of access to effective Government-led measures.

FULL ECONOMIC ASSESSMENT

Price Base Year 2020	**PV Base Year** 2022	**Time Period Years** 20	**Net Benefit (Present Value (PV)) (£m)**		
			Low: 0	**High:** 0	**Best Estimate:** 0

COSTS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Cost** (Present Value)
Low	0	All	0	**0**
High	0		0	**0**
Best Estimate	0		0	**0**

Description and scale of key monetised costs by 'main affected groups'

There are no additional costs to the OFW industry as there is no intervention by Government.

Other key non-monetised costs by 'main affected groups'

The current regulatory consenting process for OFW development would continue with project and plan level compensatory measures being difficult and time consuming to deliver, resulting in consent and decision challenge risk increasing as the industry grows, time delays for OFW construction and no additional benefits to the environment, society or industry. Industry would continue to incur unnecessary option fee costs to secure the seabed rights for a longer than necessary time.

BENEFITS (£m)	**Total Transition** (Constant Price)	Years	**Average Annual** (excl. Transition) (Constant Price)	**Total Benefit** (Present Value)
Low	0	All	0	0
High	0		0	0
Best Estimate	0		0	0

Description and scale of key monetised benefits by 'main affected groups'

No benefits from doing nothing.

Other key non-monetised benefits by 'main affected groups'

No benefits from doing nothing.

Key assumptions/sensitivities/risks	**Discount rate (%)**	3.5

The OFW wind industry would continue to have a long consenting process, increasing risk of development consent being refused and long periods pre-construction to implement project-specific measures. It could therefore risk Government's ambition of up to 50GW in OFW by 2030 and the related climate change and energy security policy objectives. It could also risk the future of the industry in the UK, as developers move to countries with more predictable regulations.

BUSINESS ASSESSMENT (Option 2) - Price base 2019, Present Value 2020, 20-year appraisal period

Direct impact on business (Equivalent Annual) £m:			**Score for Business Impact Target (qualifying provisions only) £m:**
Costs: 0	**Benefits:** 0	**Net:** 0	0

Contents

Evidence Base

Section 1: Introduction

This IA considers **primary legislation to**

1) **give Government the power to tailor the approach for HRA in secondary legislation for the OFW industry.** This would allow the SoS to make or amend regulations on HRA for OFW projects. The options for secondary legislation under this policy measure were being developed at the time of the analysis. Therefore, our assessment looked at potential secondary legislation to give an indication of scale and type of impact that could occur (see Section 3.1).
2) **allow developers and plan promoters to delegate their compensatory responsibilities to the MRF who will carry them out on their behalf using strategic compensatory measures.** This includes giving the responsibility to carry out, and monitor the effectiveness of, the strategic compensatory measures to the MRF administrator (see Section 3.2).

The impact of these measures across the UK will be varied, given varying levels of OFW capacity in different administrations' waters. This IA therefore considers impacts across the UK, but also breaks it down to show England-only impacts.

This document is structured as follows:

- **Section 2** summarises the policy objectives, the rationale for the forthcoming primary legislation and the approach used in this analysis.
- **Section 3** describes the individual policy measures, their objectives and options considered.
- **Section 4** summarises the impacts of the policy measures and the Equivalent Annual Net Direct Cost to Business (EANDCB).
- **Section 5** discusses the impacts and risks of the policy measures in more detail.
- **Section 6** describes the main anticipated impacts on small and micro businesses (SaMBA) and medium businesses.
- **Section 7** describes any possible wider impacts, including trade, investment, supply chain and consumer price impacts.
- **Section 8** describes how we intend to monitor and evaluate the policy measures.

Section 2: Policy background, rationale for intervention and analytical approach

This section provides the overarching policy background and rationale for intervention of the two policy measures. It then goes through the approach we have taken to assess their impact.

Section 2.1: Policy background

Current policies

The BESS[1], announced on 7th April 2022, sets an ambition of deploying up to 50GW of OFW by 2030 (Government also has a minimum target of 40GW by 2030 so has committed to deliver at least that much), with up to 5GW delivered through innovative floating offshore wind to meet the twin challenge of supporting our climate change commitments and providing greater energy security. This is a large step up from the c13GW[2] of current capacity in the UK and aligns closely to, and builds on, several previous UK government policies and wider strategic priorities.

In 2019, the Government committed to net-zero greenhouse gas emissions by 2050, following up in 2021 with the Net Zero Strategy.[3] Decarbonising the energy grid is vital to deliver on the net-zero objective, with energy supply responsible for 24% of UK greenhouse gas emissions in 2021.[4] Accelerating the transition away from oil and gas depends critically on how quickly renewable capacity

[1] UK Government - British Energy Security Strategy

[2] UK Government - Latest BEIS energy trends publication gives figure of 12.7GW as at end Q1 22.

[3] UK Government - Net Zero Strategy

[4] UK Government - 2021 UK greenhouse gas emissions, provisional figures

can be deployed, with OFW energy identified as having a central role in decarbonising energy production.[5]

The Government has various domestic policies in place seeking to protect and recover the marine environment. These include the 25 Year Environment Plan,[6] the UK Marine Strategy,[7] and the 2021 Environment Act.[8] The UK is also a signatory to key international environmental commitments. The scale and speed of OFW expansion risks having a significant negative impact on the UK's environmental objectives. It is therefore vital these impacts are avoided, reduced and mitigated wherever possible, and otherwise compensated for, in order to balance OFW expansion with environmental objectives.

The BESS will contribute towards the Government's Levelling up[9] ambitions and support the Build Back Better plan for growth[10] by accelerating investment in OFW. Much of the sector relies on coastal industry and labour, areas which are often among the most deprived.[11,12]

External economic and political context

The need to deliver OFW quicker, to ensure long-term domestic energy security, has been shown through a number of external factors over the last year. The war in Ukraine and following sanctions on Russia have led to a rapid restriction in the availability of oil and gas. Russia is responsible for 29% of oil imports in the EU, 8% of the UK's oil supplies[13] and 4% of the UK's gas supply.[14] The impact of these restrictions has been exacerbated by the scaling back of production during the Covid-19 pandemic and the subsequent lag in scaling up following demand returning to pre-pandemic levels. Domestic production reached its lowest level in over 50 years in 2021, down 14% on 2020 levels.[15]

Consequently, the price of electricity and gas in the UK has risen by c51% between October 2021 and April 2022[16], and the price of crude oil from c£62 per barrel at the end of 2021 to c£90 per barrel in June 2022.[17] This is having a significant impact on the UK economy, contributing towards inflation rising to 10.1% year-on-year in both July and September[18] and with falling real wages placing substantial, and in some circumstances unmanageable, pressures on household budgets. These external shocks have clearly illustrated a need for greater energy security within the UK and the expansion of domestic OFW capacity, to mitigate the impact of any future external shocks to the global energy supply.

In parallel to this, the environmental agenda continues to grow in importance. The Environment Act 2021 will place a legal duty on Ministers of the Crown to have due regard to the Environmental Principles Policy Statement when making policy.[19] The relevance of these Principles in the context of the Defra policy measures are discussed in detail under the 'rationale for intervention' section. With the UK having hosted and chaired the latest UN Climate Change Conference (COP26) in 2021, there is a strong ambition from Government to demonstrate and implement solutions to the environmental crisis. The UK is a signatory for the Convention on Biological Diversity – a legally binding international treaty to ensure the conservation and sustainable use of biodiversity and a fair/equitable sharing of benefits arising from the use of genetic resources.[20] The Government also committed 30% of UK land and sea to be for nature by 2030 (i.e., 30 by 30 commitment).[21] OFW projects can remove or disturb habitats, disrupt food

[5] UK Government - UK's path to net zero set out in landmark strategy

[6] UK Government - At a glance: summary of targets in our 25-year environment plan

[7] UK Government - Marine strategy part one: UK updated assessment and Good Environmental Status

[8] UK Government - World-leading Environment Act becomes law

[9] UK Government - Levelling Up the United Kingdom

[10] UK Government – Build Back Better: our plan for growth

[11] ONS Coastal towns in England and Wales

[12] UK Government Indices of Deprivation 2015 and 2019

[13] UK Government - UK to phase out Russian oil imports

[14] UK Government - Russia-Ukraine and UK energy: factsheet

[15] UK Government Energy Trends March 2022

[16] June 2022, ONS CPI INDEX

[17] Trading economics - Crude oil - 2022 Data

[18] ONS - Consumer price inflation

[19] UK Government – Environmental Principles Policy Statement

[20] United Nations – Convention on Biological Diversity

[21] UK Government – 'PM commits to protect 30% of UK land in boost for biodiversity'

webs and harm protected species such as seabirds and marine mammals, making the scale up and acceleration of OFW developments a key risk to delivering Good Environmental Status in the UK seas.[22, 23]

The policy objectives of these Defra measures are therefore to:

1. Speed up the consenting process for OFW to meet the twin objectives of managing climate change and ensuring energy security.
2. Ensure that the marine environment is protected and enhanced during the rollout of OFW.

The marine elements of the BESS will deliver on these objectives through the OWEIP and the associated policy measures. Those considered in the Energy Bill are summarised below and explained in more detail in Section 3.

1. The way **HRA** is undertaken for OFW will be reviewed to reduce inefficiencies in the assessment process, enabling improved consideration of environmental mitigation and compensatory measures early on and greater consideration of impacts across multiple projects and plans. This will speed up the consenting process for OFW, whilst ensuring environmental protection.
2. The introduction of **strategic compensatory measures and a MRF** will reduce the cost/time burden and uncertainty of finding compensatory measures required from developers or plan promoters by enabling resources to be pooled, and compensatory measures to be delivered more strategically, across projects/plans and by Government. This is expected to deliver environmental benefits greater than if compensatory measures were delivered site specifically in isolation from other developments.

Section 2.2: Rationale for Government intervention

The policy measures considered seek to address multiple market failures and inefficiencies:

- **Correcting inefficiencies created from current Government intervention.** The current environmental assessment and offsetting process was designed to protect the marine environment whilst allowing development to take place. However, the HRA element of this process could be streamlined with inefficiencies, which have resulted in time delays for construction and limited additional benefits, taken out of the system.

- **Speeding up national energy security – a quasi-public good.** National energy security is non-excludable because once energy security at the national level is provided, it is not possible to exclude individuals from benefitting from it. This leads to a free-rider problem, whereby individuals can benefit from energy security without contributing towards its cost. In a free market, firms may not provide a socially optimal level of energy security as they have difficulty recouping the cost of doing so (given it's not possible to exclude people from its benefits and given consumers pay for energy not energy security) and as they may be able to import energy at a relatively lower cost. Therefore, in the absence of Government intervention, energy security is likely to be under-provided.

- **Speeding up clean energy rollout – reducing negative externalities from greenhouse gas emissions.** The overarching rationale behind government action to decarbonise energy is to correct the negative externalities of emissions and to adhere to the Environmental Principles of 'rectification at source', 'integration' and 'prevention'.[24] Government intervention is needed to address the social cost of emissions from the production of energy from unabated fossil fuels. In the absence of government intervention, energy from unabated fossil fuel sources would be over-produced due to the private costs of their production being lower than the social costs, which include pollution costs borne by wider society.

[22] Assessing environmental impacts of OFW farms: lessons learned and recommendations for the future

[23] UK Government- Environmental Impacts and Siting of Wind Projects

[24] Three of the five Environmental Principles: 1) the prevention principle means that government policy should aim to prevent environmental harm, 2) the rectification at source principle states that environmental damage should, as a priority, be addressed at its origin to avoid the need to remedy its effects later, and 3) the integration principle proposes that policymakers should look for opportunities to embed environmental protection in fields of policy that environmental effects,

- **Avoid, reduce, mitigate and compensate for environmental impacts from OFW construction – correcting for a negative externality.** Constructing, operating and decommissioning OFW farms can damage the marine environment and marine ecosystems. These activities may remove or disturb habitats, disrupt food webs and harm protected species such as seabirds and marine mammals. A healthy ocean is critical in terms of providing ecosystem services[25], regulating the climate and limiting global temperature rises and supporting sustainable economic activity. The developers of OFW do not directly pay for the damages that their developments can cause to marine ecosystems and therefore government intervention is needed to internalise this externality and protect the public good of our marine ecosystems - this is in line with the 'polluter pays'[26] and 'integration' Environmental Principles. The UK also has legally binding commitments to take the necessary measures to deliver Good Environmental Status in our seas. Government intervention is needed to address the social cost of environmental damage.

Section 2.3: Approach to analysis

This analysis assessed the two Defra OWEIP policy measures under the Energy Bill and their respective policy options together. This is because the policy measures are expected to work together to achieve the desired policy objectives and address the market failures / inefficiencies, as discussed in the previous Section 2.1 and 2.2, and so that we can understand the cumulative impact of the multiple measures on the OFW industry.

Although this analysis is for primary legislation, the HRA Review policy measure will be brought in through secondary legislation linked to the powers given in the Energy Bill. As per RPC guidance,[27] analysis supporting primary legislation must consider the impacts of the whole policy (i.e. including secondary legislation). However, where the detail of all the secondary legislation is not known, analysis of the whole policy should only be presented in the evidence base using potential secondary legislation to show indicative impacts.

In this scenario, the summary tables at the front of the IA should only present the impacts that would occur directly through primary legislation (i.e., not including secondary legislation where the detail is not yet known). As elements of the HRA Review were still being determined by Defra policy at the time of this analysis, due to the pace of policy development in response to the BESS and urgency around national energy security, we used potential secondary legislation to give an indication of the potential scale and nature of possible impacts. For the policy measure strategic compensatory measures via the MRF, impacts are expected to occur through primary legislation. Therefore, these latter estimates are used to calculate the EANDCB (see Section 4.3) and are included in the summary tables at the front. **This is in line with RPC guidance on Scenario 1b: primary legislation IAs where some of the primary legislation is implemented without the need for related secondary legislation and where the detail of the required secondary legislation is not known.**

For this analysis, we carried out

a) individual assessments for the policy measures, including of potential secondary legislation options where appropriate and,
b) a cross-cutting assessment for where there were overlaps in costs and benefits.

The policy measures are connected (see Figure 1) resulting in interdependent benefits and costs. For example, the value of strategic compensatory measures needed depends on elements of the HRA Review (e.g., if SNCB evidence of environmental impacts was given earlier and proportionate weighting, the amount of strategic compensatory measures required could increase – see Section 5.2).

We were able to monetise some of the impacts of the policy measures but where this was not possible, a qualitative assessment was undertaken. We had to take a practical approach given the timescales of the Bill and the development of Defra policy, monetising the costs that could be most impactful and likely.[28] We were unable to monetise benefits due to time constraints. To reflect uncertainty in our estimates, we

[25] See Annex 3 for further information on ecosystem services.

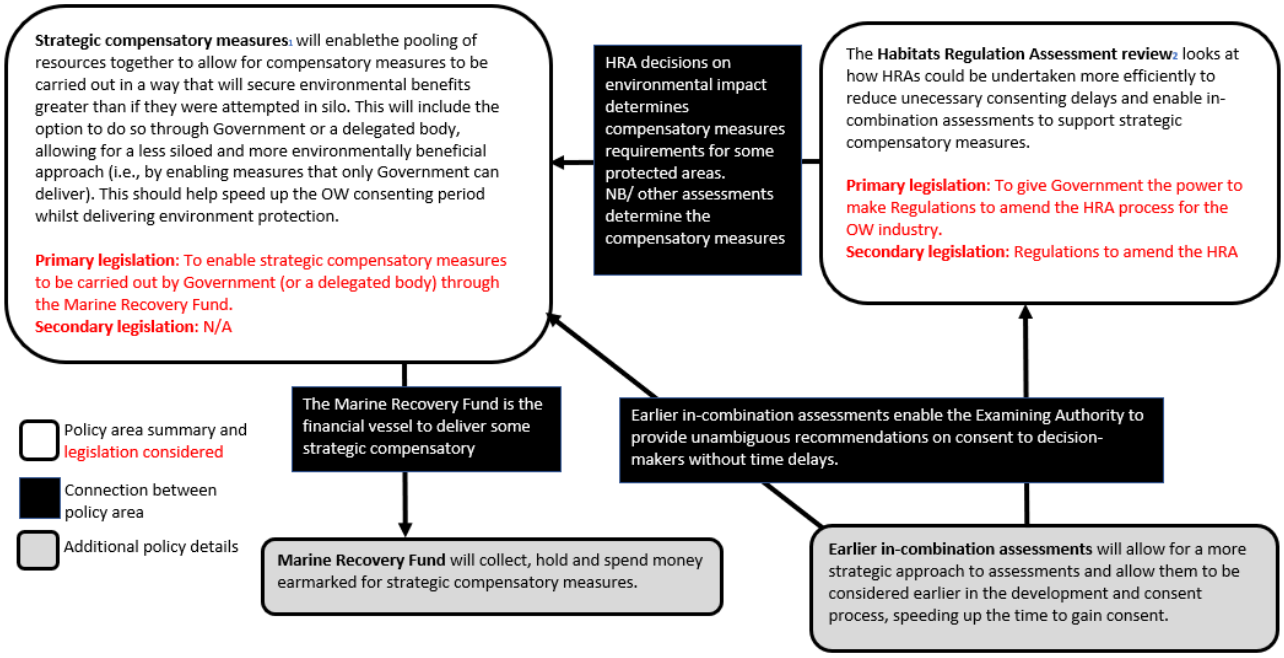
[26] One of five Environmental Principles: the polluter pays principle means that, where possible, the costs of pollution should be borne by those who are causing it, rather than the person who suffers the effects of the resulting environmental damage, or the wider community.

[27] RPC guidance - assessment and scoring of primary legislation measures

[28] From discussions with policy.

present them as a range. The key assumptions have also been provided with a confidence and impact on an analysis rating (see Section 5.4). The analysis only assessed Policy Option 1 (regulatory policy option) and did not assess the Policy Option 2 (non-regulatory policy option) or Policy Option 3 (do-nothing) given the timescales and as the former is the preferred option and would have the greatest impact. As previously mentioned, the impact of these measures across the UK will be varied, given varying levels of OFW capacity in different administrations' waters. This IA therefore considers impacts to developers operating in the UK, but also provides a breakdown to show the impact on developers assumed to operate in England only, to give a sense of the impact's distribution. All sensitivities are run on a UK-wide basis only.

Figure 1 - Mapping of policy measures and summary of legislation being considered



1 – Compensatory measures are required from OFW developers to 'compensate' for any damage or loss to designated features in a protected area when developing an OFW. These are determined from the environmental assessment and offsetting process, of which HRA is an element.
2 - HRA is a development consent requirement to assess potential impacts of an OFW development on certain protected sites.

Section 3: Policy measures, options and their objectives

We have considered three options under each policy measure, including a regulatory, non-regulatory and a 'do nothing' option. As above, some of the policy will be enacted through secondary legislation, we therefore assumed possible secondary legislation where appropriate in consultation with the Defra policy team.

Section 3.1 Habitats Regulations Assessment Review

The current HRA process – the assessment process that identifies likely impacts and the need for compensatory measures, required from OFW developers, to correct for environmental damage to national network sites in or near the OFW development - needs changing. This is because:

- During the HRA process, project developers or plan promoters, with advice from SNCBs, can currently both provide estimates of expected environmental effects from OFW development. These estimates are used to inform the compensatory measures required for consent and there may be large differences in advice between industry and SNCB experts. This has led to a period of debate and delay for many projects to determine which estimates should be used. Government intervention is needed to reduce unnecessary consenting delays and to make sure the cost of adverse environmental effects from OFW construction are internalised by the developers (i.e. correcting for negative externality) and proportionate to the harm caused.
- Substantial case law on HRA, which influences how applications are considered, has built up driving developers, plan promoters and SNCBs to take a precautionary approach to evidence and assessment leading to development delays. This has resulted in the HRA issues causing the

Development Consent Order Examination to become more resource intensive as it copes with increased uncertainty on scale of impacts and outcomes. Government intervention is required to correct the inefficiency created by over-compliance and to ensure HRA work is proportionate and informative.

- To reduce the compensatory measures required developers or plan promoters should, as far as possible, avoid, reduce and *mitigate* environmental impacts that may lead to an 'Adverse Effect on Site Integrity'. However, the 'People Over Wind' ruling[29] requires the initial screening of environmental impacts to not consider any mitigation, even though these measures may have a proven track record of successfully mitigating impacts. This results in a long assessment period with unnecessary impacts being screened in and mitigation only being brought forward in a subsequent assessment. If mitigation were included from the beginning, there could be a shorter consenting period with no additional negative environmental impacts. Government intervention is needed to correct for the inefficiency created by current case law precedence of primary legislation.
- The impact of developments and subsequent compensatory measures currently takes place at the end of the consenting process during the Examination and decision-making stages for projects, due to the first bullet point above of developers and SNCBs not agreeing on whether there will be adverse effects on the site and the difficulty in identifying acceptable compensation measures. This has caused long extensions to consent decision timeframes while compensation is developed and agreed. By requiring this assessment earlier, either at plan level or in the pre-application stage of the consents process, timescales for consenting could be reduced by preventing these delays at the end of the process. It would also reduce pressure on SNCB resources, as they are no longer constrained to deliver the assessment of impacts and compensatory measures needed in the time-constrained Examination stage (i.e., SNCBs would be able to deliver it over a less constrained time period and could therefore manage resources to avoid bottlenecks in delivery). Government intervention is needed to correct for the inefficiency created by current legislation and to reduce consenting time while ensuring assessment of impacts remains robust and transparent.
- Project-level HRAs currently set out compensatory measures that a project alone must deliver, as required in a project's Development Consent Order. HRAs are undertaken at plan and project level for OFW farms. These inform consenting authorities on what impacts will be however to date this has not translated into strategic solutions to offset impact (see Section 3.2 for rationale of strategic compensatory measures). Although the OFW industry could group together to jointly deliver project compensatory measures this is proving difficult due to a lack of agreed delivery models. Plan-level HRAs may also identify compensation requirements and the process for delivery of plan-level compensation by promoters is in development. As there is limited availability of compensatory measures deliverable by offshore wind developers, industry may be reluctant to voluntarily share detailed information due to commercial sensitivities and there will be difficulties in working with other developments who are at an earlier stage of development, without consent or CfD. Government intervention is needed to enable delivery of strategic compensatory measures at plan and project level.

To address the above, supporting Government's commitment to reducing consenting time for OFW development (speeding up the provision of clean energy and domestic energy security), the following options were considered:

Option 1: Primary legislation (preferred) to give Government the power to amend HRA legislation for the OFW industry. This would allow the SoS to make or amend regulations on HRA for OFW projects.

This would be enacted through secondary legislation. Potential examples of secondary legislation considered were:

- To give earlier and proportionate weighting to SNCB's evidence/baselining at all stages of the consent process, given they are subject matter experts.
- To set OFW specific HRA so that mitigation measures with a proven track record of success, are incorporated at the earliest possible stage of the project development and secured through the Development Consent Order and Marine License. This would allow earlier consideration of

[29] UK Government – 'People Over Wind' judgment for HRAs

mitigation measures, shortening timescales for assessment and allowing compensatory measures to be set to the correct level earlier with no cost to the environment.

- To require OFW developers to co-operate together and with public authorities to share information such that if necessary in-combination/plan assessments can be properly carried out on their behalf, enabling strategic compensatory measures to be implemented.

Option 2: Guidance on current process given to OFW developers and plan promoters to streamline the current HRA process and provide clarity to developers (with applications within the next 12 months) on what must be assessed. Earlier and in-combination assessments are being encouraged but it is the developers' choice to provide information needed, and therefore a comprehensive understanding across all effects for development is unlikely.

Option 3: Do nothing with no change to the current HRA process.

Section 3.2 Strategic compensatory measures and Marine Recovery Fund

As discussed earlier, OFW developers currently have to deliver project-level compensatory measures for any adverse environmental impacts on protected sites that they cannot avoid, reduce or mitigate from the construction of the OFW (as determined by the environmental assessment and offsetting process, of which the HRA is an element). Failure to do so results in refusal of consent and project failure. This is in line with the mitigation hierarchy[30], where the hierarchy emphasises best practice of avoiding, reducing and minimising any negative environmental impacts, and then mitigating the impacts of a development before finally considering offsetting (compensating) residual impacts. Following this is critical for all development projects, such as OFW development, to ensure no significant impact on the species and habitats of protected sites. Until recently, OFW have been able to avoid adverse effects that they would need to provide compensatory measures for to get development consent.[31]

However, it is becoming increasingly difficult to rule out such impacts (i.e., due to cumulative impacts of a large number of projects) so Defra policy are expecting most new developments will need to deliver compensatory measures to secure development consent. For the developers who have started to go through this process of establishing and delivering these measures, there have been multiple issues raised. For example, they have found it difficult and time consuming to find compensatory measures at a project level where there are limited compensatory measures available. This was noted to be a particular concern for relatively smaller OFW developers.

Strategic compensatory measures pool resources and deliver compensatory measures by joining up to deliver environmental benefits greater than the sum of its parts. However, commercial sensitivities and a lack of agreed delivery models limit the opportunities for developers to deliver strategic compensatory measures collaboratively without Government. There are also strategic compensatory measures that can only be delivered through Government (e.g. enhanced protection, management of other pressures etc).

Government intervention is needed to develop and co-ordinate strategic compensatory measures to reduce the consenting time for OFW development and provide compensation at an ecological meaningful scale.

To address the above, the following options were therefore considered:

Option 1: Primary legislation (preferred) to enable strategic compensatory measures to be carried out through the MRF. It also gives the Defra SoS clear statutory authority for compensatory measures to be provided strategically and the power to provide or facilitate strategic compensation measures. This would allow OFW developers or plan promoters the voluntary option of discharging compensation obligations by paying the required compensatory measures' costs to the MRF where the administrator then carries out strategic compensatory measures on their behalf. It would also enable OFW developers or plan promoters to pay a monitoring fee to the MRF such that strategic compensatory measures can be monitored and evaluated. There is the additional benefit of early delivery through the MRF, as some projects have received DCO conditions which require a multi-year implementation period for measures before projects can go into operation, which stalls delivery of renewable energy. This option includes getting a library of strategic compensatory measures which is agreed by the SoS.

[30] UK Parliament, Biodiversity offsetting

[31] Note the first OFW farm with a negative effect on site integrity submitted its development consent application in 2020.

Option 2: Voluntary guidance on some strategic compensatory measures where OFW developers or plan promoters can deliver project or plan level compensatory measures, but Government provides them with guidance on how strategic measures could be delivered. They could choose to follow this guidance or continue with delivering project or plan level compensatory measures. This policy option does not address the issue of commercial sensitivities preventing industry join up and does not allow for effective strategic compensatory measures that can only be delivered by Government, however, it could help join up across projects which are run by the same developer.

Option 3: Do nothing where OFW developers or plan promoters continue to deliver project or plan level compensatory measures with the option of carrying out strategic compensatory measures independently but with no Government guidance or coordination.

Section 4: Summary of impacts from Policy Option 1 (preferred)

Section 4.1 Summary of preferred Policy Option 1

Our preferred option is to secure primary legislation in the Energy Bill to enable strategic compensatory measures to be carried out through the MRF and to set up powers to allow for the option to amend HRA for the OFW industry. For the latter, this analysis used potential secondary legislation options, that could result from primary powers, and their possible impact. For the purpose of the analysis, we have assumed that primary and secondary legislation and the associated costs and benefits would occur from 2023, although a sensitivity for 2024 and 2025-start was also run. This analysis did not consider the ownership structure of the OFW projects for our capacity forecasts (i.e., whether they would be international vs UK owned, and if the former, whether there would be UK subsidiaries and the size of these) as this evidence is complex and was still be considered by BEIS at the time of the analysis. It is therefore possible that some of the costs and benefits considered would be taken outside of the UK, which would make them out of scope of this impact assessment (which should only look at the impact on UK businesses).

Section 4.2 Summary of Policy Option 1 impacts

This section summarises the impact of the regulatory options across the two Defra policy measures. We have focussed on presenting the impacts of the primary legislation options as this is the preferred policy option and would have the largest costs and benefits (i.e., largest impact when considering the whole policy). The breakdown of the costs and benefits for the different policy measures are shown in Table 5, but a summary is provided in the following paragraphs. These estimates are discounted to 2022 over a 20-year appraisal period and a price base year of 2020.

The voluntary options of the policy measures would deliver a portion of these costs and benefits, which would be driven by the take up rate of industry. There are aspects of the mandatory policy options that could not be delivered in the voluntary options due to logistical constraints also reducing benefits and costs (e.g., the voluntary option would not be able to set new OFW specific HRA in secondary legislation or deliver certain strategic compensatory measures such as those that require Government levers to implement).

For the regulatory options, benefits were not monetised, however the energy system carbon savings from achieving two illustrative net zero scenarios were. Achieving these scenarios would result in between £320 – 360 million worth of carbon savings to the energy system per year over our appraisal period (using central carbon value estimates). These Defra policy measures are assumed to increase the likelihood and speed of delivering a fully decarbonised power sector and therefore delivering the savings presented. There are also other benefits across all of the measures that could be realised, such as the possibility of increased revenue and cost saving for the OFW industry. The measures aim to decrease consenting time, allowing for a quicker rollout of OFW in the short run, and could therefore lead to an increase in revenue as more OFW energy is produced, but this depends on other factors discussed in Section 5 below. The OFW industry could also benefit from significant cost savings as they no longer have to pay option fees[32] for an unnecessary long period of time. At an individual policy level, benefits include protecting and enhancing the marine environment and their related ecosystem services. For example, more strategic compensatory measures can be delivered by the MRF administrator than by the OFW industry or plan promoter alone. This policy also aims to increase co-ordination for measures,

[32] Option fees are paid for a period of time to secure the seabed rights for OFW farm development.

which is critical to garner the benefits associated. By ensuring environmental damage is compensated for, where it cannot be avoided or mitigated, ensures the provision of ecosystem services that a healthy marine ecosystem provides. All benefits are discussed in detail in Section 5 and a summary of ecosystem services is provided in Annex 3.

Table 1 summarises the present value costs quantified for both of the measures for OFW developers operating in the UK. These are calculated by summing the costs across all of the policy measures (see next paragraph for detail). The costs presented are total discounted over the 20-year appraisal period and average annual costs to the whole OFW industry over the duration of the appraisal period. Table 2 to Table 4 breaks this UK cost up between England, Wales and Scotland. We do not scope in Northern Ireland into the UK costs as there is uncertainty regarding the design of any future support scheme in NI (they do not currently take part in the Contract for Difference (CfD) scheme).[33] The annual costs of the two policy measures to the OFW industry operating in England, Wales and Scotland is between £0.40 - 7 million, £0.05 - £2 million, and £0.50 – 8 million, respectively. Note, these ranges use the highest estimate in the 'high' row of the tables and the lowest estimate in the 'low' row of the tables (i.e., presenting a possible 'worst' and 'best' case scenario). This sums up to around £1 - 15 million in cost per year for developers operating in the UK, as seen in Table 1.

*Table 1 - Discounted costs to OFW developers operating in **UK** for Defra Energy Bill policy measures*

Cost of all measures	**Total costs – 20 years** (£mn)	**Average yearly costs** (£mn)
High-cost scenario	300	15
Low-cost scenario	20	1

*Table 2 - Discounted costs to OFW developers operating in **England** for Defra Energy Bill policy measures*

Cost of all measures	**Total costs – 20 years** (£mn)	**Average yearly costs** (£mn)
High-cost scenario	120 - 140	6 - 7
Low-cost scenario	8 - 9	0.40 - 0.45

*Table 3 - Discounted costs to OFW developers operating in **Wales** for Defra Energy Bill policy measures*

Cost of all measures	**Total costs – 20 years** (£mn)	**Average yearly costs** (£mn)
High-cost scenario	15 - 30	0.8 – 2
Low-cost scenario	1 - 2	0.05 – 0.10

*Table 4 - Discounted costs to OFW developers in **Scotland** for Defra Energy Bill policy measures*

Cost of all measures	**Total costs – 20 years** (£mn)	**Average yearly costs** (£mn)
High-cost scenario	150	8
Low-cost scenario	10	0.50

These monetised costs are not all encompassing but they do sum up some of the largest costs that the OFW industry would incur (detail on how these costs were calculated can be seen in Section 5 and in Annex 1). These costs include the crosscutting familiarisation cost of introducing new legislation (<£0.003 million annually for developers operating in the UK), the cost of running a MRF for an estimated value of strategic compensatory measures (£0.1 -2 million annually for developers operating in the UK), the cost of more compensatory measures needed, as a result of SNCB evidence being prioritised, and the additional cost of running a larger MRF as a result of this (£0.9 – 13 million annually for developers operating in the UK). The costs may seem relatively small, when considering the financials of the OFW industry, but this is because in the baseline industry would still have to carry out the environmental assessment and offsetting process (either directly or through a plan promoter) and deliver any necessary compensatory measures, where the policy options considered only look at changing these current

[33] A CFD is a legally binding agreement between a "buyer" and a "seller", requiring that the buyer will pay to the seller the difference between the current value of an asset and its value at contract time. Developers of OFW projects bid for the CfD contracts in competitive auctions where the Government sets out a pot of money for the auction in advance. The lowest bids are all accepted until the maximum budget has been reached. The UK has a CfD scheme in England, Wales and Scotland but not NI.

requirements to address the market failures and inefficiencies, as discussed in Section 3.1. It is therefore not inclusive of all costs, as some were qualitatively assessed due to time constraints, including those to Government or the environment, as set out in Table 5.

We assumed for the basis of this assessment, with BEIS economists, that around 5 - 10%, 40 - 45% and 50% of OFW rollout, and therefore cost, would take place in Wales, England, and Scotland respectively. This is an illustrative split based on extrapolations from the current medium-term pipeline of projects.[34] This split should be treated as indicative as the devolved administrations may undertake further pipeline planning, new projects may come forward near the end of the appraisal period, and the pipeline may not reflect the location of actual deployment, which will depend on whether projects successfully progress to construction and operation.[35] Other assumptions underpinning the analysis are discussed in Section 5.4 and a detailed methodology is presented in Annex 1. Throughout the analysis assumptions used a range to reflect uncertainty, and these were combined into two 'high' and 'low' cost scenarios for each of the measures.

The £1 - 15 million per year needs to be put into the context of the OFW industry financials. In 2020 the revenue from the OFW industry in the UK was around £3.8 billion[36], equivalent to £3.6 billion in 2022 present value. The costs we have monetised are equivalent to less than 0.5% of this revenue. Additionally, as OFW industry revenue will also likely increase in line with the rapid rollout of OFW, these costs will become a lower proportion of revenue than currently estimated against 2020 levels (i.e., if industry revenue increases but the cost of these measures remain the same as currently presented, the proportion will fall[37]). This has been shown recently with increasing energy generation coinciding with increasing revenue: For the UK, electricity generation from OFW has grown significantly from around 5% of total energy generation in 2015 to 11.5% in 2021.[38] From the carbon and renewable energy economy estimates (LCREE) data we can see revenue for the UK OFW industry has grown from around £2.3 billion in 2015 to £3.8 billion in 2020.[39]

Current OFW GW operating capacity in the UK is around 13GW[40] with an ambition of up to 50GW[41] operating by 2030 in the BESS. The Climate Change Committee has also estimated that OFW capacity needed to meet UK net zero is between 65 - 140GW by 2050 in their lower and upper end scenarios.[42] This increase in supply is likely to be matched by increased OFW energy demand, as heat and transport decarbonise through electrification, with renewable energies like wind becoming a critical part of decarbonising economies and slowing climate change.[43] This increase in supply and demand will therefore likely be translated into increased revenue for the industry, reducing the relative cost of these measures.

Although the proposed measures are expected to lead to a relatively small increase in cost, they will also enable the faster rollout of OFW and therefore the realisation of potential increased revenue and saved costs (i.e., from no longer having to pay an option fees for unnecessary time), which could result in a net positive impact of industry finances.

[34] Northern Ireland is assumed to have 0% as it does not take part in the GB CfD scheme. Note, in 2019 Northern Ireland's Department of Economy said their coastline was not suitable for OFW farms due to likely objections in how they look. However, since then they have revealed a new plan for their energy, with a focus on renewables such as OW. The exact uptake however remains very uncertain.

[35] Northern Ireland is assumed to have 0% as it does not take part in the GB CfD scheme. Note, in 2019 Northern Ireland's Department of Economy said their coastline was not suitable for OFW farms due to likely objections in how they look. However, since then they have revealed a new plan for their energy, with a focus on renewables such as OFW. The exact uptake however remains very uncertain.

[36] LCREE data

[37] Note, the costs already factor in the increase in energy generation requiring more infrastructure (and therefore greater strategic compensatory measures) needed.

[38] Energy Trends (publishing.service.gov.uk)

[39] LCREE data

[40] Latest BEIS energy trends publication gives figure of 12.7GW as at end Q1 22.

[41] Note, up to 50GW is an ambition and conditional on cost reductions and what happens in the wider system (e.g., electrolyser demand increase need for renewable generation).

[42] The Climate Change Committee – electricity generation

[43] Office for National Statistics - Wind energy in the UK

Table 5 – Policy Option 1 impacts

Policy measure	Brief description of Policy Option 1	Impacts	Metrics: Annual present value of cost/benefits (annual PVC/PVB) Present value: 2022 Price base: 2020
HRA Review	The potential secondary legislation intends to give earlier and proportionate weighting to SNCBs during the HRA, allows mitigation and compensatory measures to be considered earlier in the consent process and enables appropriate in-combination/plan assessments to be made.	**Benefits:** Shorter consenting period benefits such as possible increased OFW revenue, OFW cost savings and carbon savings - qualitatively assessed in crosscutting impacts. Environmental benefits from giving earlier and proportionate weighting to SNCB evidence/baselining and in-combination/plan assessments carried out properly – qualitatively assessed. Earlier assessment means SNCBs can better plan and manage their resources, including reducing bottlenecks in delivery that would have occurred in the Examination stage of the Assessment – qualitatively assessed. **Costs:** Familiarisation cost to industry –quantified in crosscutting impacts below. More compensatory measures for certain receptors possibly needed from earlier and proportionate weighted SNCB evidence and baselining – quantified. Cost passed to industry to fund larger value MRF (either directly from government or via plan promoter) – quantified. Costs to SNCBs to develop baselines – qualitatively assessed. Government resourcing - qualitatively assessed.	**Primary legislation:** No impacts expected from primary legislation. **Secondary legislation (potential):** PVB: not quantified Annual PVC: UK: £0.9 - 13 million England: £0.3 – 6 million
Strategic compensatory measures and MRF	The primary legislation option enables strategic compensatory measures and their monitoring to be carried out through the MRF.	**Benefits:** Environmental benefits from pooling of measures – qualitatively assessed. Shorter consenting period benefits such as possible increased OFW revenue, OFW cost savings and carbon savings - qualitatively assessed in crosscutting impacts. **Costs:** Familiarisation cost to industry –quantified in crosscutting impacts below.	**Primary legislation:** PVB: not quantified Annual PVC: UK: £0.1 - 2 million England: £0.05 – 1 million **Secondary legislation:** No impacts expected from secondary

		Cost passed to industry to fund MRF (either directly from government or via plan promoter) – quantified. Government resourcing - qualitatively assessed.	legislation.

Table 6 - Crosscutting impacts for all policy measures

Crosscutting impacts	**Benefits:** Shorter consenting period leading to: -Possible increased revenue and cost savings to industry from faster rollout of OFW – qualitatively assessed. - Possible increased carbon savings to energy system from faster rollout of OFW – potential energy system carbon savings from achieving two illustrative net zero scenarios have been illustratively quantified. Defra measures are assumed to increase the likelihood and speed of delivering a fully decarbonised power sector and therefore delivering these savings. **Costs:** Familiarisation cost to industry – quantified. Monitoring and evaluation - qualitatively assessed. Option fee revenue loss to Government – qualitatively assessed	**Primary and secondary (potential) legislation:** These impacts could occur at both the primary and secondary legislation stage, but the exact split is uncertain (depends on the detail of the secondary legislation brought in). Annual PVB: Revenue and cost savings not quantified but Defra measures are assumed to help deliver two illustrative net zero energy system carbon savings. Annual PVC: UK: <£0.003 million England: <0.002 million

Section 4.3 EANDCB

As per RPC guidance, the direct cost to business was calculated using 2019 prices and 2020 Present Value at the HMT 3.5% discount rate. Using our 20-year appraisal period, the partial EANDCB for the part of the proposal detailed in primary legislation (i.e., strategic compensatory measures and MRF) is between £0.1 - 2 million.

Section 5: Further detail on impacts and risks of Policy Option 1

For this analysis, we carried out individual and cross-cutting cost-benefit analysis of the two policy measures. We were able to create monetised estimates for some of these costs and benefits. A detailed breakdown of the methodology for each measure can be found in Annex 1. Workshops and meetings were held with Defra policy officials and BEIS economists to agree the assessment method and identify usable data. We used the OWEIP Opportunity to Comment to allow stakeholders to flag any economic or wider impacts for us to consider. We also sent out a data request to the OFW industry via the 'Pathways to Growth' (P2G)[44] group to check our cost assumptions, however the return was limited due to time constraints and data availability.

All figures were calculated using a range to capture the uncertainty of the analysis. For the costs, we used two BEIS OFW illustrative pathways that meet 50GW (Government ambition) in 2030. We also ran five types of sensitivity tests (higher and lower test for each type) on areas identified as being the most uncertain but could have large impacts on the results. The sensitivities leading to higher costs are presented in the sub-sections below with sensitivities resulting in a lower cost presented in Annex 2. We decided to do this to flag what the upside risks to our costs could be in the main assessment. Section 5.4 also details our level of confidence in our underpinning assumptions and how these could impact the analysis.

Section 5.1 Crosscutting impacts and risks

This section considers costs, benefits and risks that are crosscutting across both of the policy measures.

Costs – monetised

There is one monetised cost that is cross-cutting across all measures:

- Familiarisation costs of new legislation: familiarisation costs help us estimate the cost of implementing regulation (e.g. it could be the cost of updating IT systems or training etc.). For the OWEIP measures in the Energy Bill, we assumed that the familiarisation cost would be the cost of disseminating information throughout the business by reading technical guidance. We assumed that this would be a one-off cost occurring in the year the legislation was introduced, and was calculated using the following equation with further detail on the inputs for this presented in Annex 1:

$$Familiarisation\ Cost = No.\ employees\ effected \times time\ taken\ to\ familiarise \times wage \times non\ wage\ uplift$$

  This cost was the lowest of all the monetised costs, costing OFW developers operating in the UK less than £0.003 million annually and less than £0.06 million over the 20-year appraisal period, as seen in Table 7. This cost accounts for less than 0.02% of all monetised costs for both Defra measures. When looking at developers operating in England only, the familiarisation cost is less than £0.001 million annually and less than £0.03 million over the appraisal period, as seen in Table 8. We can therefore confidently say that this cost would not be a high burden on the OFW industry in light of the context given in Section 4.2 above.

  It is also possible that this cost is not realised, for example, as marine compensatory requirements are novel to industry, the familiarisation cost may already be incurred without the introduction of the Defra measures. In fact, the HRA Review could reduce the familiarisation cost to industry by simplifying their requirements.

  This cost was not calculated explicitly for other stakeholders, such as plan promoters but we would expect the cost to be similar or less, as they will likely consist of a few individuals who work across different Leasing Area plans.

*Table 7 – Discounted familiarisation costs to OFW developers operating in the **UK***

Familiarisation cost	**Total costs** (£mn)	**Average yearly costs** (£mn)
High-cost scenario	0.06	0.003
Low-cost scenario	0.03	0.002

[44] Part of The Offshore Wind Sector Deal – a partnership between the industry and the UK Government to provide a long-term strategy.

*Table 8 – Discounted familiarisation costs to OFW developers operating in **England***

Familiarisation cost	**Total costs** (£mn)	**Average yearly costs** (£mn)
High-cost scenario	0.02 – 0.03	~0.001
Low-cost scenario	0.012 – 0.013	~0.0006

Costs – sensitivity

There is one cross-cutting sensitivity that had a significant impact on all monetised costs incurred by the Defra measures:

- Sensitivity on start year: In our analysis we assumed all policies would be implemented in 2023 (earliest possible date) however in reality they may be implemented in 2024 or 2025. Delaying the start date to 2024 and 2025, whilst keeping the appraisal period constant from 2022, reduced the costs over the appraisal period by 0.4 - 3% and 3 - 6% respectively, as summarised in Table 9 and Table 10. This is driven by less costs falling within the appraisal period as opposed to less costs occurring overall. This implied that our 'core' monetised costs were a worst-case scenario in respect to timing of legislation within our appraisal period.

*Table 9 – Difference in total discounted cost to OFW developers operating in UK from delaying start year from 2023 to **2024***

Difference to core scenario[45]	**Total costs** (£mn)	**Average yearly costs** (£mn)	**% change from core scenario**
High-cost scenario	-1	-0.06	-0.4
Low-cost scenario	-0.6	-0.03	-3

*Table 10 - Difference in total discounted cost to OFW developers operating in UK from delaying start year from 2023 to **2025***

Difference to core scenario[46]	**Total costs** (£mn)	**Average yearly costs** (£mn)	**% change from core scenario**
High-cost scenario	-9	-0.50	-3
Low-cost scenario	-1	-0.06	-6

Costs – non-monetised

There are three main non-monetised costs that are cross-cutting across all measures:

- Monitoring and evaluation for OWEIP (in addition to monitoring of strategic compensatory measures): The Defra policy measures under the OWEIP will need to be monitored and evaluated, as discussed in Section 8. This would involve a cost to Government, and possibly industry if the cost is passed on, in time and resources to ensure it is carried out to an appropriate standard.
- Government resourcing: Different policy measures will have different impacts on requirements and are therefore considered under each sub-section below.
- Option fee revenue loss to Government: Option fees, as discussed in the non-monetised benefits section below, are payments from the OFW industry to the Crown Estate to secure seabed rights for development. By shortening consenting time, these measures will reduce the amount of time industry have to pay the option fee. However, as the public sector is the recipient of the fee, this does mean less revenue for Government (i.e., the benefit is transferred from the Government to industry).

Benefits – non-monetised

For the regulatory options, benefits were not monetised, however the energy system carbon savings from achieving two possible net zero scenarios were.

Benefits of reduced emissions from a faster rollout of OFW have not been monetised. Estimating carbon savings in the power sector is complex and highly dependent on the scenario and technology mix

[45] I.e. start year in 2023 with costs as illustrated in Table 1

[46] Ibid

assumed.[47] For this reason, it was not appropriate to quantify the carbon savings of increased OFW deployment in isolation, whether to 40GW or up to 50GW by 2030.

Nonetheless, OFW is crucial in supporting the decarbonisation of the power sector and rolling out more OFW would help deliver on the UK's carbon commitments and importantly help mitigate against delivery risks. We therefore present the carbon savings, provided by BEIS, from achieving two illustrative net zero scenarios relative to a current 'known policy' trajectory.[48]

Through cutting down the time it takes to deliver an OFW farm, and therefore increasing the likelihood of delivering more OFW capacity more quickly, the policies assessed are assumed to increase the likelihood and speed of delivering a fully decarbonised power sector and therefore delivering the carbon savings valued at £320 – 360 million per year over our appraisal period (using central carbon value estimates), as shown in Table 11 and valued in Table 12. However, the extent to which this is true will depend on developments in the wider power system.

These two net zero scenarios were calculated using pre-BESS renewable deployment and as the proposed measures could enable up to 50GW of OFW to be installed by 2030 (up from 13GW currently installed), this would enable greater carbon savings in the power sector and wider economy when combined with other policies (e.g., greater electrification of heat and transport, production of green hydrogen through electrolysis).

Table 11: Energy system carbon savings under two net zero illustrative pathways

Energy system carbon savings	**Total carbon savings** (mTCO2e[49])	**Average yearly carbon savings** (mTCO2e)
Net zero high vs known policy	104	5
Net zero low vs known policy	103	5

Table 12 – Discounted value of carbon savings

Value of possible energy system carbon savings (central carbon values[50])	**Total benefits** (£mn)	**Average yearly benefits** (£mn)
Net zero high vs known policy	7,100	360
Net zero low vs known policy	6,300	320

Benefits – carbon savings from two illustrative net zero pathways - monetised - sensitivity

To calculate the value of the possible energy system carbon savings under these scenarios, we applied carbon value as per Green Book[51] guidance. These carbon values were calculated to reflect the marginal cost[52] of getting the country to meet its net zero carbon target in 2050. As per the guidance, we used the central carbon values in Table 12, but also ran a sensitivity analysis on the low and high carbon (+/-50% of central values). The higher sensitivity, as shown in Table 13, led to significantly higher energy system carbon savings of £470 – 540 million per year over our appraisal period, of which increased OFW would help deliver.

Table 13 - Sensitivity analysis using high carbon value (+50% to central values)

Discounted value of possible energy system carbon savings (high carbon values)	**Total benefits** (£mn)	**Average yearly benefits** (£mn)
Net zero high vs known policy	11,000	540
Net zero low vs known policy	9,500	470

[47] There are many pathways to decarbonising the power sector and the carbon savings of any one technology will depend heavily on the counterfactual used, technology mix assumed and speed of decarbonisation. To ensure a fair comparison, BEIS analysts typically compare the impact of individual technologies from a carbon neutral perspective, where the emissions trajectory is the same as a net zero counterfactual.

[48] "Known policy" includes known, planned and implemented policies and represents the current trajectory. The net zero scenarios represent two illustrative pathways to meeting the UK's carbon budget and net zero commitments, with varying levels of electricity demand from the electrification of heat and transport. See annexes of the 2021 partial update of the Energy and Emissions projections report.

[49] Million tonnes of CO2 equivalent.

[50] High and low carbon values shown in Annex 2 – Sensitivities.

[51] HMT Green Book - Carbon values

[52] Cost incurred in the production of one more unit of a good or service

Table 14- Sensitivity analysis using low carbon value (-50% to central values)

Discounted value of possible energy system carbon savings (low carbon values)	**Total benefits** (£mn)	**Average yearly benefits** (£mn)
Net zero high vs known policy	3,600	180
Net zero low vs known policy	3,200	160

There are two other main non-monetised benefits that are cross-cutting across all measures:

- Possible cost saving from reducing consenting time and simplifying the process:

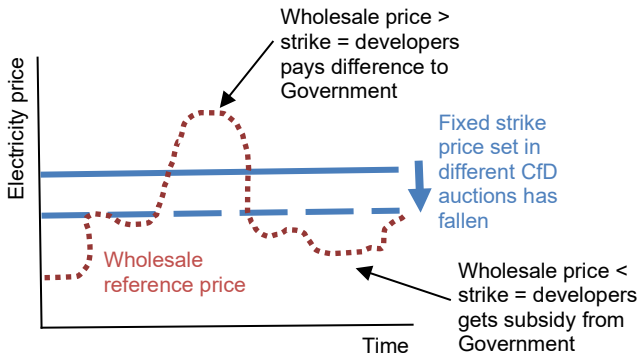
  Respondents to the OWEIP Opportunity to Comment identified a key benefit as the expected reduction in complexity for the assessment process, leading to reduced costs and resource demands within organisations. However this reduction in complexity in assessment process should be carefully monitored to ensure organisation are adjusting to new approaches.

  Saving on option fees is a key benefit for OFW developers from shortening the OFW consenting process. Option fees are paid by OFW developers in exchange for securing seabed rights for OFW farms. Developers pay this up to the point the OFW farm starts constructing. Therefore, any delays to consenting would cause them to pay the option fee for a longer period of time. These costs are dependent on the size of the seabed secured, but for a project delivering 1.5GW of capacity, this could range between £100-250 million per year (in 2022 prices) until construction takes place.[53] Anecdotally, Natural England has been told that delays have cost certain developers £10 million per week in lost revenue.[54] We were unable to quantify the total amount of expected industry option fee savings due to time constraints, but the amount will depend on the exact time savings delivered from the policies.

- Possible increased OFW industry revenue from quicker rollout of OFW: It is possible that the Defra policy measures could increase the present value of industry revenue. The measures aim to decrease consenting time, allowing for a quicker rollout of OFW in the short run.

  These measures could therefore lead to an increase in revenue in the short run as more OFW energy is produced, but this will depend on other factors such as the wholesale price of electricity and the strike price developers secure in future CfD auctions.[55] In the CfD agreements, projects are paid the difference between a fixed strike price and the reference wholesale price (i.e., the strike price is the price of energy consumers have agreed to pay developers in the future). When the wholesale price is below the strike price, the developer receives a top-up payment, paid for by consumers. When the wholesale price is above the strike price, the developer pays the difference back, reducing the net cost of the scheme. This is shown by Figure 2. As the lowest bids are accepted in a CfD auction, competition and lowered production costs in the industry has led to decreasing strike prices over time.

Figure 2 – Reduction in strike price reducing revenue



This analysis has not been quantified at this primary legislation stage as it would require detailed

[53] Defra policy provided statistics from industry data.

[54] Provided by Defra policy officials.

[55] A CFD is a legally binding agreement between a "buyer" and a "seller", requiring that the buyer will pay to the seller the difference between the current value of an asset and its value at contract time. Developers of OFW projects bid for the CfD contracts in competitive auctions where the Government sets out a pot of money for the auction in advance. The lowest bids are all accepted until the maximum budget has been reached.

analysis of all current and future policy measures, which are currently highly uncertain and/or in development, and an understanding of how they contribute to precise time savings in the OFW development process. Work would need to be done to estimate future strike prices, wholesale prices, competition and market conditions would also need to be developed.

- Whether this increased revenue and cost saving corresponds to increased profits will depend on future average construction costs. It is possible that there could be increased average construction costs to industry from speeding up the rollout of OFW. This is not a cost of the policy as it would be up to industry to develop OFW farms sooner, but it is important to understand the net financial impact of the OFW industry from developing sooner.

  The average cost of OFW farm construction has decreased substantially over the last few decades. The falling Levelised Cost of Electricity (LCOE)[56] over time has shown this trend. In 2013, the UK Government estimated that an OFW farm opening in 2025 would generate electricity for £140/MWh (£2018). In 2020, this was reduced to £57/MWh (£2018), equivalent to a 60% reduction in costs.[57]

  There have been three main drivers for decreasing average costs: supply chain evolution, steep decline in the cost of capital (financing), and technological development. Over time, the OFW supply chain has matured, and larger companies have taken on wider scopes and risk, allowing cross-disciplinary collaboration to reduce cost. Larger companies have also carried out investment in making large-scale production more efficient.[58] The presence of the CfD and other global factors including deployment, have driven a steep decline in the cost of capital (financing) as the industry has matured.[59]

  However, to date the biggest driver of costs has been the increase in turbine ratings (i.e., maximum amount of power a wind turbine can produce) from 2 megawatt (MW) turbines to greater than 10MW turbines. Evidence suggests we may continue to expect larger turbines, with 14MW turbines expected by 2025 and 20MW turbines expected by 2035.[60] Although this is historically based on fixed OFW farms, there is evidence that floating turbine ratings will be similar and that they could align with fixed ratings by 2037.[61] However, only demonstrator projects have been deployed to date and this remains highly uncertain.

  This is important as larger turbines drive down the per MW cost of foundations, installation and operation of OFW farms. They also increase energy production per MW installed as they can reach higher into the wind field. It is therefore likely that average costs continue to fall in upcoming years. BEIS estimate the LCOE of an OFW plant commissioning in 2040 will fall to £40/MWh (in 2018 prices), around 30% lower than commissioning in 2025.[62]

Risks

There are possible risks which cut across both of the policy measures:

- Regulatory resource: ensuring compliance with regulatory options will have implications for regulatory resources, but this will likely be offset by the resource savings that will be made as less time will be needed to assess license applications.
- Government resource: designing the policies will result in increased resource requirements in core Defra. If this cannot be provided, there is a risk to policy delivery and associated benefits.
- Impact on rollout of OFW overstated: it is possible that the impact of the Defra measures in reducing consenting time and enabling a quicker rollout of OFW is overstated. For example, industry may choose not to develop sooner such that they can benefit from decreased future

[56] The discounted lifetime cost of building and operating a generation asset, expressed as a cost per unit of electricity generated (£/MWh).

[57] Carbon Brief, 2020

[58] Guide to an OFW farm

[59] BEIS economists

[60] Siemens Gamesa have announced the largest offshore turbine yet, rated at 14MW and other manufacturers are expected to follow suit. The turbine already has >4GW of orders with delivery expected in 2025. The 20MW is taken from this report by the NREL. experience shows jumps in turbine sizes have happened faster than predicted and there is already some evidence of this for 2025 (e.g., 15MW planned for production in 2024 and 16MW turbine planned for production in 2024).

[61] OREC report suggests floating and fixed turbine ratings will converge but there is more uncertainty regarding the trajectory of floating turbines.

[62] BEIS – Electricity generation costs 2020

construction costs (as discussed in the section above). Although this is likely offset by the fact that developers all face the same costs and can secure a stable revenue stream at a fixed price through the CfD. If developers wait they might benefit from lower deployment costs but so would competitors, meaning the CfD strike price they can obtain will likely be lower.

- Competition risk: depending on how measures work in practice across the UK (for example if more strategic compensatory measures are identified for English projects), there could be impacts on competition, as developers can choose between the Devolved Administration locations in the CfD auction. If the measures have a net positive impact on developers, this could decrease the competitiveness of other Devolved Administration locations relative to England (and vice versa if a net negative impact on developers).
- Compensatory measures costs needed sooner from speeding up the rollout of OW: if more OFW farms can be developed sooner, the developers will likely have to pay (either directly or indirectly through the plan promoter) for compensatory measures sooner (increasing the present value of costs). This will depend on the pace of the rollout from the Defra specific measures and on the timing in which compensatory measures costs (including strategic compensatory measures costs) are required to be paid for by developers.

Section 5.2 Habitats Regulations Assessment Review

This section considers costs, benefits and risks that are only relevant to the HRA Review. This analysis uses potential secondary legislation to indicate impacts.

Potential costs – monetised

There are three potential costs to the OFW industry that we have monetised for the HRA Review: familiarisation cost (covered in crosscutting impacts above), the higher cost of compensatory measures from greater weighted SNCB evidence and baselining, and subsequent costs passed to industry to fund a larger value MRF. For the compensatory measures, our analysis uses a bundle of four measures that have been looked into by the OFW industry to meet compensatory requirements.

The latter two costs are detailed in the bullets below and sum up to an annual HRA Review cost of £1 - 13 million for the OFW industry operating in the UK, equivalent to £17 - 260 million over the appraisal period, as seen in Table 15. This is very small when considered contextually against the OFW industry financials (i.e., £3.8 billion UK OFW industry revenue in 2020[63], equivalent to £3.6 billion in 2022 present value). When looking at developers operating in England only, these two costs sum up to between £0.3 - £6 million annually and £7 - 120 million over the appraisal period.

*Table 15 – Potential discounted cost of HRA Review to OFW developers operating in the **UK***

Total HRA cost	**Total costs** (£mn)	**Average yearly costs** (£mn)
High-cost scenario	260	13
Low-cost scenario	17	1

*Table 16 – Potential discounted cost of HRA Review to OFW developers operating in **England***

Total HRA cost	**Total costs** (£mn)	**Average yearly costs** (£mn)
High-cost scenario	100 - 120	5 - 6
Low-cost scenario	7 - 8	0.3 - 0.4

Below is a breakdown of the two HRA Review specific costs contributing to the total HRA Review cost tables above. These costs are indicative only as they will depend on the exact secondary legislation put in place.

- Higher cost from more compensatory measures needed as a result of earlier, proportionate weighting of SNCB evidence and baselining:

  Currently competent authorities seek evidence from developers and SNCBs on negative environmental impacts to protected sites, determining the level of mitigation and compensatory measures required. This leads to periods of debate and unnecessary delays. As developers are profit maximising firms, they may have an incentive to produce a 'better case' of environmental impacts (i.e. lower impacts) compared to SNCBs, although it is still possible industry estimates

[63] UK Government - LCREE data

could be precautionary. SNCBs are often driven to be precautionary in their assessment due to case law precedents. If SNCB evidence was given earlier and proportionate weighting, and the margins between industry and SNCB evidence were notable, this could therefore result in developers paying more in mitigation and compensatory measures.

We have assumed this could increase our value of strategic compensatory measures by 10 - 40%, with the latter being a less likely worst-case scenario for the increase. This assumption was decided with Defra policy but is caveated (see Section 5.4) as the impact is uncertain and based on policy judgment from different stakeholder engagement.

For developers operating in the UK, this element of the HRA Review would lead to an annual increase in costs of £1 - 12 million and £17 - 250 million over the appraisal period, as seen in Table 17. For developers operating in England, this would lead to an annual increase in costs of £0.3 - 6 million and £7 - 110 million over the appraisal period, as seen in Table 18. These figures demonstrate that SNCB evidence prioritisation is the main driver of our total HRA Review cost.

*Table 17 – Potential discounted costs of additional compensatory measures required to OFW developers operating in the **UK***

Additional compensatory measures cost	**Total costs** (£mn)	**Average yearly costs** (£mn)
High-cost scenario	250	12
Low-cost scenario	17	1

*Table 18 – Potential discounted costs of additional compensatory measures required to OFW developers operating in **England***

Additional compensatory measures cost	**Total costs** (£mn)	**Average yearly costs** (£mn)
High-cost scenario	100 - 110	5 - 6
Low-cost scenario	7 - 8	0.3 - 0.4

- Subsequent cost passed to industry to fund MRF:

  If SNCB evidence was given earlier and proportionate weighting that did increase the value of compensatory measures required, this would in turn impact the size of the MRF (given this is the vessel for strategic compensatory measures to be delivered and assuming a take up of the MRF by developers – see Section 5.4) and therefore the amount of money needed to run the Fund (which is a proportion of the total Fund's value – see Section 5.4). We assume this cost is fully passed on to OFW developers.

  For developers operating in the UK, this element of the HRA Review would lead to an increase in costs of around £0.01 - 0.6 million annually and £0.3 - 12 million over the appraisal period, as seen in Table 19. For developers operating in England, this would lead to an increase in costs of around £0.005 – 0.3 million annually and £0.1 – 5.4 million over the appraisal period, as seen in Table 20. The MRF cost is therefore a smaller proportion of the total HRA Review cost.

*Table 19 - Potential discounted cost of additional MRF to OFW developers in the **UK***

Additional MRF cost	**Total costs** (£mn)	**Average yearly costs** (£mn)
High-cost scenario	12	0.6
Low-cost scenario	0.3	0.01

*Table 20 - Potential discounted cost of additional MRF to OFW developers in **England***

Additional MRF cost	**Total costs** (£mn)	**Average yearly costs** (£mn)
High-cost scenario	4.8 - 5.4	0.2 - 0.3
Low-cost scenario	0.10 - 0.11	0.005 - 0.006

- *Potential costs –monetised – sensitivities*

  As these estimates were determined using the value of strategic compensatory measures (see section 5.3 for further details), the sensitives[64] run on this value filtered through to these potential HRA costs:

  - Higher cost of compensatory measures (or more compensatory measures needed)

[64] 1) average land use for OFW energy production and 2) the cost of the compensatory measures

Our current analysis uses a bundle of four[65] measures that have been looked into by the OFW industry to meet compensatory requirements. As it is only recently that OFW farms have had to start carrying out compensatory measures (it is becoming trickier for OFW development to avoid adverse effects as the marine space becomes more crowded), other measures and their cost are still being determined.

To reflect this, we have done a sensitivity increasing costs by 50% (the equivalent of increasing the number of measures needed to gain development consent by 2). Again, as this impacts the value of strategic compensatory measures required, this sensitivity would increase the cost from earlier and proportionate SNCB weighting and the associated MRF cost, as seen by Table 21 and Table 22. This would increase the annual HRA cost to £20 million per year in the high-cost scenario, as shown in Table 23, which is still small when considered contextually.

*Table 21 - Sensitivity analysis on potential discounted costs of additional compensation for OFW developers in the **UK***

Additional compensatory measures cost	**Total costs** (£mn) (percentage change compared to core scenario)	**Average yearly costs** (£mn)
High sensitivity and high-cost scenario	380 (50% ↑)	19 (50% ↑)

*Table 22 - Sensitivity analysis on potential discounted cost of additional MRF for OFW developers in the **UK***

Additional MRF cost	**Total costs** (£mn) (percentage change compared to core scenario)	**Average yearly costs** (£mn)
High sensitivity and high-cost scenario	30 (50% ↑)	1 (50% ↑)

*Table 23 - Sensitivity analysis on potential discounted cost of HRA Review for OFW developers in the **UK***

Total HRA cost	**Total costs** (£mn) (percentage change compared to core scenario)	**Average yearly costs** (£mn)
High sensitivity and high-cost scenario	400 (50% ↑)	20 (50% ↑)

- More OFW turbines needed for same amount of electricity produced:

This sensitivity allowed us to explore what would happen if OFW farms operated at a lower energy production efficiency (i.e. needing more OFW turbines, and therefore more seabed needed for their construction, for the same amount of electricity created). Although this is a less likely scenario given historical and expected movements in efficiency, this sensitivity reflects future uncertainty.

This would likely increase the probability of an impact occurring such that compensatory measures would be necessary, as there would be more or larger OFW farms. As the earlier and proportionate SNCB weighting and the MRF costs depend on the value of strategic compensation, this sensitivity would increase these costs as seen in Table 24 and Table 25. In the low-cost scenario, this sensitivity leads to a 0% change in costs but in the high-cost scenario, this sensitivity leads to an 11% increase in costs with the HRA Review specific cost increasing to £14 million annually for the OFW developers operating in the UK, as shown by Table 26. This is a relatively small change to our 'core' scenario and minimal when considered contextually.

[65] Four measures – three on benthic and one on birds due to availability of evidence and cost data.

Table 24 - Sensitivity analysis on potential discounted costs of additional compensation for OFW developers in UK

Additional compensatory measures cost	**Total costs** (£mn) (percentage change compared to core scenario)	**Average yearly costs** (£mn) (percentage change compared to core scenario)
High-cost scenario	280 (11% ↑)	14 (11% ↑)
Low-cost scenario	17 (0%)	1 (0%)

Table 25 - Sensitivity analysis on potential discounted cost of additional MRF for OFW developers in UK

Additional MRF cost	**Total costs** (£mn) (percentage change compared to core scenario)	**Average yearly costs** (£mn) (percentage change compared to core scenario)
High-cost scenario	14 (11% ↑)	1 (11% ↑)
Low-cost scenario	0.3 (0%)	0.01 (0%)

Table 26 - Sensitivity analysis on potential discounted cost of HRA Review for OFW developers in UK

Total HRA Review cost	**Total costs** (£mn) (percentage change compared to core scenario)	**Average yearly costs** (£mn) (percentage change compared to core scenario)
High-cost scenario	300 (11% ↑)	14 (11% ↑)
Low-cost scenario	17 (0%)	1 (0%)

Costs – non-monetised

There are a number of costs we have not monetised in this assessment:

- SNCB effort/cost of establishing baseline: There is a short-term cost to SNCBs of needing to establish environmental baselines to inform their environmental impact analysis for the HRA process. This cost would consist of employee time and resources for monitoring, potentially leading to other work not being carried out.
- Possible increased compensatory measures costs from 'in-combination' assessments being carried out by Government: Currently the onus is on developers or plan promoters to carry out these assessments (i.e., joint assessment of more than one development – for example, it could be an assessment of all developments in a plan area) on their project impact on protected areas. Due to commercial sensitivities, developers are unlikely to carry this out together at a strategic level and therefore unlikely to fully reflect the cumulative impacts from multiple OFW farms within the development process. Government carrying out the 'in-combination' assessments, and requiring the relevant data from industry, could therefore lead to an increase in compensatory measures required as it may pick up impacts that were previously missed due to the siloed approach. For the secondary legislation IA, this impact will need to be considered in tandem with the greater weighted SNCB evidence possibly requiring greater compensatory measures to determine the cumulative impact on the OFW industry.
- Government resourcing: any specific change to OFW HRA will need to be implemented and monitored by ALBs.

Benefits - illustratively monetised

The HRA Review contributes to a shorter consenting period this could lead to potential energy system carbon savings as discussed in the crosscutting impacts. The OWEIP Opportunity to Comment found that c60% of respondents thought streamlining the HRA process and assessing mitigation earlier would be appropriate to support faster consenting of OFW (c10% disagreed and c30% did not answer).

Benefits – non-monetised

There are multiple benefits from the HRA Review that have not been monetised. Note, these changes will be most beneficial to future leasing round developments beyond Round 4.[66] The benefits are:

- Shorter consenting period benefits revenue and cost savings: The HRA Review contributes to a shorter consenting period, as discussed earlier, this could lead to revenue benefits and cost savings as discussed in the crosscutting impacts.

- Environmental benefits from earlier and proportionate SNCB weighting. This policy would ensure that the correct level of mitigation and compensatory measures was carried out for any environmental damage to protected areas, ensuring no net loss is achieved and preserving the ecosystem services (as detailed in Annex 3) these areas provide.

- Earlier consideration of impacts and compensatory measures should allow SNCBs to better plan their flow of resources during the HRA, to avoid bottlenecks in delivery and reduce delivery risk.

- Greater emphasis on 'in-combination' assessments – by considering impacts more holistically and across greater geographic areas or receptor populations, cumulative impacts can be better understood and therefore managed. This is important due to the rapidly increasing scale of OFW development and the dynamic nature of the marine environment meaning cumulative impacts are almost certain. These assessments also enable strategic compensatory measures and their associated benefits (as discussed in Section 5.3 below).

Risks

There are risks associated with this measure:

- Higher cost to industry from earlier and proportionate SNCB evidence weighting/baselining than expected. Our current costs are based on expected value of strategic compensatory measures, however as the first HRA resulting in compensatory measures from OFW development was only consented in December 2020, there is a risk these costs could be greater (we do not have the history of data to confirm costs with certainty). There is also uncertainty around how much this might change from better SNCB evidence and therefore the impact could be greater than expected.
- By giving greater weight to SNCBs during the assessment, it is possible that overly precautionary evidence is used when determining the compensatory measures required to gain development consent. This could result in unnecessary costs to OFW developers.

Section 5.3 Strategic compensatory measures and Marine Recovery Fund

This sub-section considers costs, benefits and risks that are only relevant to strategic compensatory measures and the MRF.

Costs – monetised

There are three costs that we have monetised for strategic compensatory measures and the MRF: familiarisation cost (covered in crosscutting impacts above), and the cost of the MRF to deliver i) strategic compensatory measures and ii) monitoring of the strategic compensatory measures. For the latter two, we assume 30 - 70% of compensatory measures will take place through the MRF (i.e., this is the assumed take up of the MRF) and we assume the MRF costs are fully passed on from the MRF administrator to industry (either directly or through the plan promoter). The latter two costs are detailed in the bullets below.

Together, they provide a MRF cost of £0.1 - 2 million annually for OFW developers in the UK, and £3 - 40 million over the appraisal period, as shown by Table 27. This shows that the MRF and strategic compensatory measures policy should incur lower costs on the OFW industry compared to the HRA Review. This cost is also very small when considered contextually against the OFW industry financials (i.e., £3.8 billion in UK OFW industry revenue in 2020,[67] equivalent to £3.6 billion in 2022 present value).

[66] A mechanism through which developers will apply for rights to build OFW farms to provide low-carbon electricity.

[67] UK Government - LCREE data

When considering OFW developers in England, this policy measure would lead to an annual increase in costs of £0.05 - 1 million and £1.1 – 19 million over the appraisal period, as seen in Table 28.

*Table 27 - Discounted cost of enabling strategic compensatory measures and the MRF to OFW developers operating in the **UK***

Total MRF cost	**Total costs** (£mn)	**Average yearly costs** (£mn)
High-cost scenario	40	2
Low-cost scenario	3	0.1

*Table 28 - Discounted cost of enabling strategic compensatory measures and the MRF to OFW developers operating in **England***

Total MRF cost	**Total costs** (£mn)	**Average yearly costs** (£mn)
High-cost scenario	17 - 19	0.9 - 1.0
Low-cost scenario	1.1 - 1.2	0.05 - 0.06

Below is a breakdown of the two strategic compensatory measures specific costs contributing to the tables above:

- Cost passed to industry to fund the running of the MRF:

  We have assumed that strategic compensatory measures and their monitoring will be delivered through the MRF. This will incur a cost driven by the size of the Fund and the take up of the Fund by industry and plan promoters (see Section 5.4). We assume that any cost incurred by the plan promoter would be passed on to industry (as per the Polluter Pays principle). The size is dependent on the value of strategic compensatory measures and the value of monitoring the compensatory measures, therefore this was estimated to calculate the costs. The former contributes to a larger amount to the total MRF cost as seen by the breakdown Table 29 and Table 30. This relative contribution of the two components of the Fund's size is the same for OFW developers in England and therefore not explicitly tabled below.

*Table 29 - Discounted MRF cost excluding monitoring costs on OFW developers in the **UK***

MRF cost – strategic compensatory measures (exc. monitoring)	**Total costs** (£mn)	**Average yearly costs** (£mn)
High-cost scenario	30	2
Low-cost scenario	3	0.1

*Table 30 - Discounted MRF cost from compensatory measures monitoring on OFW developers in the **UK***

MRF cost – compensatory measures monitoring	**Total costs** (£mn)	**Average yearly costs** (£mn)
High-cost scenario	12	0.6
Low-cost scenario	0.09	0.004

- *Costs – monetised – sensitivities*

  As the largest driver of the MRF cost was the value of strategic compensatory measures we ran two sensitivities on this. These sensitivities did not impact the MRF related to monitoring due to the way the analysis was undertaken (see Annex 1 for detailed methodology), therefore the change in the MRF cost is driven by the increased value of strategic compensatory measures expected only.

  - Higher cost of compensatory measures (or more compensatory measures needed)

  This sensitivity is described in the previous section. Again, as this impacts the value of strategic compensatory measures required to get development consent, this sensitivity would increase the MRF cost depending on whether the number or cost of compensatory measures was higher than our core scenario. In the high-cost sensitivity scenario, this would increase the MRF cost to £3 million annually or to £60 million over the appraisal period for OFW developers in the UK, as shown in Table 31. This is still small when considered contextually.

*Table 31 - Sensitivity analysis impact on discounted MRF cost to OFW developers operating in the **UK** - considering strategic compensatory measures only*

Total MRF cost	**Total costs** (£mn) (percentage change compared to core scenario)	**Average yearly costs** (£mn)(percentage change compared to core scenario)
High sensitivity and high-cost scenario	60 (36% ↑)	3 (46% ↑)

- More OFW turbines needed for same amount of electricity produced:

This sensitivity is described in the previous section. In the low-cost scenario, this sensitivity does not impact costs. However, in the high-cost scenario this sensitivity leads to an 8% increase in the cost of the MRF, totalling £2.3 million annually and £50 million over the appraisal period, as seen in Table 32. This is a relatively small change to our 'core' scenario and minimal when considered contextually.

*Table 32 - Sensitivity analysis impact on discounted MRF cost to OFW developers operating in the **UK** - considering strategic compensatory measures only*

Total MRF cost	**Total costs** (£mn) (percentage change compared to core scenario)	**Average yearly costs** (£mn) (percentage change compared to core scenario)
High-cost scenario	50 (8% ↑)	2.3 (8% ↑)
Low-cost scenario	3 (0% ↑)	0.1 (0% ↑)

Costs – non-monetised

There are also several costs we have not monetised in this assessment:

- Government resourcing: Government will have to spend time scoping and agreeing strategic compensatory measures with the Defra SoS. They will have to work with developers and plan promoters to come up with a list of compensatory measures for this agreement. This is expected to be a short-term cost and expected to be minor relative to other costs quantified.

Benefits - illustratively monetised

Strategic compensatory measures and the MRF contribute to a shorter consenting period. As discussed earlier, this could lead to potential energy system carbon savings as discussed in the crosscutting impacts.

Benefits – non-monetised

There are multiple benefits from introducing strategic compensatory measures and the MRF in primary legislation that have not been monetised:

- Environmental benefits: strategic compensatory measures pool resources and deliver compensatory measures by joining up to deliver environmental benefits greater than the sum of the individual project parts. There may also be strategic compensatory measures that can only be delivered through Government and its coordination (e.g. enhanced protection, management of other pressures). These measures would reduce risks to compensation not being delivered and therefore protect the environment, delivering ecosystem service benefits.

  Two examples of this are below:

  1) To compensate for loss of red-throated divers a sanctuary zone could be created. It is unlikely that a single developer could create this on their own, given the various sea users that would be affected. Only small aspects of compensation would be in the developers control, but these in isolation would not constitute compensation. A coordination role is needed to ensure all aspects of a sanctuary zone could be developed and created and to attribute compensation to all affected developers as necessary.

2) Regarding compensatory measures for kittiwakes, the problem with compensation is that it is not exclusive to a given project, with any new development in the English North Sea likely requiring kittiwake compensation. The compensation option of onshore artificial nesting has already been exhausted by current projects that have put forward this measure for compensation. While offshore nesting platforms are still an option for developers to pursue, they have their own issues which also require Government intervention to resolve. Other measures (prey availability) can only be actioned by Government, and all measures possible will likely require implementation to offset impacts on kittiwakes.

Government intervention in both cases would therefore ensure red throated divers and kittiwakes do not decline, ensuring biodiversity is maintained and their related ecosystem services are provided (ecosystem services are discussed in detail in Annex 3).

- Shorter consenting period benefits revenue and cost savings: strategic compensatory measures contribute to a shorter consenting period, as discussed earlier, this could lead to revenue and cost saving benefits as discussed in the crosscutting impacts.

- Potentially lower administrative cost going through the MRF rather than delivering monitoring and compensatory measures on their own. For example, industry and plan promoters would have to set up their own steering groups to advise, pay for other individuals to carry out the administrative tasks etc.

- Potentially lower cost of compensatory measures and reduced risk of project failure: it is possible that strategic compensatory measures will be lower in cost for individual developers or plan promoters than current measures. Moreover, failure to identify compensatory measures could result in total OFW development failure, this risk is reduced by allowing the MRF administrator to carry out these responsibilities.

Risks

There are risks associated with this measure:

- Industry costs may be greater than expected. These costs will be driven by the amount of strategic compensatory measures required which is dependent on the scale of environmental impact, the cost of the strategic compensatory measures and the number needed to get consent. There is limited data on historical compensatory measures.[68] Although it's been a long-standing requirement under the HRA for any development that cannot rule out adverse effects on a protected area but is consented on the basis of imperative reasons of overriding public interest, the first HRA resulting in compensatory measures in the marine environment from OFW development was consented in December 2020. Some types of compensatory measures would need a marine licence which would increase costs and delivery risk.
- The amount Government requires industry to pay for compensatory measures could therefore change over time as they learn more about what measures work, impacting the size of the MRF and monitoring required.
- The environmental benefits may be overstated if Government does not take a flexible approach to developing the strategic compensatory measures. Some measures may not work as well in providing compensatory measures for the environmental damage. It is also unclear how Government will protect the measures to ensure the environmental benefits are not short-lived. Government will therefore need flexibility to adjust measures approved by SoS accordingly. Without this, there is a risk that the desired environmental benefits will not be achieved.
- There is a risk to timings of environmental benefits too where there is uncertainty on how soon post consent we expect compensatory measures to be in place, but these are expected to be in place before environmental damage is done.
- The costs could be larger for some OFW developers compared to others as the size and location of the OFW project plays an important role in how many compensatory measures they have to deliver, and therefore how much they have to contribute to the MRF.[69] We have not undertaken

[68] OFW industry could not provide estimates of what their compensatory measures could be so we have had to model a potential scenario.

[69] From engagement with OFW industry.

analysis considering impacts at an individual developer level.

Section 5.4 Key assumptions

The following are key assumptions that have been made when developing the analysis. They have been assigned an 'importance' and confidence rating (rated low, medium or high), with the former depending on how much each individual assumption impacts the analysis. These ratings are summarised in Table 33 below with a Red-Amber-Green scale highlighting the assumptions of small/no concern (green), medium (amber) and large concern (red). This is determined by the combination of the importance and confidence ratings. A justification for the RAG rating is provided in the text below the table and further detail on the analytical methodology and assumptions can be seen in Annex 1.

Table 33 Summary of assumption ratings

Assumption	Importance	Confidence
Analytical transformation assumptions	High	High
Secondary legislation implemented in 2023	Medium	Medium
Floating OFW project impacts same as fixed	Low	Low
Two Devolved Administration split possible scenarios	High	Medium
OFW illustrative pathways to meet 50GW in 2030	High	Medium
Average size of an OFW project and spatial conversion	High	Medium
Strategic compensatory measures value	High	Medium
HRA Review impact on compensatory measures value	High	Low
MRF	High	Medium
Familiarisation costs	Negligible	Low
Carbon savings in the energy system	Low	Low
Consumer price impact	High	Medium

1. **Analytical transformation assumptions:** these included using a 20-year appraisal period from 2022, 2020 prices and the 3.5% HMT Green Book discount rate. We also assumed varying optimism biases as shown in the table below and justification provided in Annex 1. We are confident in these assumptions and therefore they are rated as 'green' (small/no concern).

   Impact on analysis: High – shorter appraisal period and lower optimism bias in particular would decrease costs substantially, and vice versa.

   Confidence: High – these were made following HMT guidance and confirmed with BEIS and Defra economists.

   Table 34 - Specific optimism bias levels per intervention

Optimism bias	Level
Familiarisation costs	37%
Compensation/environmental impact estimates	66%
Carbon values	40%

2. **Policy measures implemented in 2023:** some policies may not be implemented until 2024/25. This has been managed through sensitivity analysis – see Section 5.1. We are sufficiently confident in this assumption as it is based on conversations with Defra policy, but there is a risk some of the policy may come in later. However, as this would decrease the costs occurring in the appraisal period we have rated the assumption as 'green' (small/no concern).

   Impact on analysis: Medium - as seen through sensitivity analysis.

Confidence: Medium – it is possible some measures are implemented through secondary legislation after 2023.

3. **Floating OFW project (FLOW) impacts assumed to be the same as fixed:** this is a simplifying assumption agreed with BEIS economists, where we do not split out impacts of fixed and floating OFW projects. There is high uncertainty around the turbine rating, geographical coverage and forecasted deployment for FLOW (as it is dependent on how FLOW costs develop). There is also uncertainty on the environmental impacts from FLOW. We therefore viewed this as an appropriate assumption to make with further detail on any FLOW specific impacts to be included for any further impact assessments if available. We have rated this assumption as 'amber' (medium concern) as while this is uncertain, the impact on the analysis is low.

   Impact on analysis: Low – but there is potential considering floating impacts separately could have different impacts, although these are uncertain. As FLOW is a smaller proportion of OFW development this should not have a large impact on the analysis.

   Confidence: Low – in reality, there could be differences between the two but there was no sufficient data to create separate assumptions at the time of the analysis.

4. **Two Devolved Administration split scenarios:** for England, Wales and Scotland we have assumed, following BEIS economists' advice, a 40%, 10% and 50% OFW capacity split respectively in scenario (a) and 45%, 5% and 50% OFW capacity split respectively in scenario (b).[70] We have also assumed 0% in Northern Ireland. These are possible splits based on the extrapolation from the current medium-term pipeline of projects and may differ from the actual capacity split as this will depend on ongoing pipeline planning in the devolved administrations. Using the current pipeline of projects may not reflect the actual split of deployment as this will depend on which projects are successful in progressing to build and operate. There is also uncertainty around the Welsh uptake of OFW, and design of any future support scheme in Northern Ireland[71] (which does not currently take part in the Great Britain CfD scheme). We have rated this assumption as 'amber' (medium concern) as although it is based on current pipeline, there is uncertainty and this could have large impacts on the interpretation of the analysis (i.e., where the impacts will take place).

   Impact on analysis: High – This impacts all monetised costs for Devolved Administration breakdown analysis.

   Confidence: Medium – this is based on the current pipeline, but there is uncertainty around which projects will progress successfully along with Welsh and Northern Ireland take up in the future.

5. **OFW illustrative pathways to meet 50GW in 2030:** we used the OFW capacity in BEIS' illustrative net zero (NZ) pathways for 40GW in 2030 scenarios and added extra capacity in 2028-2030 evenly across the years to hit 50GW by 2030. We then assumed less deployment post-2030 so that capacity realigns with the BEIS OFW NZ capacity scenarios by around 2040. We assumed a linear trajectory back to this as while we might expect capacity post-2030 to increase in this scenario, this is inherently uncertain and depends on what happens both in the power sector and the wider energy system (e.g., additional demand from electrolysers). These are illustrative pathways to NZ with different levels of electricity demand. The 50GW assumes that Government implements planned policies to enable this, and industry is able to step-up to the challenge of delivering the up to 50GW of capacity at value for money. These assumptions were made and agreed with BEIS economists. They are therefore rated as 'amber' (medium concern) as although they are based on best available evidence, there is uncertainty which could impact the analysis significantly.

   Impact on analysis: High – this assumption underpins all of the analysis undertaken except familiarisation costs.

   Confidence: Medium – this is based off BEIS pathways, but these are only illustrative.

6. **Average size of an OFW project, spatial conversion and ownership structure:** we have assumed the average size of an OFW project will be 1-1.5 GW based on the current pipeline of

[70] Based on conversations with BEIS economists.

[71] Note, in 2019 Northern Ireland's Department of Economy said their coastline was not suitable for OFW farms due to likely objections in how they look. However, since then they have revealed a new plan for their energy, with a focus on renewables such as OW. The exact uptake however remains very uncertain.

projects. Spatially we have assumed 3.5 MW/km^2 with a high and low range of 6 and 2MW/km for sensitivity testing.[72] Analysis of the pipeline suggests this is the right ballpark for projects in the 2020s and 2030s for both fixed bottom and floating OFW projects. To note there is significant variation across projects and it is possible that projects in the mid to late 2030s will be larger on average. We did not assume an ownership structure for the forecasted OFW projects (i.e., whether they would be international vs UK owned, and if the former, whether there would be UK subsidiaries and the size of these) as this evidence is complex and was still be considered by BEIS at the time of the analysis. It is therefore possible that some of the costs and benefits considered would be taken outside of the UK, which would make them out of scope of this impact assessment (which should only look at the impact on UK businesses).These assumptions are rated as 'amber' (medium concern) as although the first two are based on best available evidence there is uncertainty going forward and as no ownership structure gives a worst-case scenario for UK business impacts.

Impact on analysis: High – this assumption underpins the strategic compensatory measures and HRA Review costs.

Confidence: Medium – assumptions are either based on evidence but there is uncertainty going forward or allow for a worst-case scenario for UK business costs.

7. **Strategic compensatory measures value:** we have assumed the value of strategic compensatory measures is the same as the sum of individual compensatory measures requirements. In reality, the Fund administrator is likely to also charge a risk premium to carry out strategic compensatory measures on industry's behalf, which has not been included in the costs. As strategic compensatory measures will have had limited or no historical trialling in UK waters, the Fund administrator may want to charge to account for delivery risk[73], given they would be taking on the legal responsibility to secure the measure and any inherent risk that it does not succeed. This premium could be an added charge through the MRF (i.e., would increase Assumption 9). It is also possible that the strategic compensatory measures cost less than individual measures, due to economies of scale, and therefore our value may be an overestimate.

   We have assumed a bundle of four measures to deliver strategic compensation: three on benthic and one on birds. These are based on four existing compensatory measures and their cost profiles. These were provided through industry engagement and are the measures with the best available evidence, providing us with the confidence to use them in our calculations. Note there are likely to be many more types of strategic compensatory measures developed in the future to reflect the diverse range of possible impacts. For these birds and benthic measures, we have assumed a different probability of an OFW developer needing to pay these.

   For benthic measures, we have assumed between 40-80% of OFW projects overlap with MPAs incurring impacts and assumed 0-100% of these impacts would have an impact such that compensatory measures are needed. The 40-80% was based on a visual assessment of current OFW developments and protect areas and a large range was used to reflect the uncertainty of future developments and possible measurement error.

   For the 0-100%, the zero-lower bound was based on the three existing OFW farms that have had very small areas that would need to compensate relative to the OFW farm size as seen in Table 35 below. The 100% upper bound was based on an upcoming OFW that is known to impact 100% on loss on site integrity. In reality future OFW farms are unlikely to close to this upper bound (they are no longer allowed to build 100% in an MPA) or zero-lower bound (as more OFW farms are developed, developers are less able to avoid adverse impacts on site integrity due to cumulative impacts and less choice in site location). To reflect uncertainty and the Precautionary Principle[74] we have therefore used the 0-100% range.

[72] BEIS assumption.

[73] if the measure costs more than expected or a project's impacts turn out to be greater than expected from the plan level HRA.

[74] One of the five Environmental Principles Government must adhere to when making policies.

Table 35: Existing compensatory measures area percentage of total OFW farm size

OFW farm	% of area needing compensatory measures to total OFW project area
OFW project 1	0.06%
OFW project 2	0.01%
OFW project 3	0.003%
Average OFW farm	0.03%

For the bird compensatory measure, we have assumed 80-100% of OFW projects will need to compensate. As birds move outside of MPAs the spatial overlap used in the benthic analysis would not be appropriate. Based on Defra policy expertise from stakeholder engagement, we have used an 80-100% as the range instead as it is likely that all OFW development will need to compensate for some kind of bird impacts.

We have rated these assumptions as 'amber' (medium concern) as although they are based on best available evidence, there is uncertainty which could impact the analysis. Sensitivity analysis was however carried out to mitigate against this concern.

Impact on analysis: High – this assumption underpins the strategic compensatory measures and HRA Review costs.

Confidence: Low – this is based off limited evidence and therefore very uncertain.

8. **HRA Review impact on compensatory measures value:** we have assumed that earlier and proportionate weighting on SNCB evidence and baselining could increase the value of compensatory measures required between 10-40%. This is a simplistic assumption based on policy discussions and likely to differ in reality. The 40% is also likely to be an overestimate but given the uncertainty and the Precautionary Principle, it is used as the upper-bound. This assumption is rated as 'red' (large concern), however as this element of the policy will be delivered through secondary legislation, further refined analysis will be undertaken then and therefore this concern is mitigated.

   Impact on analysis: High – this assumption underpins the HRA Review costs and therefore a large proportion of total Defra measures costs.

   Confidence: Low – this is based off policy judgment only and therefore very uncertain. The large range helps mitigate against this. It only impacts the potential costs from secondary legislation and would be re-looked at for the secondary legislation IA.

9. **MRF:** we have assumed that strategic compensatory measures and their monitoring/ data analysis would be carried out via the MRF in the regulatory policy option (Policy Option 1). We have assumed that it costs between 5-7% of the Fund's value to operate the Fund. This is based on a literature review of funds carried out by Defra policy. Under the legislative options, developers and plan promoters can choose to carry out their compensatory measures through the MRF, we assumed with Defra policy that between 30-70% will do this. In reality, take up could start low (i.e., 30%) and then increase (i.e., to 70%) as confidence in the Fund is gained. Take up of the MRF may also be higher or lower than expected. We assume all costs incurred by plan promoters are passed on to industry (following the Polluter Pays principle). These assumptions are rated as 'amber' (medium concern) as there is uncertainty around the take-up of the MRF by developers which could impact the analysis significantly.

   Impact on analysis: High – this assumption underpins the strategic compensatory measures and HRA Review costs.

   Confidence: Medium – the administration cost is based off a literature review led by Defra policy but it may be larger if a risk premium is applied. There is more uncertainty around the uptake but a large range has been used to reflect this.

10. **Familiarisation costs:** we have assumed all measures will incur a familiarisation cost. We assume this is borne through a certain number of individuals per organisation needing to read new technical guidance. We assume the guidance to be the same length as existing or similar guidance, that between 2-4 individuals per OFW developer would need to read this guidance, and that their average wage rate was around £40,000/year. These assumptions are rated as

'green' ('little/no' concern) as although there is low confidence in the evidence, the impact on the analysis is expected to be negligible.

Impact on analysis: Negligible – this assumption underpins the familiarisation cost, but this has a very small impact on total costs of the Defra measures.

Confidence: Low – OFW industry was unable to confirm our estimates for this analysis.

11. **Carbon savings in the energy system:** we have assumed that the energy system's carbon savings from two possible net zero scenarios compared to a known policy scenario can be achieved with reduced risk from these Defra measures. We however cannot assume the exact proportion due to the dependence on the wider power system. Further caveats and interpretation of these estimates can be seen in Section 5.1. These assumptions are rated as 'green' (small/no concern) as the analysis' purpose is to simply illustrate possible energy system carbon savings the measures and based on BEIS data.

    Impact on analysis: High – this assumption underpins the illustrative energy system carbon savings analysis.

    Confidence: High – this uses illustrative BEIS scenarios and standard carbon values but note these are only two possible pathways.

12. **Consumer price impact (See Section 7):** we have assumed that OFW developers will pass 100% of any costs incurred onto consumers. This is to give us a worst-case scenario from a consumer perspective, where there is uncertainty on how the firms might behave. In reality, the pass through will depend on how many projects are impacted, the level of competition in future CfD auctions (which may reduce the ability of some developers to pass through costs) and how these factors affect the project that sets the clearing price. This is rated as 'amber' (medium concern) as in reality the assumption is contingent on many factors, however as we used a worst-case assumption this concern in the analysis is mitigated.

    Impact on analysis: High – this assumption underpins the consumer price impacts analysis.

    Confidence: Low – in reality, the pass through to consumers is expected to be less. It is also based on costs only and does not consider any financial benefits the industry may get.

Section 6 Impact on small and micro businesses (SaMBA) and on medium businesses

Section 6.1 SaMBA

A small business is defined in the Better Regulation framework manual as one employing fewer than 50 full-time equivalent employees, and a micro business as one employing up to 10 employees.

OFW developers are not limited to being large or medium sized enterprises, as although OFW development is capital intensive[75] and requires a substantial balance sheet to deliver, developers can work together in consortia in which smaller partners can operate without being well capitalised. Alternatively smaller players can undertake early-stage development activities before selling the site to a larger player or develop smaller test and demonstration sites for innovative technologies like floating OFW farms.

Smaller OFW developers are more likely to be impacted by the two measures' costs due to reduced economies of scale impacting their ability to absorb costs, in comparison to larger firms. OFW development is capital intensive, and with less capital finance, smaller firms may find it harder to handle costs and the necessary or required changes in operation. Therefore, smaller firms stand to be disproportionally affected by costs of measures compared to their larger counterparts.

The two policy measures considered are, however, unlikely to impact these due to the market characteristics of the OFW industry. Analysis by BEIS economists of the lead developers involved with

[75] OFW is a capital-intensive sector and the option deposits paid when a project secures an area of seabed for development alone are significant – through an open market process for Leasing Round 4, successful bidders committed an initial investment of £879m in option fee deposits (see CE round 4[75] or ScotWind[75]).

the UK OFW pipeline implies that there are a total of ~30 OFW developers that have been, or will be, operating in the UK. Of these, ~20 could be impacted by the Defra policy measures (i.e., are currently at, or before, the pre-consenting stage of OFW development). Out of these 20, research found that only three developers could be micro/small (referred to as Developer 1,2, and 3 respectively). The rest of the developers were expected to either pass into the medium or large business threshold.

Subsequent research found that Developer 1 currently has 63 employees.[76] It was found that Developer 2 has 46[77] employees and is therefore in scope for a SaMBA. However, Developer 2 has grown in employment size by around 40% in the last 6 months, around 70% in the last 12 months and around 90% in the last 24 months.[78] At their current rate of employment growth and considering the upscaling in OFW developments to 2030 providing opportunities for expansion, Developer 2 are likely to cross the SaMBA threshold of >50 employees and will soon be considered a medium business. Developer 1 is only UK-based and Developer 2 was head quartered in the UK with international subsidiaries but has now been sold internationally, so it was not possible to determine the employment split of any future subsidiaries due to time and evidence constraints. Given this research, a SaMBA has not be completed for Developer 1 or 2, with both firms assessed as medium businesses. There was one small international OFW developer, Developer 3, operating in the UK with 20 employees.[79] However, they did not have a UK subsidiary and therefore a SaMBA was not completed for them as they are not in scope of this IA (only considering UK businesses).

It should be noted that the supply chain could consist of small or micro businesses; however, we have not assessed these as they would be indirect, and the impact is uncertain (i.e., depends on how the developers pass on costs). The conclusion that no small/micro OFW developers exist is based on the current market, however, as there are likely to be additional developers in the future it is possible that micro/small businesses could be impacted by the regulatory changes. Excluding any small businesses would prevent them from realising the expected benefits of the regulatory changes, which could put them at a disadvantage against their medium and large competitors. Although micro/small firms would find financing the cost of regulation more than medium/large, the makeup of the industry does suggest that even smaller developers are likely to be able to offset any costs by partnering with larger developers.

Section 6.2 Impact on medium businesses

A medium business is defined as one employing between 50 - 499 full-time equivalent employees as defined by the regulatory exemption assessment.[80] Although the primary legislation's EANDCB is below the £5 million threshold, we still considered the impact of our regulatory policy on medium businesses.

The OFW sector is dominated by a few key players with the 'big 6' expected to dominate the EU market from now out to 2030 (Wood MacKenzie estimate they will account for 40% of the market).[81] Ørsted (a Danish company), has the largest UK OFW portfolio by owner share (~24%); other companies who own a significant proportion of the current offshore capacity deployed offshore include Vattenfall (~13%), SSE (~12%), Iberdrola (~11%) and Innogy (8%), leaving 32% for the other developers.[82]

As highlighted in the SaMBA assessment, however, there are two medium sized OFW developers in scope who currently operate (referred to as Developers 1 and 2). Additional research also found two other medium businesses based on the current pipeline provided by BEIS (referred to as Developers 4 and 5). Developer 4 will have over 200 employees at the time of its launch and expects to reach 300 towards the end of the year.[83] Developer 5 have around 400 employees.[84] These latter two companies are international but have UK subsidiaries, although we could not determine the exact split of employees due to time and evidence constraints so treating them as in scope of assessment.

[76] Developer 1 company website

[77] Developer 2 company website

[78] Apollo website looking at Developer 2

[79] Developer 3's website

[80] Medium sized business regulatory exemption assessment: supplementary guidance - GOV.UK (www.gov.uk)

[83] Developer 4's company website

[83] Developer 4's company website

[83] Developer 4's company website

[84] Developer 5's company website

It is expected that the regulatory measures would reduce existing costs for industry (i.e., from no longer paying option fees for unnecessary periods of time) and could increase the present value of revenue for industry (dependent on other factors), meaning there is likely a net benefit for businesses from these measures. It would not be possible for businesses to get these benefits, without incurring the costs associated. We therefore believe it would be inappropriate to exempt medium sized businesses from the regulatory policy option as it would likely disadvantage them more than any costs incurred by the legislation.

Note, the list of developers considered in this analysis included international organisations, where medium and large developers have/could develop UK subsidiaries to deliver future UK OFW farms. BEIS were still considering the ownership structure of future UK OFW developments at the time of this assessment, so we were unable to assume the number of UK subsidiaries of international businesses expected. We therefore took a precautionary approach in the assessment and considered both international and UK-based businesses to determine 'medium' business impacts, unless clear evidence suggested otherwise. Moreover, as in the SaMBA there are likely to be additional developers in the future it is possible that medium businesses could be impacted by the regulatory changes. The supply chain could also consist of medium businesses; however, we have not assessed these as these would be indirect, and the impact is uncertain (i.e., depends on how the developers pass on costs).

Section 7 Wider impacts

Section 7.1 Trade and investment impacts

The policy options proposed through these measures are not expected to lead to a direct impact on investment and trade. However, if it contributes towards, and enables, an acceleration or increase in OFW deployment there may be some indirect impacts.

OFW primarily contributes towards electricity supply in the UK. Electricity demand in the UK was 330 terawatt-hours (TWh) in 2020.[85] The BESS commits to deploy an ambition of up to 50GW of OFW by 2030 which equates to 207TWh generated per year.[86] Producing this level of electricity through OFW could likely replace other existing sources such as gas (36% of electricity generation in 2020), *ceteris paribus.* As the UK relies on importing a significant amount of gas supplies (c500TWh in 2020), increases in OFW capacity could reduce the level of gas imports. The UK primarily imports natural gas from Norway (c33% total gas supply) and LNG from Qatar, the US and Russia (combined 22% total gas supply).[87]

The increase in OFW capacity may lead to an increase in energy exports, particularly gas but also OFW. The gas industry in the UK produced 439TWh in 2020, meeting more than half of demand. Only low levels are currently exported (c1TWh in 2020[88]). If increases in OFW capacity reduce the UK's reliance on gas for electricity production, then the level of gas exports is likely to increase. There may also be the potential for us to export excess OFW generation to Europe via interconnectors. This depends on global and domestic demand, and supply conditions in 2030 and beyond which are uncertain.

The policy options could impact investment decisions, where if the cost burdens were too high, developers may decide to locate their business abroad if a project is no longer able to bid into future CfD rounds at a competitive strike price. There is the potential that this would reduce the UK's ability to scale up OFW and the UK may remain reliant on energy imports. However, this risk is relatively unlikely as the costs of the new measures are likely to be outweighed by potential benefits such as bringing forward increased revenue. Investment in the UK energy industries has remained largely stable since 2016 (excluding the Covid-19 shock), with 66% of total investment channelled into electricity.[89] Between 2010 to 2019 the UK has attracted 48% of new OFW investments, making it the biggest OFW market in that period.[90] This is underpinned by sophisticated infrastructure capability and demonstrates the favourable investment conditions created through being an early adopter of OFW technology.

[85] DUKES 2021 Chapters 1 to 7 (publishing.service.gov.uk)

[86] Benchmark UK OFW load factors seen rising to 57% in 2030: BEIS | S&P Global Commodity Insights (spglobal.com)

[87] DUKES 2021 Chapters 1 to 7 (publishing.service.gov.uk)

[88] ibid

[89] UK Energy in Brief 2021 (publishing.service.gov.uk)

[90] OFW Sector Deal - GOV.UK (www.gov.uk)

Section 7.2 Supply chain impacts

The increase in the deployment of OFW as a result of these measures is likely to have an indirect impact on the wider supply chain. Increased investment by developers could lead to greater levels of activity and orders for UK based suppliers. The Offshore Wind Sector deal announced in 2019 included an industry commitment to 60% local content by 2030.[91] Ørsted is one of the largest OFW developers active in the UK and they alone have directly placed major contracts with over 200 UK firms in the last 5 years.[92] Direct employment in OFW had grown to 7,200 FTE in 2019, with a total of 430,000 jobs in low carbon businesses and their supply chains.[93,94]

The specific impact on domestic supply chains is uncertain but growing OFW capacity from the current 13GW up to 50GW has the potential to lead to significant growth in the supply chain. If industry delivers on their 60% local content commitment, these supply chains will be predominantly based in the UK, creating high skilled jobs, economic spill overs and other benefits to society.

Quicker OFW deployment could have jobs and Gross Value-Added benefits, though the extent of this will also depend on how much OFW developers use domestic supply-chains.

There is a small but unlikely risk that developers may pass on the additional costs of the policy measures to suppliers over the shorter term. This is less likely as the ambitions on OFW are currently ramping up faster than supply-chains (e.g., UK 50GW ambition, EU commitments), which has increased the bargaining power of manufacturers. This could affect suppliers' abilities to deliver and breakeven, potentially reducing their ability to reinvest profits and expand, affecting the sectors overall competitiveness relative to international competition. As the regulations become more established these will likely be priced into any contracts, reducing the longer-term impact and risk to the supply chain.

Section 7.3 Consumer price impacts

It is possible that there will be no or decreased consumer price impacts from these measures. This could be a result of costs saved (i.e., from not having to pay the option fee for longer than necessary) for the OFW industry. However, it is also possible that there could be increased consumer price impacts from these measures, as any cost imposed on developers of OFW could be passed on to consumers through higher CfD strike prices.

The net outcome will depend on the revenue versus cost impacts on the OFW industry as well as how many projects are impacted by the measures, the level of competition in future CfD auctions (which may reduce the ability of some developers to pass through costs) and how these factors affect the project that sets the clearing price

The impact of the measures on consumer prices was calculated through collaboration with BEIS. We assumed that all costs incurred by developers from these Defra measures would feed through to higher strike prices and therefore be passed on to consumers. Benefits, such as cost savings to industry, were not included in this analysis as they were not monetised. In reality, these increased price impacts are unlikely to be realised as they are likely to be at least partially counteracted by a lower pass-through rate. However, for this analysis we wanted to present a worst-case scenario for future household costs given the current pressures on household bills. We have assumed that these costs are spread across all consumers (businesses and households) but only through electricity prices, and the bill impacts hold for dual fuel households only.

Given this, if full pass-through of the whole-policy potential costs did occur, the Defra policy measures could add £0.01 – £0.20 to the annual household dual fuel bill if implemented UK-wide. In 2018 this would have equated to ~0.02% maximum increase in the annual household dual fuel bill[95], and now to a ~0.006%[96] maximum increase based on expected future bills under the new price cap level in October.

[91] ibid

[92] Wind Energy Supply Chain | Ørsted (orsted.co.uk)

[93] OFW Sector Deal - GOV.UK (www.gov.uk)

[94] Wind energy in the UK - Office for National Statistics (ons.gov.uk)

[95] Based on Ofgem's 2010 state of the market report with £1,200 as average dual-fuel energy bill.

[96] Based on BBC estimate of £3,000 annual dual household bill calculated using Ofgem methodology.

Section 8 Monitoring and evaluation

Understanding the impact of any regulatory policy is a key responsibility for Government. For the two policy measures in this IA, a detailed monitoring and evaluation plan will be put forward at the secondary legislation stage however initial thoughts are provided below. This is appropriate as all Defra measures will be scoped out further at this point. For one of the two measures discussed in this IA, the primary legislation is to give Government the power to mandate future policy options and the secondary legislation stage is where the policy options will be defined.

Theory of Change

A Theory of Change (ToC) is used to model how a policy or programme is expected achieve desired outcomes and benefits**,** alongside and considering other policies / initiatives and external factors. The point of ToC is to understand how the policy is intended to work not only to measure it. **Annex 4** shows the ToC for strategic compensatory measures (OWEIP measure to be enacted at primary legislation stage). This ToC can be used to create confidence in the delivery of the impact from the policy measures and highlights assumptions and dependencies which influence change.

Monitoring

Under the strategic compensatory measures and MRF Policy Option 1, industry can contribute to the monitoring of the effectiveness of the strategic compensatory measures. The MRF may also be used to collate and analyse data from this monitoring.

Evaluation

Some expected external factors that could cause an impact on the success of the intervention include:

- Changes to the Government OFW deployment targets,
- Supply chain challenges,
- Changes to Government environmental commitments,
- Regulatory challenges,
- Effective uptake of policy by industry and plan promoters,
- Effective delivery of policy by regulators and SNCBs,
- Collaboration working across Government and between Government and stakeholders,
- The impact of partner or similar programmes (e.g., Offshore Wind Evidence and Change[97] and EcoWind[98] programmes), and
- Skills and capabilities to deliver accelerated OFW ambitions.

This programme of work will be independently evaluated by external contractors. Prior to the publication of the BESS, Defra's Marine & Fisheries Directorate began the Offshore Wind Enabling Actions Programme (OWEAP), funded by HM Treasury and in partnership with BEIS. The OWEAP evaluation started in November 2021 and ran to March 2022 after finishing the scoping phase. The scoping phase included delivery of the evaluation framework, evaluation questions, and Key Performance Indicators.

This evaluation will be reviewed to capture new priority areas and remain fit for purpose. Once the adjusted desired outcomes are set, impact evaluation will measure whether these outcomes have been met. Impact evaluation will be complimented by process evaluation to understand how and why the intervention is or is not working and for whom to provide evidence to inform policy amendment.

The evaluators will be able to build on data collected during the scoping phase via interviews, document review, ToC (programme and project level) and system mapping to develop a baseline. Extra data will need to be collected to assess the success of the new programme of work associated with the OWEIP.

Methods and timescales are yet to be defined but care will be taken to manage stakeholder fatigue around multiple consultations and engagement requests. OWEAP operated and delivered impactful outputs and outcomes in a dynamic, fast-paced environment and will continue to do so, using findings from the evaluation to inform decision-making. Broadening focus from the evaluation to consider policy,

[97] Offshore Wind Evidence and Change Programme

[98] Ecological consequences of OFW (ECOWind)

accelerated deployment of OFW and increased, or decreased, environmental commitments might require the policy to be reviewed in the near future and have the potential to alter recommended policy options.

Annex 1: Detailed methodology

General analytical assumptions

Appraisal Period

Analysis has been appraised over a **20-year period starting in 2022**. This decision was taken internally by Defra economists and is in line with HMT Green Book Guidance: costs and benefits should be calculated over the lifetime of the proposal or those regarding administrative changes should use a 10-year period only. We expect most impacts to occur over the next 20 years as this is when OFW development will be at its greatest (i.e., to meet the 2030 ambition and net zero targets). Costs considered also mostly occur at the start of OFW development or are potentially subsiding in realty as time goes on. Benefits may last longer than the development itself but there is uncertainty around how long they could last.

Discount Rate

Per HMT Green Book guidance, all monetised analysis in this assessment has been **discounted at a rate of 3.5%**. This accounts for the social time preference rate (of money), to factor society's willingness to postpone consumption now to consume later. Thus, benefits and costs in the future are valued less than they are at present. A base year of 2022 has been used (when policy is expected to be fully implemented) but for the business calculation the standard present value base year of 2020 has been used.

Price Deflation

Costs and benefits have been deflated to account for future price inflation, with a **price base year of 2020** to align with the other Energy Bill IAs. The GDP deflator set used is updated after every ONS Quarterly National Accounts release (at the end of each quarter) and usually twice a year by HM Treasury.[99] For business calculations the standard price base year of 2019 has been used.

Optimism bias

All optimism bias values used were related to non-standard civil engineering projects, as this most aligns with OFW development. OFW development meets all criteria necessary for a project to be considered non-standard civil engineering; a) it is innovative; b) it has mostly unique characteristics; and c) construction involves a high degree of complexity and/or difficulty.

Optimism bias values presented take the upper bound where possible, due to the uncertainty of the analysis. All values are taken from HMT Green Book Supplementary Guidance on optimism bias.[100] Specific optimism bias levels and rationale are as follows:

- **Familiarisation cost (37%):** optimism bias includes two contributory factors to upper bound optimism bias; project management (2%) and inadequacy of the business case (35%) to mitigate against uncertainty in analysis.
- **Compensation/environmental impact estimates (66%):** takes the full upper bound optimism bias level for non-standard civil engineering projects overall, to mitigate uncertainly associated with this analysis.
- **Carbon values (40%):** optimism bias includes two contributory factors to upper bound optimism bias; environmental impact (5%) and inadequacy of the business case (35%) to mitigate against uncertainty in analysis.

OFW assumptions

GW capacity illustrative pathways

[99] UK Government – GDP deflator

[100] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/191507/Optimism_bias.pdf

As discussed in Section 5.4, we used the OFW capacity in BEIS' illustrative net zero pathways for 40GW in 2030 scenarios and added extra capacity in 2028-2030 evenly across the years to hit 50GW by 2030. We have then assumed a linear trajectory to the same capacity as in the BEIS OFW net zero capacity scenarios.

Average size of an OFW farm and spatial conversion

As discussed in Section 5.4, we have assumed the 'average' size of an OFW will be 1-1.5 GW. Spatially we have assumed 3.5 MW/km^2 with a high and low range of 6 and 2MW/km for sensitivity testing.

Analytical methodology

Strategic compensatory measures
The main quantified cost for strategic compensatory measures was the cost of the MRF to the OFW industry. We assumed operational costs to be 5-7% of the Fund's value based on a policy literature review. The size of the MRF therefore was dependent on the value of strategic compensatory measures, the associated monitoring costs and the uptake of the MRF (assume a 30-70% take-up across all years, however in reality it is likely to start from a lower take up and move to a higher take up). There is, however, likely to be some non-linearity in operational costs (the greater the Fund's size the lower the percentage share of total costs).

Value of strategic compensatory measures: we assumed that the value of strategic compensatory measures would be the same as the sum of individual compensatory requirements. To calculate this, we used a bundle of four measures to deliver strategic compensatory measures: three on benthic and one on birds. These are based on four existing compensatory measures and their cost profiles over time (i.e. costs in Year 1 vs cost in Year 10 etc.). Note, there are likely to be many more types of compensatory measures than these depending on the impact as time progresses.

For birds and benthic measures, we assumed a different probability of an OFW developer needing to pay for these compensatory measures:

- For benthic measures, we assumed between 40-80% of OFW farms overlap with MPAs incurring impacts. To determine the proportion of OFW developments that overlap with MPAs, a visual assessment was undertaken. A map of current OFW developments and protect areas was divided into 6 equal sections and the portion of overlap was determined visually. Given the likelihood of human error in this approach, a large range was applied. We then assumed 0-100% of these impacts would have an impact that needed compensation. The zero-lower bound is based on the three existing OFW farms that have had very small areas that would need to compensate relative to the OFW farm size as seen in the table below. The 100% upper bound is based on one upcoming OFW farm that is known to impact 100% on loss on site integrity. In reality, future OFW farms are likely to be closer to the lower bound (they are no longer allowed to build 100% in an MPA) but to reflect uncertainty we have used this range. These two probabilities were interacted together and then applied to the three existing benthic compensatory measures and their cost profiles.

- For the bird compensatory measure, we have assumed 80-100% of future OFW farms will need to compensate based on policy advice from stakeholder engagement. As birds move outside of MPAs the spatial overlap used in the benthic analysis would not be appropriate. Based on Defra policy advice, we have used an 80-100% as the range instead, as this was deemed most likely for bird compensatory measures to be needed for all OFW developers. This probability was then interacted with the cost profile of the bird compensatory measure.

Due to the uncertainty on the number of compensatory measures by individual projects needed, we ran a sensitivity equivalent to increasing or decreasing the compensatory measures 'bundle' by 2 measures. We assumed these measures would cost the average of the four measures and therefore ran a +/- 50% sensitivity on the cost profiles.

BEIS also requested we run a sensitivity on spatial land use of OFW farm as this impacted our benthic strategic compensatory measures estimates. We assumed a low and a high land use of 6 and 2 hectares/GW respectively.

Value of monitoring strategic compensation: We assumed that this would be dependent on the number of OFW farms and an OFW specific monitoring cost. We used MMO data on the cost of OFW farm seabed monitoring as the assumed cost of benthic monitoring, and industry provided data for assumed bird monitoring costs.

We assumed that after a compensatory measure was implemented, monitoring would take place from the following year and would occur annually. We assumed that the probability of an OFW development needing to carry out strategic compensatory measures would be the same probability of an OFW development needing to carry out monitoring of strategic compensatory measures. These probabilities were interacted with the monitoring cost profiles over the 20-year appraisal period.

HRA Review
The main monetised costs of HRA Review were the increased costs to OFW developers from increased compensatory measures requirements when giving earlier and proportionate weighting to SNCB evidence and the associated increase in the MRF cost.

We have assumed that the HRA Review could therefore increase the value of compensatory measures required between 10-40%. This is a simplistic assumption based on policy discussions and likely to differ in reality.

To estimate the increase in funding needed for the MRF to deliver this increased compensation, we applied the same 5-7% of the Fund's value and 30-70% uptake to carry out strategic compensatory measures via the MRF assumptions to the additional value of strategic compensation.

The sensitivities that were run in the strategic compensatory measures analysis (i.e., more/less measures needed and higher/lower land use (i.e., more/less OFW turbines needed for same electricity produced) per GW) were also run through this analysis to account for the uncertainty.

Familiarisation Costs
An assessment of familiarisation costs has been undertaken and aligned with RPC guidance.[101] Per this guidance, familiarisation costs that are expected to fall onto OFW developers because of Defra measures within the Energy Bill come in the form of reading and understanding new/amended regulatory requirements and guidance. Therefore, familiarisation costs consider the need for colleagues at OFW developing firms to become familiar with guidance on the following three areas: Environmental Standards, Strategic Monitoring, and the HRA Review.

Familiarisation cost was determined using the following equation:

$$Familiarisation\ Cost = No.effected \times time\ taken\ to\ familiarise \times wage \times non-wage\ uplift$$

Methodology on determining familiarisation costs is as follows:

1. Technical written guidance on each area will be produced and has been assumed to total 128,000 words in length.
2. RPC guidance[102] suggests that reading of technical documents is 50 to 100 words per minute, normal documents upwards of 250 words per minute. This assessment therefore assumes a reading speed for individuals of 75 words per minute. These assumptions equate to a familiarisation time of 28 hours per individual.
3. Average wages were for relevant individuals were determined using ONS' Annual Survey for Hours and Earnings (AISHE) [103], and taken from an average of the following employees: civil engineers, waste disposal and environmental services managers and OFW technicians.
4. Assuming a 40-hour working week, an average hourly wage was determined, with a 22% non-wage uplift as recommended by RPC[104]. This generated a baseline familiarisation cost per individual per firm.

[101] RPC_short_guidance_note_-_Implementation_costs__August_2019.pdf (publishing.service.gov.uk)
[102] RPC guidance
[103] AISHE ONS
[104] RPC guidance

5. A high and low range was determined, by estimating that between 2 and 4 employees of OFW developers would need to become familiar with new guidance. These values were then multiplied by 34 – the number of OFW developers currently operating – to determine industry wide familiarisation costs. In reality this is likely to be lower as OFW developers tend to use the same consultants for environmental matters.

Carbon Savings
We have assumed that the energy system's carbon savings from two possible net zero 40 GW scenarios compared to a known policy scenario can be at least partially attributed to these Defra measures. We calculated the value of these savings by applying the carbon values (price base year of 2020) to them.

We however cannot assume the exact proportion due to the dependence on the wider power system. Further caveats and interpretation of these estimates can be seen in Section 5.1.

As per appraisal guidance, we ran a high and low sensitivity on the carbon values of +/- 50%.

Consumer price impact
BEIS used their model for consumer price impacts to estimate the impact of our policies. We provided them with total costs and an assumed pass-through rate to consumers. We assumed that OFW developers will pass 100% of any costs incurred onto consumers. This is to give us a worst-case scenario where there is uncertainty on how the firms might behave. In reality, the pass through will also depend how many projects are impacted and how this affects which projects sets the clearing price.

Annex 2: Additional sensitivity analysis

HMT Green Book recommends conducting sensitivity analysis to baseline analysis, which is presented in the main body of this analysis. Per HMT Green Book: *Sensitivity analysis explores the sensitivity of the expected outcomes of an intervention to potential variations in key input variables. It can demonstrate, for example, the changes in key assumptions required to change the preferred option on an NPSV or BCR basis or to turn the NPSV of an option positive.*

The main body of the analysis describes the rationale for the sensitivities undertaken, with the main driver being the uncertainty in the analysis. Below we present the outputs of the sensitivities that would have a positive impact on costs (I.e., lowering costs).

HRA Review

Costs – monetised – sensitivities

- Less OFW turbines needed for same amount of electricity produced: Low land use to show higher efficiency of production and therefore lower spatial use of future OFW farms.

Table 36 - Decreased potential discounted additional compensatory measures cost for OFW developers in the UK

Additional compensatory measures cost	**Total** (£mn)	**Average yearly costs** (£mn)
High	230 (decrease 6% from core scenario)	12 (decrease 6% from core scenario)
Low	17 (no change from core scenario)	0.9 (no change from core scenario)

Table 37 - Decreased potential discounted additional MRF cost for OFW developers in the UK

Additional MRF cost	**Total** (£mn)	**Average yearly costs** (£mn)
High	11 (decrease 6% from core scenario)	0.6 (decrease 6% from core scenario)
Low	0.3 (no change from core scenario)	0.01(no change from core scenario)

Table 38 - Decreased potential discounted total HRA Review cost for OFW developers in the UK

Total HRA Review cost	**Total** (£mn)	**Average yearly costs** (£mn)
High	240 (decrease 6% from core scenario)	12 (decrease 6% from core scenario)
Low	17 (no change from core scenario)	0.9 (no change from core scenario)

- *Lower cost of compensatory measures:* To show how compensatory costs could be if less are needed or if they cost less.

*Table 39 - Sensitivity analysis on potential costs of additional compensation for OFW developers in the **UK***

Additional compensatory measures cost	**Total costs** (£mn) (percentage change compared to core scenario)	**Average yearly costs** (£mn)
Low sensitivity and low-cost scenario	8 (50% ↓)	0.4 (50% ↓)

*Table 40 - Sensitivity analysis on potential cost of additional MRF for OFW developers in the **UK***

Additional MRF cost	**Total costs** (£mn) (percentage change compared to core scenario)	**Average yearly costs** (£mn)
Low sensitivity and low-cost scenario	0.4 (50% ↓)	0.02 (50% ↓)

*Table 41 - Sensitivity analysis on potential cost of HRA Review for OFW developers in the **UK***

Total HRA Review cost	**Total costs** (£mn) (percentage change compared to core scenario)	**Average yearly costs** (£mn)
Low sensitivity and low-cost scenario	8 (50% ↓)	0.4 (50% ↓)

Strategic Compensatory measures and MRF

Costs – monetised – sensitivities

- *Less OFW turbines needed for same amount of electricity produced:* Low land use to show higher efficiency of production and therefore lower spatial use of future OFW farms.

*Table 42 - Sensitivity analysis on total MRF cost to OFW developers operating in the **UK** – strategic compensatory measures*

Total MRF cost	**Total** (£mn)	**Average yearly costs** (£mn)
High	40 (decrease 4% from core scenario)	2 (decrease 4% from core scenario)
Low	3 (no change from core scenario)	0.1 (no change from core scenario)

- *Lower cost of compensatory measures:* To show how HRA Review costs could be if less compensatory measures are needed or if they cost less.

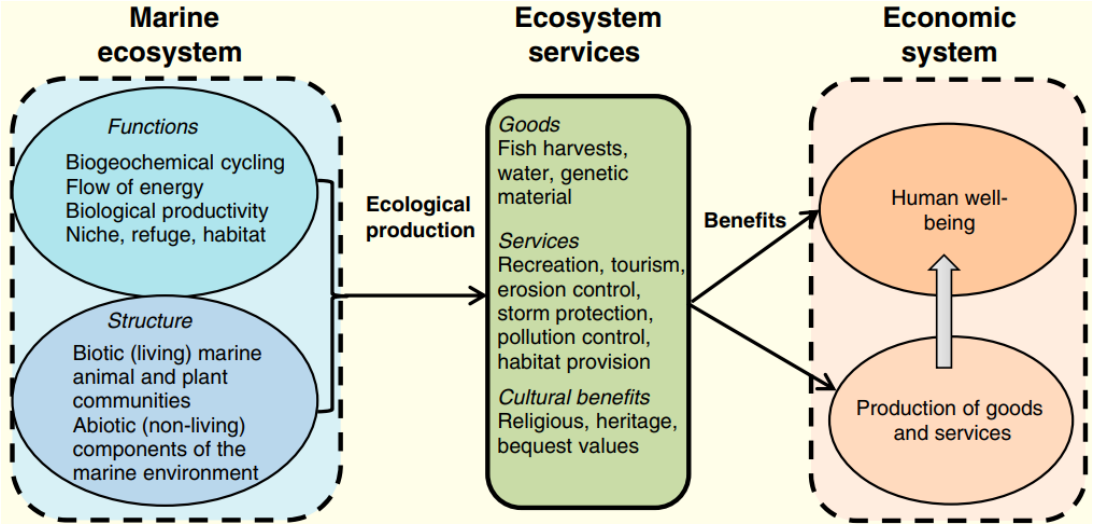
*Table 43 - Sensitivity analysis on total MRF cost to OFW developers operating in the **UK** – strategic compensatory measures*

Total MRF cost	**Total costs** (£mn) (percentage change compared to core scenario)	**Average yearly costs** (£mn)(percentage change compared to core scenario)
Low sensitivity and low-cost scenario	1 (48% ↓)	0.1 (48% ↓)

Annex 3: Marine ecosystem services

Marine ecosystems provide important services, associated with their regulatory and habitat functions.[105] Services relevant to the BESS include breeding and nursery habitats for fish species leading to improvements in biodiversity and fisheries. As the graphic below details, there is a causal chain associated with marine ecosystems, ecosystem services and the economic benefits that they provide. By enhancing marine ecosystem through measures included under the BESS, ecosystem services, such as improved fish harvest and habitat provision can be realised. This can lead to economic gains in the form of the production of goods and services and ultimately, improved human wellbeing.

Figure 3 - Causal chain of marine ecosystems leading to economic returns



The measures in this IA are expected to protect and enhance these services.

[105] Current biology, 'Marine ecosystem services'

Annex 4: Theory of Change