# Options assessment

Proposed changes to the Major Hazards Regulatory Framework in relation to Carbon Capture Storage and Offshore Hydrogen

Title:

Regulatory

Type of measure:

Health and Safety Executive (HSE)

Department or agency:

…

IA number:

…

RPC reference number:

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**Summary**

* 1. HM Government is supporting the development of industrial clusters that will co-locate high energy industries with onshore hydrogen production, Carbon Capture Usage and Storage (CCUS) projects, and offshore hydrogen production using wind turbines. On 4 October 2024 the Department for Energy Security and Net Zero (DESNZ) announced[[1]](#footnote-2) that funding of up to £21.7 billion over the next 25 years will be invested in the CCUS sector in the UK. Offshore Hydrogen projects have been included in the Hydrogen Allocation Rounds process for projects that may receive government funding[[2]](#footnote-3).
  2. HSE considers transport of carbon dioxide (CO2) by pipeline, and other work activities connected to the offshore storage of CO2 and the offshore generation of hydrogen to constitute a ‘major accident hazard’ (see paragraphs 2.2.1-2.2.6). This is a generic term for industries that could cause catastrophic harm to people and the environment such as offshore oil and gas production, manufacture and storage of hazardous chemicals, transportation of dangerous substances in pipelines and the manufacture and storage of civil explosives.
  3. Regulations made under the Health and Safety at Work etc. Act 1974[[3]](#footnote-4) (HSWA) concerning offshore activities and the transportation of dangerous fluids in pipelines were written, primarily, for the regulation of hydrocarbons (for example, crude oil, petroleum and natural gas). HSE’s review of the existing major hazards regulatory framework and legal advice indicates that the definitions and application do not fully, clearly, or consistently apply to the proposed CCUS operations or offshore hydrogen production, limiting HSE’s ability to influence safety standards and control measures as these industries develop.
  4. HSE’s preferred option to address the problem (detailed in Section 4) is to make changes to certain regulations that form part of the major hazards regulatory framework and relate to major hazards work activities. This will ensure that regulations are appropriate for these emerging technologies and that dutyholders have clarity in relation to their duties under the framework to ensure that major hazards are proportionately managed. Dutyholders include pipeline operators, operators of plants that will capture CO2, and operators of offshore installations.
  5. Early stage cost-benefit analysis for the preferred option indicates that the likely annualised cost of compliance per offshore hydrogen installation is between £590k and £2.1m, with a best estimate of £1.3m per installation. Annualised costs for CCUS installations are estimated to be between £800k and £2.4m, with a best estimate of £1.6m per installation. CCUS costs are higher as a result of the use of wells, necessitating well examinations and well notifications.
  6. The likely cost of compliance per onshore CO2 CCUS pipeline is lower, although there is significant uncertainty around this cost estimate with a range of annualised costs between £5.4k and £260k, with a best estimate of £83k per pipeline. The range of potential costs for pipelines is particularly wide because they are drawn from a survey of operators which received a limited response rate. These estimates will be improved through the consultation process.
  7. The key uncertainty in this analysis is the number of installations and pipelines expected to begin operating over the appraisal period. Even with the highest quality data available this would remain highly uncertain as these industries are not yet operating and their ability to scale up depends on a vast range of unpredictable practical and economic factors.
  8. At this stage a reasonable assumption for industry size has only been made for offshore CCUS and sensitivity analysis has been undertaken around this assumption. This results in a likely annualised cost to industry of compliance of between £12m and £40m, with a best estimate of £26m.
  9. These costs trade off against unquantified benefits which have been described qualitatively in the cost-benefit analysis. Based on prior examples, a major hazard incident could cost in the region of £1bn in impacts upon households, businesses and government. It is not known the degree to which compliance with offshore and onshore pipeline major hazard regulations reduce the risk of such a costly incident.
  10. This Options Assessment (OA) sets out the problem definition and explains the process by which policy options were longlisted and shortlisted leading to a preferred option. Anticipated costs and benefits of shortlisted options identified are analysed at Annex 1. Alternatives to regulation have been considered and have not been deemed to be appropriate due to the severity of the major hazard safety risks associated with these new industries.

1. **Strategic case for proposed regulation**
   1. **Background**
      1. Through the Climate Change Act 2008[[4]](#footnote-5), the UK has a legally binding target to achieve Net Zero by 2050. The achievement of Net Zero targets will require changes to the UK’s energy mix, decarbonisation of existing industries, and the development of new industries. Two critical elements to delivery are the development of low or zero carbon hydrogen production and the development of CCUS to support decarbonisation of important industries where it is otherwise difficult to reduce emissions such as cement and steel production.
      2. HSWA is the basis of the UK health and safety regulatory framework, placing a fundamental general duty on employers to ensure, so far as is reasonably practicable, the health, safety and welfare at work of their employees, and of other people who may be affected by the work activity. HSWA provides powers to create secondary legislation, and HSE has introduced more prescriptive and specific regulations to apply to work activities that create a major accident hazard risk.
      3. CO2 and hydrogen are both well-known and understood as industrial chemicals. Hydrogen can be used to produce ammonia, power vehicles, generate electricity, power industry, and heat homes or businesses. CO2 is primarily used in food and beverage manufacture, medical and chemicals industry, or in agriculture.
      4. However, their current applications differ from those now being proposed in which CO2 will be captured in higher quantities, at higher pressure and be highly refrigerated. For hydrogen, the main issue is that it is highly flammable.
   2. **Problem definition**

**The major accident hazard potential of CO2****and CCUS operations offshore**

* + 1. The CCUS process involves CO2 being captured from existing industrial processes, transported, and permanently stored in offshore geological formations. The first UK projects will involve CO2 being transported by pipeline and stored offshore using existing installations and wells. Future projects may use other forms of transportation.
    2. In June 2011, HSE published its `Assessment of the major hazard potential of Carbon Dioxide`[[5]](#footnote-6). The paper is authored by a Principal Specialist Inspector (Risk Assessment) in HSE’s Major Accidents Risk Assessment Unit, and advisers included HSE’s Process Safety Section at the Health and Safety Laboratory and the scientific and technical advisor to HSE’s Emerging Energy Technologies Programme.
    3. The report noted that where in existing CO2 handling facilities an inadvertent release of CO2 may create a small-scale hazard, potentially only affecting those in the local vicinity, a very large release of CO2 in gaseous phase from a CCUS scale operation had the potential to produce a harmful effect over a significantly greater area and therefore could affect a significant number of people. The report concluded that CCUS scale CO2 operations therefore had the potential to introduce a major accident hazard (MAH). There is no new evidence to suggest that the HSE paper published in 2011 is inaccurate in its conclusions. A recent example of the type of major incident that can occur is the 2020 Denbury Gulf Coast Pipeline Rupture[[6]](#footnote-7) where the failure of a pipeline resulted in a significant CO2 release, with 200 people evacuated from their homes, and 45 people hospitalised. The incident also highlighted the challenges to the emergency services of responding to a CO2 incident.

**The major accident hazard potential of offshore hydrogen production**

* + 1. Hydrogen is a highly flammable substance with a low ignition point which has extensive industrial applications including as a coolant in generators and as a crucial element of the chemical process to produce ammonia. Hydrogen is already defined as a dangerous substance under regulation to control onshore MAH and its presence in significant quantities is subject to the Control of Major Hazards Regulations 2015[[7]](#footnote-8) (COMAH).
    2. Offshore hydrogen production involves siting electrolysers on offshore installations that split the hydrogen and oxygen atoms in seawater; the hydrogen generated by this process is then piped or shipped onshore for use. The presence of hydrogen on an offshore installation introduces the additional hazard of a highly flammable substance to a work environment that already creates many hazards, and where emergency arrangements are constrained by the challenges of location.

**Regulatory inconsistencies**

* + 1. Following policy and legal analysis, HSE has identified regulatory inconsistencies in the existing major hazards regulatory framework, which do not currently support effective regulation of the safety risks associated with the CCUS industry and offshore hydrogen production.

**Regulatory application to CCUS onshore**

* + 1. The Pipelines Safety Regulations 1996[[8]](#footnote-9) (PSR96) apply to the transportation of fluids (with some exceptions) by pipeline. PSR’s general provisions apply to all pipelines, with additional requirements for Major Accident Hazard pipelines (MAHP). MAHPs carry substances defined by PSR as dangerous fluids. The designation of a pipeline as a MAHP places additional duties to notify HSE of new pipelines at the design stage, before construction and to prepare a major accident prevention document (MAPD). Further duties in relation to emergency planning and response attract land use planning controls limiting development in the proximity of the pipeline.
    2. Legal advice indicates that there is a lack of clarity as to whether these provisions apply to pipelines transporting CO2 and it is also currently unclear whether CO2 meets the definition of a dangerous fluid in PSR.

**Regulatory application to CCUS offshore**

* + 1. The Offshore Installations and Pipeline Works (Management and Administration) Regulations 1995[[9]](#footnote-10) (MAR95) place goal-setting duties on installation owners and operators to ensure the integrity of an installation throughout its lifecycle and provide a framework for ensuring the safe condition of wells on land and offshore, throughout their lifecycle, including an examination scheme. MAR95 provisions also apply to mobile installations while in transit to a location.
    2. These Regulations were amended in 2013 to include ‘*the storage of gas in or under the shore or bed of relevant waters or the recovery of gas so stored*’, aimed specifically at the regulation of offshore CO2 storage. However, the word ‘*gas*’ potentially limits the applicability to gaseous phase CO2, and planned UK CCUS projects will involve CO2 being transported and stored in other chemical phases.
    3. The Offshore Installations (Offshore Safety Directive) (Safety Case etc) Regulations 2015[[10]](#footnote-11) (SCR15) require operators of offshore installations to, among other duties, prepare a safety case for approval by HSE. An offshore installation is defined in MAR95 ‘*as a structure which is used for the exploitation, or exploration of mineral resources by means of a well; for the storage of gas in or under the shore or the recovery of gas so stored; for the conveyance of things by means of a pipe; or mainly for the provision of accommodation for persons who work on or from a structure falling within any of the provisions of these regulations*.’
    4. An installation needs to meet the definition in MAR95 for the safety case regulations to apply. The definition was drafted with the intention of applying to oil and gas installations. In a CCUS context an installation is used to connect the injection well used to inject CO2 into seabed deep rock formations with the pipelines transporting CO2 from onshore capture plants.
    5. However, not all planned CCUS projects will use an offshore installation and wells to facilitate permanent storage. Some projects plan to use offshore subsea injection: concepts where ships are used as the mode of transport from collection to storage, and an injection from the ship straight to the seabed deep rock formations. Consequently, the requirements of the offshore regime, including safety cases, do not clearly or consistently apply to CCUS projects.
    6. The Offshore Installations and Wells (Design and Construction, etc.) Regulations 1996[[11]](#footnote-12) (DCR96) contain requirements for ensuring that offshore oil and gas installations, and oil and gas wells are designed, constructed, and kept in a sound structural state, and other requirements affecting them, for purposes of health and safety. They apply to hydrocarbon wells and so do not apply to CCUS activities involving using wells to inject CO2. This creates inconsistency of application of major hazard regimes to well activities involving similar hazards.
    7. The Health and Safety at Work etc. 1974 (Application outside Great Britain) Order 2013[[12]](#footnote-13)(AOGBO) applies specific sections of HSWA beyond the mainland of Great Britain to specified offshore areas and work activities. Article 8 of the AOGBO clarifying HSE jurisdiction was amended in 2013 to expand the description of an offshore installation to include offshore CO2 storage and injection, this had the effect of extending general duties under HSWA but not further specific duties under major hazard regulation. This means that specific changes will be required to ensure duties for CCUS, and hydrogen are extended to address MAH.

**Regulatory application to offshore hydrogen production**

* + 1. As the protections and provisions in existing offshore regulation including, MAR95, SCR15, DCR96 and AOGBO were drafted primarily to apply to hydrocarbons, there are similar issues for the offshore production of hydrogen to those described above for CCUS activities especially concerning the definition of an offshore installation.
    2. For example, as currently drafted in SCR15, an installation for the production of hydrogen would be classed as a non-production installation, because it doesn’t involve extraction of hydrocarbons. This would not adequately address the hazards of hydrogen production or provide the Competent Authority, which comprises HSE and the Offshore Petroleum Regulator for Environment and Decommissioning (OPRED) (part of the Department for Energy, Security and Net Zero) with sufficient opportunity to provide assurance of the appropriate management of operations e.g. through the receipt of design notifications or the assessment of safety cases.
  1. **Why is government intervention necessary, and what gaps or harms would occur without intervention**

* + 1. HSE considers intervention by way of changes to the existing major hazards regulatory framework is necessary for the following reasons:

**CCUS transport by pipeline onshore**

* + 1. Changes to PSR96[[13]](#footnote-14) will ensure that:

1. the application of the additional requirements of major accident hazard provisions (MAHPs) of PSR are made explicit. If CO2 is not brought into the scope of the major accident hazard provisions of PSR96, HSE will not be notified of CO2 pipelines before their construction, or their use.
2. any future developments around CO2 pipelines will be subject to consultation zones for land use planning. If CO2, is not brought into scope it would create the risk that planning applications for developments could be granted without regard to their proximity to the pipeline.
   * 1. Additionally, if CO2 is not classed as a dangerous fluid, then there will be no regulatory requirement for the Local Authority (LA) to prepare an emergency plan that outlines the associated hazards, operating conditions, and evacuation of people. Changes to the regulations would allow HSE to influence safety standards at an early stage through the receipt of PSR96 notifications and would allow land use planning controls to create consultation zones managing development around pipelines.

**CCUS offshore**

* + 1. Changes to MAR95 are required to ensure that:

1. The regulations will cover all phases of CO₂: gaseous, liquid, and supercritical;
2. These Regulations align with other regulations that will be amended; and
3. All CCUS installations and projects that may use CO₂ subsea injection fall within the scope of these regulations.

* + 1. If the definition of “*gas*” in the AOGBO is extended to MAR95, this would ensure there is a clear basis for an installation used for the storage of CO2 to qualify as an offshore installation under MAR95.
    2. Changes to SCR15 are required to ensure:

1. That MAH duties are extended to regulate CCUS, in particular the requirement for operators of installations to prepare a safety case.
   * 1. Changes to DCR96 are required to ensure:
2. That CCUS activities are included in the scope of the regulations;
3. These Regulations align with other regulations that will be amended;
4. That all phases of CO₂, gaseous, liquid, and supercritical, are included within the scope of these regulations;
5. That all CCUS projects that may use CO₂ subsea injection will be within the scope of these Regulations.
   * 1. Changes to AOGBO are required to:
        1. ensure that the appropriate sections of HSWA are correctly applied to the activities as they will be defined following the proposed changes.

**Offshore hydrogen production**

* + 1. Changes to MAR95 are required to:

1. Bring hydrogen production activities within scope of MAR95 regulations;
2. Classify work activities connected to offshore hydrogen production as offshore installations, meaning that MAR95 and the offshore major hazard regime apply
   * 1. Changes to SCR15 are required to ensure:
3. That platforms used to produce hydrogen are designated as production installations.
   * 1. Changes to AOGBO are required to:
4. Add hydrogen production and hydrogen storage to the list of items that define an offshore installation under AOGBO so that platforms which are used to produce hydrogen are classed as offshore installations and therefore subject to the broad framework of HSWA.
   * 1. Engagement with industry and DESNZ indicates that significant onshore storage is not currently planned in CCUS operational models and so it is considered more time-critical to address the major hazard risks associated with the transport of CO2 by pipeline and offshore storage where CCUS projects are already in the planning and design stage.
     2. In summary, regulatory changes are required to ensure that CCUS activities and offshore hydrogen production are appropriately brought into scope of HSE`s major hazard regulatory framework. Failure to ensure an appropriate regulatory frameworkhas the potential to:
     3. Create an unclear and inconsistent regulatory picture for dutyholders and limit HSE’s ability to ensure the effective regulation of these industries.
     4. Limit the application of planning controls around sites and subsequent developments relating to CCUS activities and offshore hydrogen production, and the extent of duties placed on Local Authorities to carry out emergency planning.
     5. The Government intention is for the first CCUS projects to commence in mid-2020s, and for hydrogen production to rise significantly by 2030. HSE intends that changes to the regulations outlined in this section will be made in line with these plans for development and deployment.
5. **SMART objectives for intervention** 
   1. The overall strategic objectives are to:
6. Support the UK Government in achieving its net zero objectives through deployment and expansion of CCUS and offshore Hydrogen production;
7. Ensure the regulatory regime for CCUS and offshore hydrogen production is proportionate to the hazards generated;
8. Ensure the regulatory regime for CCUS and offshore hydrogen production is clear for dutyholders and other stakeholders.
   1. In assessing and shortlisting options against these objectives, the following critical success factors have been used:
   2. **Strategic fit.** Any proposal should align with UK Government mission to deliver clean power and accelerate to Net Zero. Any proposal should also align with HSE’s strategy, Protecting People and Places[[14]](#footnote-15) and HSE’s plans for delivering that strategy, specifically the strategic objective to enable industry to innovate safely to prevent major accidents, supporting the move towards net zero.
   3. **Industry technical and practical ability to comply with regulatory requirements**. Any regulatory changes should be reasonably practicable for dutyholders to comply with.
   4. **Feasible for HSE to deliver.** Any regulatory changes should be technically and practically possible for HSE to deliver as a regulator.
   5. **Potential value for money.** Proposals will need to ensure that they maintain or improve HSE’s ability to deliver value for money for industry and society.
   6. **Potentially affordable for HSE/ Government.** The offshore and pipelines regimes operate based on full cost recovery, and any regulatory changes should extend this to CO2 operations and hydrogen production.
   7. Based on the above strategic objectives and critical success factors the SMART objectives for intervention are to:
9. Deliver regulatory change which comes into force in line with HM Government plans for the deployment of CCUS operations and offshore hydrogen production.
10. Create a regulatory framework that is appropriate to the hazards associated with CCUS operations and offshore hydrogen production. Any changes to the framework should be clear and practicable for dutyholders to act upon; deliverable by HSE; where success can be monitored through an evaluation plan that will be determined once the intervention option has been decided on following further stakeholder consultation.
11. **Description of proposed intervention options and explanation of the logical change process whereby this achieves SMART objectives** 
    1. HSE's preferred option is to make changes to existing major hazard regulations to either clarify or extend the scope of CCUS activities offshore and the transport of CO2 by pipelines and offshore hydrogen production. This would require;
12. Changes to PSR96 so that CO2, in all phases within CCUS, is subject to the additional duties applicable to major accident hazard pipelines. This would make the application of the additional requirements of MAHPs explicit and allow HSE to influence safety standards at an early stage through the receipt of PSR96 notifications and would allow land use planning controls to create consultation zones managing development around pipelines.
13. Changes to SCR15, MAR95, DCR96 and AOGBO to clarify or where necessary extend application to CCUS activities offshore and to offshore hydrogen production. This may be achieved by copying the requirements from existing legislation to a specific regulation applicable to CCUS operations. This would have the same effect but may, presentationally, appear more straightforward.
    1. HSE’s major hazard regimes generally require an operator to prepare a comprehensive document detailing their potential risks, hazard scenarios and measures identified either to prevent those scenarios taking place or mitigating the negative effects if they do. This document is known as either a Safety Report or a Safety Case. These documents have to be submitted to HSE prior to work activities commencing. Specific wording differs between different major hazard regulations but broadly HSE must confirm it is satisfied that the operator has sufficiently identified the hazards created by their work activity and that the measures identified are appropriate.
    2. These changes would see the above-mentioned, already existing, regulatory duties for major hazards activities such as safety cases, notifications and emergency plans, extended to the emerging CCUS and hydrogen production industries. It is recognised that the preferred option would see greater costs for operators than not making any intervention; HSE considers this to be appropriate to ensure that the major hazard risks associated with these industries are appropriately regulated. Potential dutyholders are likely to be familiar with these requirements as these are duties already well known and understood within the existing pipeline and offshore sectors.
    3. This intervention option has been identified as the only one that meets the objectives outlined in Section 3 as it allows for major hazard regulatory standards to be introduced for these work activities, in a manner that is clear, appropriate, and proportionate to the hazards created. HSE’s intention is to introduce regulations to come into force in line with HM Government plans for the deployment of CCUS operations and offshore hydrogen production.
    4. A logical theory of change map of the objective and how the proposed intervention will be achieved is set out below in Diagram 1.

## Diagram 1: Theory of Change map for proposed changes to HSE`s Major Hazard regulation

|  |  |  |  |
| --- | --- | --- | --- |
| INPUTS | OUTPUTS | OUTCOMES | IMPACT |
|  |  |  |  |
|  | 110 |  |  |
|  | 223 |  |  |
|  | 197 |  |  |
| Extend Major Hazard Regulations to include CCUS facilities and offshore hydrogen production. | 134 | **Hypothesis:**  Safety considerations could help attain the social license for untested technologies. |  |
| Oak Institute | 202 |  |  |
|  | *Graduate* |  |  |
| Cedar University | 24 |  | Improved health and safety for employees and their workplaces. |
|  | 43 |  |  |
|  | 3 |  |  |
|  |  | Duty-holders benefit from guidance and feedback from HSE to improve safety risk management. |  |
|  | Include CCUS facilities and hydrogen production into the scope of onshore and offshore major hazard regulations.  Enable HSE`s interventions for safety risk management.  Include all types of offshore installations within the scope of offshore regulations.  Bring projects that will use direct injection into the scope of offshore installations.  Apply land-use planning to inform separation distances between pipelines and communities.  Potentially update the definitions of dangerous fluids in PSR96 and inform CO₂ product specifications using scientific evidence and research.  Amend PSR to include all phases of CO₂. |  |  |

1. **Summary of long-list and alternatives** 
   1. **Approach to generating a longlist**
      1. To achieve a longlist of options HSE carried out informal engagement with a range of stakeholders, including the main operators in the proposed HyNet, East Coast and Acorn CCUS clusters at several workshops convened by HSE. HSE also consulted with internal expert teams including policy, operational policy, specialist teams and Science Division who have working knowledge and experience in regulation and risk management. HSE also has engaged with DESNZ, NSTA (The North Sea Transition Authority) OPRED and the environmental regulators (the Environment Agency in England, The Scottish Environment Protection Agency in Scotland, and Natural Resources Wales in Wales). The informal engagement process focused on developing and exploring a range of potential regulatory options, with due consideration given to alternatives to regulation.
   2. **Rejected long-list options**

***Option 1 - Leave as is (Do Nothing)***

* + 1. This option would see no regulatory changes made and leave CCUS and hydrogen production activities to be regulated under the existing duties in the Health and Safety at Work etc Act 1974 and the Management of Health and Safety Regulations 1999[[15]](#footnote-16), supplemented only by HSE’s sector-specific guidance. This would mean that these activities would not be regulated to the same standard as other work activities considered to be major hazards activities e.g. there would be no requirement for notifications, safety cases etc.
    2. On this basis this option is not considered to meet the objectives outlined in Section 3 as it does not deliver a regulatory framework that regulates these activities in a way which is appropriate for the risks associated with hydrogen production and CCUS operations and results in inconsistency with the regulation of other major hazards activities. It is therefore not considered a viable option and is **Discounted**.

***Option 2 – Non-Regulatory Approaches / Guidance***

* + 1. This option would see the existing application of health and safety regulation (as described in Option 1) supplemented by sector-specific guidance to support dutyholder compliance and clarify HSE’S expectations of operators.
    2. HSE has a long history of using non-regulatory options to supplement HSWA with different approaches including influencing and achieving through others, reputation-based approaches, and collaborative efforts with industry stakeholders to enhance compliance and promote development of a safety culture beyond the constraints of regulation.
    3. These approaches have been deployed in a number of sectors which HSE is responsible for regulating, such as in the transport sector where HSE collaborated with other regulatory bodies and industry associations to promote best practice in the pallet industry and the waste and recycling sector where HSE has worked with industry bodies like the Waste Industry Safety and Health (WISH) Forum in developing and deploying sector-specific guidance.
    4. These examples have all led to measurable improvements and seen good feedback from those involved. However, they are sectors that HSE considers to be non-major hazard and whilst guidance can clarify good practice in complying with general requirements, it does not have the same legal enforceability as specific regulations. Furthermore, this option would not resolve the regulatory inconsistency described in *Option 1*.
    5. On this basis this option does not meet the policy objectives outlined in Section 3, as it does not lead to a clear, consistent, and robust regulatory regime appropriate for activities that constitute a major accident hazard. It is not considered a viable option and is therefore **discounted**.

***Option 3 – Non-Regulatory Approaches / Communications***

* + 1. This option would see the existing application of health and safety legislation (as described in Option 1) supplemented by targeted communications activity to clarify good practice in complying with general requirements.
    2. HSE has a long history of using non-regulatory options to supplement HSWA including communication campaigns planned to align with strategic priorities and areas of low compliance or poor incident history with the intention of enhancing compliance and promoting development of a safety culture beyond the constraints of regulation.
    3. Such campaigns have often addressed workplace health and safety issues not linked to specific regulations such as; ‘Dust Kills’ raising awareness on the risk of dust inhalation in construction and other industries, and ‘Working Minds’ focusing on work-related stress and mental health in the workplace. Campaigns usually involve traditional and social media outreach, partnerships with external organisations and the development and deployment of guides, toolkits and case studies.
    4. These campaigns have received positive feedback from those involved and have led to measurable improvements, often across cross-cutting topics that may benefit from a broader approach. However, they all apply to topics or sectors considered to be non-major hazard and whilst communications activities can clarify good practice in complying with general requirements, it does not have the same legal enforceability as specific regulations. Furthermore, this option would not resolve the regulatory inconsistency described in *Option 1*.
    5. On this basis this option does not meet the policy objectives outlined in Section 3, as it does not lead to a clear, consistent, and robust regulatory regime appropriate for activities that constitute a major accident hazard. It is not considered a viable option and is therefore **discounted**.

**Option 4 – *New prescriptive regulation***

* + 1. This option would see new regulation developed to apply to these activities at a higher and more prescriptive level than current HSE major hazard regulation.
    2. HSE does not, generally, stipulate what specific measures must be taken to comply with duties imposed by its major hazard regulation, and the ultimate responsibility for managing the hazards created by the work activity remains with the dutyholder. Assurance that hazards are being appropriately managed is obtained through regulatory engagement e.g. inspection. Safety Case/ Reports must be revised or updated at regular intervals or when significant changes taken place; other than this, dutyholders may take actions they consider to be appropriate to manage the hazards created by their work.
    3. Some areas of regulation are more prescriptive and place more stringent conditions on regulated entities, such as the licensing regime applied by the Office of Nuclear Regulation (ONR) to civil and defence nuclear sites. This requires ONR to grant permission to key activities[[16]](#footnote-17) and that licensees abide by detailed and stringent licensing conditions[[17]](#footnote-18). This is more prescriptive than regulations such as SCR15 or DCR96 by specifying actions and measures and limiting the amount of deviation an operator can take from the license conditions.
    4. This level of regulation is considered to be appropriate for nuclear sites given both the catastrophic and long-lasting accident potential and the levels of public assurance expected. However, it is not consistent with the level of regulatory scrutiny that HSE generally adopts for major hazards. It is therefore felt that a licensing type approach would be disproportionate compared to the approach taken for similar major hazard industries.
    5. On this basis this proposed intervention option does not meet the objectives in remaining proportionate to the hazards created. It is not considered to be a viable option and is therefore **discounted**.

***Option 5 – Regulatory Option / Partially regulate as major hazard***

* + 1. This option would involve some changes made to existing major hazard regulation to clarify their application but would not extend application to an activity that is clearly currently not in scope. This option has been **shortlisted** and will be discussed further in Section 6.

***Option 6 – Regulatory Option /Fully Regulate as major hazard***

* + 1. This option would see changes made to several pieces of major hazard regulation to either clarify and extend the scope and application of those regulations to CCUS operations offshore and transport of CO2 by pipeline, and to the offshore production of hydrogen. This option has been **shortlisted** and will be discussed further in Section 6.

***Option 7 – Non-Regulatory Approaches / Industry standards***

* + 1. This option would see the existing application of health and safety regulation (as described in Option 1) supplemented by industry standards to influence a change in behaviour towards improved levels of safety. This option has been **shortlisted** and will be discussed further in Section 6.
  1. **Small and Micro Business Assessment (SaMBA) and impact on medium sized businesses**
     1. The Companies Act 2006 defines the size of a business based on its staff headcount, annual turnover, or balance sheet. Large companies are defined as those with over 250 staff, an annual turnover exceeding £36m, or a balance sheet total exceeding £18m[[18]](#footnote-19).
     2. HSE’s regulatory approach seeks to be proportionate and appropriate to the risk that is being managed and for many areas including risk assessment and leadership[[19]](#footnote-20), and chemical classification[[20]](#footnote-21) this is supported by guidance specifically targeted at small and medium sized enterprises (SMEs).
     3. For work activities considered to constitute a major accident hazard, such as those that are the subject of this Options Assessment, that proportionality is directly related to the level of risk rather than staff numbers, turnover, or balance sheet. It is a key principle of major hazard legislation since its inception several decades ago that risks capable of causing serious harm to people and the environment need to be appropriately managed and the responsibility to do that lies with those who create the hazard. Doing so helps to address market failures around ‘moral hazard’ and addresses negative externalities from production.
     4. The strategic case for intervention, and subsequent identification and consideration of options has been carried out based on the risks that the activities pose and the major accident hazard scenarios they are capable of creating. This is deliberately and explicitly agnostic of the number of persons employed by a business engaged in the work activity. On this basis it is not considered appropriate to exempt small or micro businesses from any of the proposed regulatory changes.
     5. We have also considered potential mitigations based on the size of a business including extended transition periods, different requirements for different sizes of companies, tailored information and voluntary solutions. Non-regulatory, including voluntary, solutions have been considered as part of Options 2, 3, and 7 and considered not to meet the objectives and therefore not considered appropriate. For the same reasons described in 5.3.4, we consider that proportionality must be connected to the risk rather than the size of the business and therefore we consider mitigations based on business size are not appropriate. The preferred option would include transition periods to facilitate compliance and appropriate guidance which will be proportionate to the risks being created by these activities.
     6. As the CCUS and offshore hydrogen production industries are still in development and installations are not currently operational, it is challenging to develop an accurate picture of what the sectors may look like in the future in terms of the number of micro, small or medium enterprises that may be involved. However, the CCUS projects in DESNZ’s funding pathways and the projects that have been accepted in the Hydrogen Allocation Rounds involve a range of companies including larger companies such as BP, CF Fertilisers[[21]](#footnote-22), Cadent, INEOS[[22]](#footnote-23), EDF and Scottish Power[[23]](#footnote-24). The nature of the technical expertise and infrastructure required to deliver these projects are likely to lend themselves towards larger companies.
     7. The likelihood of micro, small, or medium businesses incurring costs from these measures will differ between offshore installations and pipelines. Many companies operating in these sectors will be large and often multi-national. It is common for these larger companies to set up smaller companies to operate specific projects or assets, albeit with the technological and financial backing of the larger parent company. The Regulatory Policy Committee (RPC) guidance on SaMBA[[24]](#footnote-25) says: “*In some instances, classification in terms of number of FTE employees might present difficulties and uncertainties, for example, … businesses that employ few people but have a large turnover or market share. In these situations, departments should explain the definition adopted for [small and micro businesses] SMBs and why it is appropriate. In these situations, the RPC would encourage departments to adopt an inclusive approach to defining and assessing impacts on SMBs*.” Although this guidance does not explicitly describe smaller subsidiaries set up by larger parent companies, the thrust of the guidance and the focus of SaMBA on identifying and limiting barriers to the growth of small businesses and new entrants (as opposed to the operational and financial entities of large incumbent multi-nationals) would seem to support such subsidiaries as being one of the instances where simple FTE employment “*might not always work perfectly as an indicator of small and micro businesses*” in the words of the RPC guidance. Therefore, in our quantified assessment below, we have taken into account HSE sector intelligence on business make-up of the relevant sectors and the requirements of regulatory duties on capability and capacity in assessing the extent of actual micro, small and medium businesses.
     8. To provide estimated quantification of micro, small and medium businesses, we have referred to current Inter-Departmental Business Register (IDBR)[[25]](#footnote-26) data and BEIS statistics on the UK Business Population[[26]](#footnote-27) and interpreted the applicability of these general sector figures to the specific novel industries in scope of these proposals. These are necessarily rough proxies at this stage, but we will explore options to develop them during policy development and consultation.
     9. For **offshore installations** operating CCUS or hydrogen production, while there is not yet data on the make-up of these sectors, the closest analogous sectors in IDBR are the SIC 0610 extraction of crude petroleum; and SIC 0620 extraction of natural gas (see Table 1). If the operators of CCUS and hydrogen installations matched the general size make-up of these sectors, then we would expect around 70% of operators in scope to be micro, 8.7% small, 8.7% medium and 13% large.

Table 1

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Employment Size Band** | | | | | | | |
| **0-4** | **5-9** | **10-19** | **20-49** | **50-99** | **100-249** | **250+** | **Total** |
| 0610: Extraction of crude petroleum | 20 | 10 | 5 | 5 | 0 | 10 | 15 | **65** |
| 0620: Extraction of natural gas | 45 | 5 | 0 | 0 | 0 | 0 | 0 | **50** |
| Size distribution micro/ small/ medium/ large | 70% | | 8.7% | | 8.7% | | 13% | **100%** |

* + 1. However, HSE inspector sector intelligence indicates that it is very unlikely that a micro or small business could operate an offshore CCUS or hydrogen installation – declared operators in this area are more likely to be consultants or contractors who do not manage the relevant risks and therefore incur costs themselves, or operating smaller support functions, service vessels. Offshore installation operators are assessed by HSE and the Offshore Petroleum Regulator for Environment and Decommissioning (OPRED) for their technical capability and financial capacity to operate an installation safely and to mount an effective response to the safety and environmental effects of a major accident and loss of containment. Such capabilities and financial capacity are sizeable and require the resources of medium or large companies. Failure to demonstrate such capability and capacity will prevent an operator from receiving permission to operate. Hence, we assume that businesses employing 0 to 49 employees will either not be operating CCUS or hydrogen installations (e.g. they are consultants, contractors or operating smaller installations) or, if they are operating CCUS or hydrogen installations, they are likely to be part of much larger companies. Economic Activity in the current sector is predominantly large businesses – accounting for around 81% of the industry’s turnover[[27]](#footnote-28). We will test this analysis further during consultation.
    2. As such, our central estimate at this stage is that only medium and large businesses will be operating CCUS or hydrogen installations in scope of these proposals. Table 1 shows there are 10 medium businesses and 15 large, giving a 40% medium and 60% large distribution. This is what we take to be our central estimate.
    3. Whilst we believe that micro and small businesses will be out of scope of these requirements due to their not being CCUS or hydrogen installations operators, exploring this in consultation will be important, given their share of the nearest comparable currently existing industry: as set out in Table 1 (around 70% of businesses are micro, 8.7% small, 8.7% medium and 13% large). Again using Business Population Estimates data, micro businesses account for around 1.4% of turnover; small around 1.4% also; and medium around 9%.
    4. For the **operators of pipelines**, if these, too, followed the general size distribution of the wider sector, we would expect them to look like the sector size distributions below, with hydrogen pipeline operators best analogised by SIC 3522 in Table 2; and CO2 pipeline operators best analogised by SIC 4950 in Table 3. This IDBR data indicates that hydrogen pipeline operators could be 67% micro, 17% medium and 17% large; and that CO2 pipeline operators could be 50% micro and 50% large if they followed the size distribution of the wider analogous sectors.

Table 2

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Employment Size Band** | | | | | | | |
| **0-4** | **5-9** | **10-19** | **20-49** | **50-99** | **100-249** | **250+** | **Total** |
| 3522: Distribution of gaseous fuels through mains | 15 | 5 | 0 | 0 | 0 | 5 | 5 | **30** |
| Size distribution micro/ small/ medium/ large | 67% | | Nil | | 17% | | 17% | **100%** |

Table 3

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Employment Size Band** | | | | | | | |
| **0-4** | **5-9** | **10-19** | **20-49** | **50-99** | **100-249** | **250+** | **Total** |
| 4950: Transport via pipeline | 5 | 0 | 0 | 0 | 0 | 0 | 5 | **10** |
| Size distribution micro/ small/ medium/ large | 50% | | Nil | | Nil | | 50% | **100%** |

* + 1. However, as with the offshore installation operators, sector intelligence from HSE inspectors indicates that many of the micro and small businesses will be consultants and smaller subsidiaries operated by larger companies – that actual pipeline operators are likely to be medium or large only. Again, we take as our central case that CO2 and hydrogen pipeline operators will be medium and large businesses.
    2. Table 2 shows five medium and five large businesses, which could indicate about a 50% medium and 50% large split for hydrogen pipeline operators. Table 3 shows no medium and five large businesses, which could indicate all will be large. We will explore in consultation data with industry to develop these estimates further, particularly given the limited data in IDBR for these two sectors.
    3. Whilst we believe that micro and small businesses will be out of scope of these requirements due to their not being CCUS or hydrogen pipeline operators, exploring this in consultation will be important, given their share of the nearest comparable industry: hydrogen as set out in Table 2 (with 67% micro, 17% medium and 17% large): and CO2 pipeline operators as set out in Table 3 (with 50% micro and 50% large). Turnover data by size for pipeline operators is not available.
    4. Although HSE considers that the efforts and costs of achieving compliance should be proportionate to the risk created, the SaMBA asks whether they are proportionate to employment size – does it cost smaller businesses less than larger ones? We do not currently have quantified data on whether compliance costs are likely to be disproportionate for medium businesses (or micro or small ones, should they enter the sector) versus large ones. There are arguments to think that smaller operators would incur lower costs, as their operations could be less complicated (thereby requiring fewer people to operate) and they will have fewer staff on site exposed to risk and in need of potential evacuation. On the other hand, automation and remote management technology is decoupling the complexity of an operation from the number of people on-site needed to deliver it; and economies of scale and the natural monopoly characteristics of pipeline operations present opportunities for larger companies to reduce their costs relative to smaller ones. In short, this is an area for further development through the consultation process. We will explore the quantified data on costs and business size that we will be collecting via our planned consultation to develop this assessment further and refine for the final stage impact assessment. For the present, we are not able to quantify any difference in costs by business size and will assume them constant in this options assessment.

1. **Description of shortlisted policy options carried forward** 
   1. Options 5, 6 and 7 from the long-list above have been carried forward for further consideration in this section. Option 1, Do Nothing, has not been carried forward to the short-list because it does not meet the defined objectives, however baseline information on the regulatory position for these sectors without any changes have been considered as a baseline when evaluating short-listed and the preferred option.

***Option 5 - Regulatory Option / Partially regulate as major hazard***

* 1. As detailed in Section 2, HSE has identified that offshore major hazard regulation applies to some aspects of the CCUS process offshore but not others, largely because of how definitions in the regulations have been drafted.
  2. This option would amend regulations to ensure that major hazard regulation applies clearly and consistently to CCUS operations offshore and transport of CO2 by pipeline but would not address any regulatory inconsistencies concerning offshore hydrogen production. This would also reflect the fact that CCUS projects are more advanced in terms of development and deployment than offshore hydrogen production.
  3. Although this option would meet the objectives with regard to CCUS operations offshore and transport of CO2 by pipeline, it would not fully meet the objectives with regard to offshore hydrogen production. Although offshore hydrogen projects are not currently as advanced as CCUS, the generation of low or zero carbon hydrogen is a key tenet of plans to achieve Net Zero and it is our view that this opportunity should be taken to clarify appropriate regulation. On this basis, this option is **not preferred.**

***Option 6 - Regulatory Option /Fully Regulate as major hazard***

* 1. This option would involve changes to clarify the regulatory requirements and where necessary extend application to CCUS operations offshore and transport of CO2 by pipeline, and to offshore hydrogen production.
  2. This intervention option fully meets the objectives outlined in Section 3 and is HSE’s **preferred option** for the reasons discussed in Section 4.

***Option 7 -* *Non-Regulatory Approaches / Industry standards***

* 1. This would be a non-regulatory option involving the use of industry standards to supplement the health and safety regulation that currently applies.
  2. Standards are generally developed by industry bodies or groups and set out agreed requirements, for example addressing product performance, safety, reliability, and the methods for evaluation. Standards have been used extensively in the offshore oil and gas industries and can be very useful to dutyholders in managing their risks, however they do not have the same legal status as regulations and therefore whilst they provide an approach to compliance dutyholders are free to adopt alternatives.
  3. Industry standards are most suitable where there are clear approaches that are widely used and accepted, and generally where there are a limited options for dealing with a particular issue. Given the novelty and complexity of the activities being considered here, we do not consider that the stage has been reached where there is agreement on industry standards or approaches which would inform agreed good practice and so use of industry standards is unlikely to be sufficient to ensure that risks are adequately controlled.
  4. Although this option could partially meet some of the objectives listed above regarding clarity and industry ability to comply, it does not fully meet the objective of fully regulating these activities in a way which is appropriate for the risks associated with hydrogen production and CCUS operations and results in inconsistency with the regulation of other major hazards activities and is therefore **not preferred.**

1. **Regulatory scorecard for preferred option**

Please provide quantitative estimates and qualitative descriptions of impacts under each heading in the following sections. The right hand column for directional ratings should be based on the description of impact and the sign of the suggested indicator (NPV, NPSV, all impacts): **Green** – positive impact, **red** – negative impact, **amber** – neutral or negligible impact, **blue** – uncertain impact. Please use the colours in the examples shown below, as these are suitable accessible colours. Please see BRF guidance technical annex for definitions.

### Part A: Overall and stakeholder impacts

|  |  |  |
| --- | --- | --- |
| **(1) Overall impacts on total welfare** | | **Directional rating**  **Note: Below are examples only** |
| **Description of overall expected impact** | The preferred option is intended to reduce the likelihood of major accidents for the sectors in scope. This should provide further protection for the safety of offshore and pipeline workers and members of the public. This also limits the potential for damage to infrastructure and loss of production capacity, as well as avoided environmental costs. As such, this can be viewed as correcting an externality as there is the risk of an under-provision of safety mitigation due to businesses not internalising the costs to workers, households, government and broader industry in the event of an accident. Additionally, there is the correction of information failures by ensuring that operators fully understand risks and how to control for them.  Further benefits are expected as a result of improved clarity in the requirements for businesses to ensure safety. This should improve public and investor confidence and help the industry secure future investment.  The costs of the preferred option is incurred by businesses operating in the sector. These costs are in the form of compliance with regulatory requirements. A detailed outline of the compliance costs is provided in the cost-benefit analysis.  As it isn’t currently possible to quantify the benefits, it isn’t possible to determine with certainty whether the overall benefits are greater than, less than or equal to the expected costs. | **Uncertain**  **Based on all impacts (incl. non-monetised)** |
| **Monetised impacts** | Ten-year PV for CCUS sector: -£220m (-£100m to -£340m)  Ten-year PV *per* CCUS pipeline: -£710k (-£47k to -£2.3m)  Ten-year PV *per* hydrogen installation: -£12m (-£5.0m to -£18m)  These estimates cover the cost of compliance with the regulations SCR, DCR, MAR, and PSR, as well as the associated cost recovery. Estimates have been developed on a per-unit basis. It has only been possible to extrapolate across the estimated size of industry for the offshore CCUS sector at this stage.  The benefits have not been monetised at this stage. | **Negative**  **Based on likely £NPSV** |
| **Non-monetised impacts** | There is an expected benefit to business in terms of the reduction in the potential for a major accident. A major accident would result in significant costs to business, and so prevention of an accident is a significant benefit. This includes capital costs caused by damage, financial costs due to shutdown of operations and the cost (hiring, retraining etc) of impacts to their workforce caused by injuries or fatalities. Additionally, avoiding an accident avoids costs to wider industry caused by reduced confidence in safety of the technology.  Application of the regulatory regime should also provide greater clarity around requirements and assurance around safety. This will contribute to greater assurance to the public, investors and HM Government (which is providing funding to some projects) that new technologies will be managed safely and appropriately regulated. In turn this should result in a better environment for investment and innovation in the sector. | **Positive** |
| **Any significant or adverse distributional impacts?** | No | **Neutral** |

|  |  |  |
| --- | --- | --- |
| **(2) Expected impacts on businesses** | | |
| **Description of overall business impact** | Measure will extend and clarify the scope of existing major hazard legislation to fully apply to the transport of CO2 in pipelines and offshore storage of CO2 related to carbon capture and storage technology, and to the offshore production of hydrogen.  Operators will need to comply with major hazard regulation which is more prescriptive than general health and safety legislation including notifying HSE of specified activities, producing a Safety Case addressing the risks and mitigation measures of their operations and emergency planning arrangements.  Businesses will incur costs in order to comply with the legislation. These costs have been monetised and outlined in detail in the CBA. There is an expected benefit to business in terms of the reduction in the potential for a major accident. A major accident would result in significant costs to business, and so prevention of an accident is a significant benefit. Additionally there will be benefits to business in terms of increased clarity around requirements and improved public confidence in safety. This should help businesses attract investment. As it is not possible to quantify the reduction in risk or value investor confidence, the impact net of compliance costs is unclear.  It is commonplace for health and safety legislation to have a negative net impact on business in order to deliver societal net benefits. In cases where there is a positive impact to business, legislation should not be required in order to ensure businesses comply with the requirements, as it would be in their own interest. While HSE believe some businesses may prefer to comply with the requirements voluntarily, there is insufficient evidence to make the claim that businesses would comply voluntarily due to the requirements benefitting them overall. |  |
| **Monetised impacts** | Ten-year PV for CCUS sector: -£220m (-£100m to -£340m)  Ten-year PV *per* CCUS pipeline: -£710k (-£47k to -£2.3m)  Ten-year PV *per* hydrogen installation: -£12m (-£5.0m to -£18m)  EANDCB for CCUS sector: -£26m (-£12m to -£40m)  EANDCB *per* CCUS pipeline: -£83k (-£5.4k to -£260k)  EANDCB *per* hydrogen installation: -£1.3m (-£590k to -£2.1m)  No pass-through to households has been included in this estimate. | **Negative**  **Based on likely business £NPV** |
| **Non-monetised impacts** | There is an expected benefit to business in terms of the reduction in the risk of a major accident. A major accident would result in significant costs to business, and so prevention of an accident is a significant benefit. Additionally there will be benefits to business in terms of increased clarity around requirements and improved public confidence in safety. This should help businesses attract investment. | **Positive** |
| **Any significant or adverse distributional impacts?** | No   SaMBA impacts and mitigations are detailed in Sections 5 and 6 of this OA. | **Neutral** |

|  |  |  |
| --- | --- | --- |
| **(3) Expected impacts on households** | | |
| **Description of overall business impact** | This measure is focused solely on regulation of businesses, therefore there are no impacts on households. | **Neutral** |
| **Monetised impacts** | There are no monetised costs to households in this assessment. | **Neutral**  **Based on likely household £NPV** |
| **Non-monetised impacts** | This measure is focused solely on regulation of businesses, therefore there are no impacts on households. | **Neutral** |
| **Any significant or adverse distributional impacts?** | No | **Neutral** |

### Part B: Impacts on wider government priorities

|  |  |  |
| --- | --- | --- |
| **Category** | **Description of impact** | **Directional rating** |
| **Business environment:**  Does the measure impact on the ease of doing business in the UK? | Introducing regulatory costs to businesses creates a potential barrier to entry. Businesses will need to be able to meet these costs in order to operate.  It is important to note that the majority of operators are expected to be businesses already operating in the offshore and major hazard pipeline sectors and so are already familiar with and capable of meeting these requirements. The sector also has high entry costs regardless of health and safety costs due large capital costs. It is not likely that the cost of complying with the health and safety requirements will make the difference in terms of businesses decision to operate. | **May work Against** |
| **International Considerations:**  Does the measure support international trade and investment? | The preferred policy option provides traders and investors with certainty over how these projects health and safety risks will be controlled. Regulatory clarity will build investor confidence and should attract further investor capital into similar projects. This facilitates UK supply chains securing global market share in new energy technologies.    Additionally, the UK intends to export carbon storage space and hydrogen to other countries. Demonstrating safety and attracting investment means that UK industry will be better placed to take advantage of those opportunities.  For example, there is a potential for £4 billion to £5 billion in Gross Value Added from UK CCUS exports by 2050, which includes exporting our expertise and storage to other countries.[[28]](#footnote-29) | **Supports** |
| **Natural capital and Decarbonisation:**  Does the measure support commitments to improve the environment and decarbonise? | Measures contribute to commitments to improve the environment and decarbonise industry as it supports wider government commitments concerning net zero technologies. The measures will support the safe development of carbon capture and storage technologies and zero carbon hydrogen production. | **Supports** |

1. **Monitoring and evaluation of the preferred option**
   1. The proposed regulatory changes will apply to industries and work activities that are still in the early stages of development and for many projects operations will not commence until mid to late 2020s. HSE anticipates that it will likely take some time for the state of the industry and the impact of regulation on it to become fully clear. However, like other major hazard sectors, it will involve a relatively small number of operators from sectors (like offshore and energy) that have traditionally had high levels of engagement with HSE. HSE’s existing intervention plans necessarily encourage close working with dutyholders and the need for ongoing dialogue around the assessment of notifications and safety cases.
   2. Monitoring and evaluation of HSE’s preferred option will be carried out by means of stakeholder and industry engagement through existing channels such as direct engagement with individual dutyholders, industry and other stakeholder forums (including DESNZ; Offshore Energies UK; the Carbon Capture & Storage Association; and United Kingdom Onshore Pipelines Operators Association).
   3. This will involve seeking feedback at regular intervals on the effectiveness of changes, considering whether they remain appropriate and proportionate for the regulation of the industry, and seeking feedback on other elements of regulation such as supporting guidance. This can be achieved through quantitively-focused online questionnaires, which will help to highlight any issues as proportionately as possible.
   4. A Post Implementation Review (PIR) of the regulatory changes will be undertaken and a report published within five years of the coming into force date of the proposed changes to regulation. Further consideration will be given to an ongoing 5 yearly review at Impact Assessment stage, following consultation.
   5. Evidence and data collection for the PIR will take the form of literature reviews (e.g. new publications relating to CCUS and offshore hydrogen), HSE enforcement information and notifications relating to the preferred option, potential advances in scientific data and evidence relating to the major hazard risks of CO2 and Hydrogen, engagement with stakeholders and dutyholders in the form of questionnaires and potentially through topic specific workshops.
   6. The evidence and data collected will be used to:
2. Understand to what extent the policy objectives outlined in Section 4 have been met and whether they remain appropriate;
3. Assess actual cost and benefits against the assumptions made in the final Impact Assessment of the preferred option;
4. Understand whether there are any unintended consequences, including whether changes have led to any disproportionate or unexpected effects, or financial implications;
5. Understand whether the data and evidence has identified any opportunities to reduce burdens on dutyholders;
6. Identify whether the regulation should remain as it is or requires any further change;
7. Compare HSE’s approach to CCUS and offshore hydrogen production to other countries that may have implemented similar changes to their major hazard regulatory frameworks.
8. **Minimising administrative and compliance costs for preferred option** 
   1. Administrative and compliance costs will be kept to a minimum in the preferred option as we would be using existing regulatory regimes and approaches rather than creating new approaches for CCUS and offshore hydrogen production. This not only has the effect of using regimes that many dutyholders are familiar with, but also allows existing suites of guidance, regulatory procedures and other tools to be utilised.

## Declaration

Energy Policy, Engagement and Policy Division, Health and Safety Executive

Department:

Contact details for enquiries:

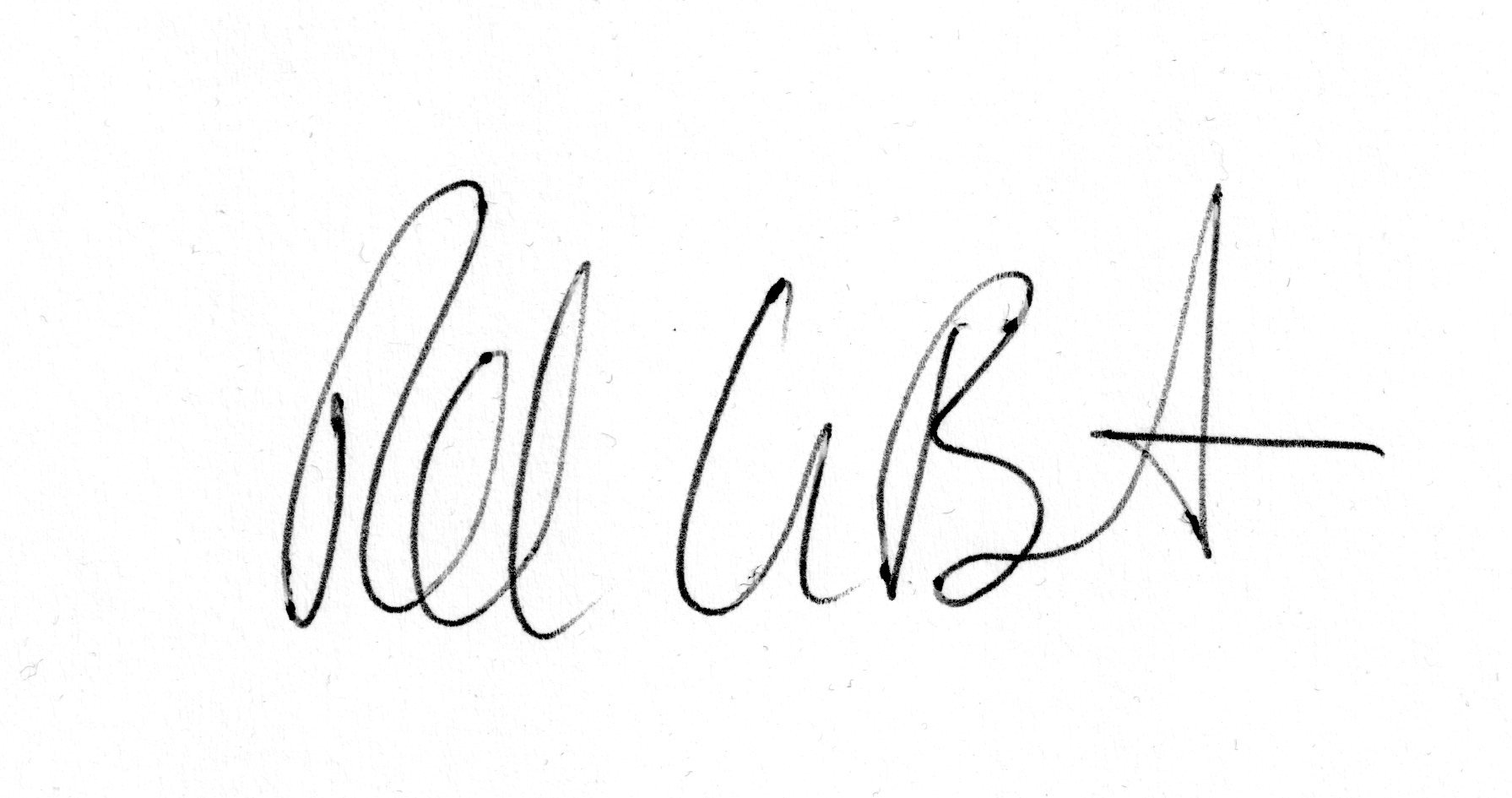
Rachel McCann, Head of Energy Policy, Engagement and Policy Division

rachel.mccann@hse.gov.uk

Rick Brunt, Engagement and Policy Division

Director responsible:

I have read the Options 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.

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Signed:

3 December 2024

Date:

## Annex 1 – Early Stage Cost-Benefit Analysis

**Introduction**

1. This section of the Options Assessment (OA) outlines in detail the early stage cost-benefit appraisal that has been undertaken for the proposed policy options outlined in the shortlist.
2. The policy proposals relate to intervention in the emerging carbon capture, utilisation and storage (CCUS) industry, looking specifically at transportation and storage, as well as the offshore hydrogen production industry.
3. The appraisal includes the option to use legislation to amend the major hazard regulatory regimes. In the case of CCUS this includes both the onshore and offshore regimes. Hydrogen production would only be brought into scope of the offshore major hazard regime as existing major hazards regulation is appliable to the transport and storage of hydrogen onshore.

**General Assumptions**

**Appraisal Period, Discounting and Base Year**

1. The cost analysis in this Option Assessment uses the standard ten-year appraisal period as outlined in HMT’s Green Book for indefinite legislative amendments. This covers the period beginning in 2026 (year 0).
2. The analysis applies a discount rate of 3.5% per annum, consistent with HMT Green Book methodology.
3. All figures are presented in 2024 prices unless specified otherwise.
4. Cost estimates presented in the following analysis have been rounded to two significant figures. As such, some totals and tables may not appear to sum exactly.

**Sources and Previous Research**

**Costs of the Offshore Major Hazard Regulations**

1. Estimates for the cost of compliance with the offshore major hazard regulations have been drawn from existing data collected by HSE in prior assessments and evaluations. These prior assessments looked at the cost of compliance for installations in the oil and gas industry at the time. It has been initially assumed, based on the opinion of HSE expert inspectors, that the cost of compliance for a CCUS or Hydrogen installation would be the same as the hydrocarbon industry. This is because the actions that dutyholders will have to take to comply, and the level of information they will have to provide in order to demonstrate that sufficient safety arrangements are in place to manage an installation with major accident potential, should require the approximately the same amount of resource.
2. This options assessment make use of compliance costing evidence for offshore installations from four principle sources.
   1. An unpublished 2012 cost assessment produced to baseline the compliance costs of the following regulations:
      1. The Offshore Installations (Safety Case) Regulations 2005 (SCR05).
      2. The Offshore Installations and Wells (Design and Construction, etc) Regulations 1996 (DCR96).
      3. The Offshore Installations and Pipeline Works (Management and Administration) Regulations 1995 (MAR95).
   2. The 2014 impact assessment of the implementation of SCR15
   3. The 2020 first post-implementation review of the implementation of SCR15
   4. The 2025 second post-implementation review of the implementation of SCR15
3. The **2012 baseline cost assessment** was produced to provide cost estimates to inform HSE’s approach to the development of what would become the 2013 EU Offshore Safety Directive.[[29]](#footnote-30) The research employed a multi-stage method. We recruited representatives from several offshore operating companies via an industry trade group.
   1. In the first stage of the research, we worked with the representatives to develop a question set that they believed accurately captured their operations and compliance costs; and to develop their understanding of what constituted reliable and unreliable evidence.
   2. In the second stage, the representatives themselves acted as researchers, taking the question set into their organisations and gathering evidence.
   3. In the third stage, the representatives brought their estimates back to the whole group to compare figures and understand variances between companies.
   4. In the fourth stage, we took the agreed estimates from the group and further validated them with a separate focus group of different offshore operating companies.
4. The research produced mostly quantitative data – estimates for one-off and ongoing costs that included both staff costs and capital spend, but that did not include any qualitative detail on the exact activity that was generating these costs. Given the number of businesses recruited and the number of individual regulatory requirements to be costed, this was a necessary compromise.
5. The 2014 SCR15 impact assessment (IA) examined the costs of implementing SCR15, which transposed into GB law the requirements of the EU Offshore Safety Directive. As such, the SCR15 IA looked at the subsequent changes in costs relative to those established in the baseline assessment above. The 2014 IA employed a similar method to the baseline cost assessment, repeating stages one to three with new participants and focusing on the proposed new requirements. Rather than convene a new group for stage four, we instead used comment on the costs during public consultation to provide an additional level of validation of the costs. As with the baseline assessment, the scale of the new costs to be assessed required us to focus on quantitative costs at the expense of qualitative detail.
6. The 2020 post-implementation review (PIR) re-examined the one-off transition costs of SCR15 estimated in the 2014 IA. The 2020 PIR looked at the one-off transitional costs only as the three-year transition period had only recently completed and it was too early to examine the ongoing annual costs. The 2020 PIR used an industry survey to gather views on the validity of the IA cost estimates and made several revisions to estimates to better reflect industry’s actual experience.
7. The 2025 PIR took the same approach for the ongoing annual costs and found that those costs from the 2014 IA it re-examined were broadly correct.
8. So, cost estimates in this options assessment for SCR15 employ the 2012 baseline assessment of SCR05, with additions from the 2014 IA and subsequent validation of the IA estimates from the two PIRs.
9. Estimates for the cost of compliance with MAR95 and DCR96 have been taken entirely from the 2012 baseline assessment as the duties remain unchanged and have not been reassessed by subsequent research.
10. Compliance costs from the previous assessments were originally estimated in different price years. The 2012 IA in 2011 prices, the 2015 IA in 2014 prices, and the 2020 PIR in 2018 prices. All cost estimates have been uprated to 2024 prices in this OA using the GDP deflator.
11. The validity of these cost estimates and their applicability to the offshore CCUS and hydrogen production industries will be tested as part of the public consultation.

**Costs of the Pipelines Safety Regulations (PSR) 1996**

1. All pipelines, including those transporting CO2 for CCUS, are currently required to comply with ‘Part 1 and Part 2’ of PSR96. ‘Part 3’ of PSR96 is applied only to major accident hazard pipelines carrying designated ‘dangerous fluids’. Options being appraised include the potential designation of CO2 as a ‘dangerous fluid’, bringing it into scope of ‘Part 3’. The cost appraisal therefore requires estimates for the cost of the operator of a CO2 pipeline complying with ‘Part 3’ of PSR96 (given that they should already be complying with Parts 1 and 2).
2. As with the Offshore Major Hazard regulations, HSE expert inspectors have agreed the initial assumption that compliance costs are likely to be approximately the same for CO2 pipelines as for existing major hazard pipelines due to roughly the same actions being required to comply. Estimates for the cost of compliance with ‘Part 3’ for existing major hazard pipelines in general can therefore be applied reasonably to CO2 pipelines.
3. No impact assessment or post-implementation review is available for PSR96 due to the age of the regulations, meaning that cost data doesn’t readily exist for compliance with PSR. It has therefore been determined that the best approach to gathering cost data for these regulations is to conduct a survey of industry.
4. HSE have engaged with the UK Onshore Pipeline Operators Association (UKOPA), a trade body representing 29 companies operating of 27,000km of pipelines, and conducted a survey of its members. The survey on the cost of complying with ‘Part 3’ of PSR was circulated to members with the backing of the board.
5. Respondents were offered the opportunity to provide cost estimates for each of the regulations in ‘Part 3’ of PSR96, with each regulation broken down into upfront and ongoing annual costs, as well as separated into labour and capital costs where appropriate. An opportunity was also provided for respondents to provide some qualitative context to help us assess their interpretation of the actions included in their cost estimates.
6. The survey received 15 responses containing some information, but a number of these advised that the regulations being asked about were not applicable to their pipelines. Eight respondents provided some form of meaningful cost data, although not all of these respondents provided cost data for every question. The data in the responses was then presented to HSE pipeline safety experts in order to help interpret the outputs and consider their feasibility, representativity and applicability to CO2 pipelines. While this response rate has been deemed suitable for informing the initial cost-benefit analysis in this OA, these costs will need to be verified further at consultation stage.

**Industry Size over the Appraisal Period**

1. In order to estimate the total costs to business and therefore the total social impact of the options for intervention, the unit costs of compliance derived from the above sources have to be extrapolated across estimates of industry size. In particular, the appraisal requires estimates of the number of offshore CCUS and hydrogen production installations that will be operated, and the number of onshore CCUS CO2 pipelines to be operated.
2. The offshore hydrogen and carbon capture industries are not yet established in terms of installations and pipelines in operation. They are however intended to play a significant role in UK decarbonisation and the meeting of Net Zero targets. As such, these industries are expected to grow across the next decade, in part due to government support in their initial deployment. The Department for Energy Security and Net Zero (DESNZ) are currently engaged with businesses in the development of operations and allocating funding to projects via the hydrogen allocation rounds (HAR) and CCUS Track-1 and Track-2 clusters.
3. In order to derive an accurate estimate of the growth of the sector across the appraisal period, HSE have engaged DESNZ as the government department leading responsibility for driving deployment of CCUS and hydrogen production through investment and support packages designed to incentivise deployment through rounds of funding.
4. In the case of hydrogen production, the Hydrogen Production Business Model (HPBM) began providing support through an initial hydrogen allocation round (HAR1). However the successful projects do not include offshore production of hydrogen and no ‘at scale’ offshore production has reached advanced stages of development, making it currently uncertain to what extent the industry is likely to develop.
5. In the case of CCUS, deployment so far includes support for four industrial clusters including transport and storage. Whilst some information is available publicly around the projects that have received funding and are in development, this information does not contain specific detail around the amount of infrastructure (pipelines and offshore installations) the projects are developing. As part of the responsibility for sector growth, DESNZ have received more detailed information from the operators around their transport and storage plans. HSE has requested this information in an anonymised form to support the economic analysis by providing estimates on the aggregate number of installations and pipelines, while remaining sensitive to commercial confidentiality around individual projects. Challenges around sensitivity of data have meant that DESNZ have been unable to provide the relevant information in time to contribute to this OA. To prevent any delay to the potential legislative timetable HSE have decided to progress with the OA without this data but will continue to consult with DESNZ as the analysis progresses.
6. As an alternative, the North Sea Transition Authority (NSTA) data on the number of licenses granted for CCUS activities has been used to estimate the number of installations. HSE inspectors advised that the 27 licenses already currently granted[[30]](#footnote-31) were reasonably likely to begin the regulatory process towards becoming operational[[31]](#footnote-32) prior to 2036, but any licenses granted in the coming years would likely become operational outside the appraisal period. Additionally, it was advised that each licensed field was likely to have just one installation, as multiple installations in a field would not be economically advantageous. It is therefore assumed that there could be 27 CCUS installations over the ten-year appraisal period. This is a high-level assumption that will be improved in the ongoing analysis. Currently there is no clear consensus on the likely size and growth rate of the industry.
7. It has also been assumed the installations will become operational at a constant rate (2.7 new installations per annum on average). It is likely that more installations will become operational towards the end of the period given that the industry is new, but assuming a constant rate maintains simplicity and errs on the side of greater costs once discounting is applied. Figure 2 demonstrates how the cost per installation has been aggregated across the sector on the basis of an assumed 2.7 new installations per annum.
8. In developing the cost-benefit appraisal, an average cost ‘per offshore installation’ and ‘per pipeline’ has first been developed in order to demonstrate the impacts per unit. These have then been extrapolated across industry where possible (for offshore CCUS) in order to estimate the aggregate social impact.

**Benefits**

1. This section outlines the general intended benefits of any intervention in offshore and onshore pipeline major hazards. The section ‘options under consideration’ describes in more detail the degree to which each option is expected to capture these benefits.
2. The options under consideration are intended to reduce the likelihood of major accidents for the sectors in scope. This should provide further protection for the safety of offshore and pipeline workers and members of the public. This also limits the potential for damage to infrastructure and loss of production capacity, as well as avoided environmental costs. As such, this can be viewed as correcting an externality as there is the risk of an under-provision of safety mitigation due to businesses not internalising the costs to workers, households, government and broader industry in the event of an accident. Additionally, there is the correction of information failures by ensuring that operators fully understand risks and how to control for them.
3. Major accidents offshore or involving onshore pipelines are rare but where they do occur they can have devastating and irreversible consequences. The impact of a major accident involving CCUS or hydrogen is not clear as these are new industries and any regulatory framework is intended to ensure appropriate controls are in place. However it is possible to demonstrate the scale of impacts where accidents have occurred on offshore installations or at major hazard pipelines in existing sectors with major hazard potential. It is important to note that the risk profile differs between these examples and CCUS transport and storage and hydrogen production but similarities in scale of impact are likely.
4. The Piper Alpha disaster in 1988 took place in the North Sea and was the incident that led to a major overhaul of regulation. One of the key recommendations was the requirement for the operator/ owner of every fixed and mobile installation operating in UK waters to submit to the HSE, for its acceptance, a safety case. The safety case must give full details of the arrangements for managing health and safety and controlling major accident hazards on the installation. It must demonstrate, for example, that the company has safety management systems in place, has identified risks and reduced them to as low as reasonably practicable, has introduced management controls, provided a temporary safe refuge on the installation and has made provisions for safe evacuation and rescue.
5. This formed the basis of the regulation in place for the offshore sector today, which HSE is considering extending to CCUS and hydrogen production. As such it forms an example of exactly the type of incident that the offshore regulatory regime seeks to prevent. Offshore Energies UK (formerly Oil and Gas UK) linked the Safety Case regime to a significant fall in the Lost Time Injury Frequency Rate for the UK since 1997[[32]](#footnote-33).
6. The Piper Alpha disaster is the worst ever offshore oil and gas disaster to date in terms of lives lost with 167 people being killed in the accident. Taking into account only the cost to society of a fatal injury in the workplace[[33]](#footnote-34), the cost of the Piper Alpha fatalities today would sum to over £320m (2022 prices). Beyond this there were a number of serious injuries, environmental impacts and significant financial impacts including the destruction of the rig and loss of production.
7. More recently, in UK waters in 2012, a major gas release occurred on the Total E&P UL Ltd Elgin Offshore Wellhead platform. Personnel on the platform and an adjacent drilling rig were evacuated without injury but HSE declared the gas release a major incident. It took 51 days to successfully “kill” the well[[34]](#footnote-35) and prevent further release. It was estimated at the time that the accident cost Total E&P $1.5m per day in lost production alone[[35]](#footnote-36). This demonstrates that even in the absence of loss of life or injury, the economic consequences of a major incident are significant.
8. It is not currently possible to estimate the reduction in risk or frequency of major accidents that would be brought about by implementing the options under consideration, therefore benefits are not quantified or monetised. This is because major accident events are rare and therefore a reliable baseline cannot be estimated. The examples of incidents provided in this section should however provide a sense of the scale of the impact of a major accident, and the benefits that would be delivered where the proposed interventions reduce the risk of such an accident occurring. It is important to note that the hazard potential of CCUS and hydrogen production does differ from that of hydrocarbons and while the scale of impact is likely to be similar, the impacts may differ (although hydrocarbon incidents can differ significantly themselves). The problem definition (see 2. Strategic case for proposed regulation) outlines the hazard potential of CCUS and hydrogen specifically.
9. Mitigation of risk in these new industries, which are considered to be crucial in achieving Net Zero targets, are also expected to contribute to greater public and investor confidence in their safety and help businesses secure investment for future projects. There are no readily available market values for these benefits, so these benefits are not quantified or monetised.
10. Legislative options also align these sectors with existing sectors deemed to have major hazard potential. This offers clarity and consistency which is beneficial to both businesses and to the regulator. This is particularly relevant as operators are expected to largely be composed of businesses already operating hydrocarbon installations and major hazard pipelines which operate under the same regimes.

**Costs**

1. The following section outlines the full set of costs associated with compliance with the sets of regulations in scope of potential application to offshore CCUS and hydrogen production. These are then broken down (in the section ‘Options Under Consideration’) into the costs for each option under consideration, based on which requirements would apply under that option.
2. For each requirement it is assumed that upfront costs are incurred by an installation or pipeline in year 0, while ongoing costs occur annually, unless specified otherwise.
3. A schedule of estimated costs for an offshore CCUS installation is described in Figure 1 at the end of the paper. Figure 2 then outlines how these costs are aggregated across the sector, based on the assumption (paragraph ‎25) of 2.7 new CCUS installations per annum.

SCR15

1. As described in the sources section, estimates of the unit cost of complying with the regulations in SCR15 have been derived from previous assessments carried out by HSE.

*Production of a safety case*

1. Operators of an offshore installation are required to prepare a safety case providing evidence that all major accident risks have been evaluated and measures taken to control those risks. This must then be submitted to HSE for acceptance before an installation commences operations.
2. Estimates produced in previous assessments indicate that the cost of producing a safety case could vary from £350k to £1.4m per installation, with a best estimate of £710k per installation. This is a one-off cost incurred upfront, prior to operation.

*Producing a 5-year review of a safety case*

1. Operators of an offshore installation are required to produce a review of a safety case at no more than five yearly intervals following the safety case first being accepted.
2. Estimates produced in previous assessments indicate that the cost of producing a review of a safety case could vary from £150k to £430k per installation with a best estimate of £240k per installation. This cost would be incurred at five-year intervals.

*Material change notifications*

1. Operators are required to notify HSE of any material changes to the safety case[[36]](#footnote-37). HSE expert opinion considered it reasonable at this stage to assume that the rate of material changes would be approximately the same for CCUS and hydrogen installations as they are for existing hydrocarbon installations. Based on previous analysis, this has been assumed to be a rate of between 0.068 and 0.075 per installation with a best estimate of 0.072 (equivalent to one notification per 14 installations per annum.
2. Estimates produced in previous assessments indicate that the cost of producing a material change notification is between £120k and £150k, with a best estimate of £140k per notification. Taking into account the assumed rate of notifications, this results in an estimated cost of between £8.4k and £11k per installation per annum, with a best estimate of £9.8k.

*Safety and environmental management system (SEMS)*

1. Operators are required to describe their safety and environmental management systems (SEMS). The upfront cost of outlining their SEMS is estimated to be between £1.8k and £24.5k, with a best estimate of £13.2k per installation. This is a one-off cost.

*Producing a combined operations notification*

1. Operators are required to notify HSE where combined operations are taking place. This is where an operation carried out from an installation with another installation or installations for purposes related to the other installation(s) which thereby materially affects the risks to the safety of persons or the protection of the environment on any or all of the installations. HSE inspector opinion is that this is not likely to happen frequently during the early years of the offshore CCUS and hydrogen sectors as the sort of large scale maintenance that often triggers these notifications is less likely. For the purposes of this assessment it has been deemed reasonable to use the hydrocarbon proxy, as per other requirements, and err on the side of higher cost.
2. Estimates produced in previous assessments indicate that the cost of producing a combined operations notification could vary from £12k to £63k, with a best estimate of £29k per notification.
3. HSE inspector opinion is that these are less likely to occur in the initial ten years of the CCUS and hydrogen industries. However due to uncertainty around the likely number of notifications and the lower cost impact of combined operations notifications, the proxy assumption that these will occur at a similar rate of hydrocarbons has been retained. This is an average of 0.2 combined operations notifications per installation per annum (or one for every fifth installation in any given year).
4. Based on the above assumption, the estimated cost per installation per annum is between £2.3k and £12k, with a best estimate of £5.5k.

*Producing a well notification – including ICP consideration*

1. Operators are required to produce a well operations notification providing prior notice of well operations to HSE. These supplement the existing safety case with well-specific information. These notifications are reviewed and considered by an independent competent person (ICP).
2. Estimates produced in previous assessments indicate that the cost of producing a well notification could vary from £81k to £100k, with a best estimate of £91k per notification.
3. At this stage it has been assumed, based on HSE expert input, that well notifications will occur at CCUS installations at a similar rate to existing hydrocarbon installations. This rate has therefore been used as a suitable proxy given that the CCUS sector is not yet up and running, so there is no data on the rate at which they make well notifications. Wells are not expected to be drilled in the offshore production of hydrogen, therefore they will not make well notifications and do not incur these costs.
4. There is an average of 2.2 well notifications per installation per annum for the existing offshore sector. This rate of notifications has been used as a reasonable proxy for the CCUS industry.
5. Applying the above assumption results in an estimated cost of between £180k and £230k, with a best estimate of £200k per installation per annum for CCUS installations only.

*ICP consideration of material changes to well notifications*

1. Operators are required to get ICP consideration of material changes[[37]](#footnote-38) to a well notification. A material change is one that is likely to change the basis on which an original safety case or notification was accepted. Such a change merits reappraisal of the risk control arrangements, whether or not they require the adjustment of measures to be taken. In practice, safety case revisions are considered material where they have the potential to affect the major accident risks or their controls, either directly or indirectly.
2. Estimates produced in previous assessments indicate that the cost of between £3.6k and £4.3k, with a best estimate of £3.9k per material change.
3. As with well notification themselves, we assume that these will occur at CCUS installations at a similar rate to existing hydrocarbon installations. Based on the 2015 SCR Impact Assessment it is estimated that there will be 0.9 material changes to well notifications per installation per annum. These do not apply to hydrogen production installations.
4. Applying the above assumption results in an estimated cost of between £3.3k and £4.0k, with a best estimate of £3.6k per installation for CCUS installations only.

*Producing a design notification*

1. Operators are required to produce a design notification containing the principle features of the design of their structure and plant prior to operation and send this to the competent authority. A competent authority is a government-appointed body responsible for enforcing laws and regulations within a particular jurisdiction. Examples include: the Control of Major Accident Hazards Regulations 2015 (COMAH) which are enforced by a Competent Authority which comprises jointly the Health and Safety Executive (HSE) in GB and the relevant environment agency (the Environment Agency in England, Scottish Environment Protection Agency in Scotland and Natural Resources Body for Wales in Wales). Offshore, the Offshore Major Accident Regulator (OMAR) is the UK's Offshore Competent Authority (CA). It comprises the HSE and the Offshore Petroleum Regulator for Environment and Decommissioning (OPRED) (part of the Department for Energy, Security and Net Zero) working in partnership.
2. Estimates produced in previous assessments indicate that the cost of producing a design notification is between £33k and £42k, with a best estimate of £38k per notification. This is a one-off cost incurred prior to operation.

*Establishing, maintaining and reviewing a verification scheme*

1. Operators are required to establish a verification scheme for ensuring that the safety and environmental critical elements are suitable and remain in good repair and condition.
2. Estimates produced in previous assessments indicate that the cost of establishing a verification scheme is between £160k and £2.8m, with a best estimate of £1.6m per installation. This is a one-off cost incurred upfront, prior to operation.
3. Estimates produced in previous assessments indicate that the cost of maintaining a verification scheme could vary between £83k and £380k, with a best estimate of £340k installation. This cost is incurred annually.
4. Estimates produced in previous assessments indicate that the cost of reviewing the verification scheme could vary between £62k and £75k, with a best estimate of £69k. This cost is incurred every 2.5 years.

*Appointing and overseeing an operator*

1. An operator capable of satisfactorily carrying out the duties under the relevant statutory provisions must be appointed for each installation.
2. Estimates produced in previous assessments indicate that there is a one-off cost of initially appointing an operator of between £37k and £45k, with a best estimate of £41k per installation.
3. It was also estimated that there would be an ongoing annual cost of overseeing the operator of the same amount (between £37k and £45k, with a best estimate of £41k) on a per installation level.
4. In addition an ongoing time cost at company level was included in the 2012 IA. It was estimated that 4.5k man hours, with a range of 4.1k to 5k, at a cost of £150 per hour, would be spent overseeing operators. This results in a cost per company of between £620k and £750k, with a best estimate of £680k per annum. At 72 companies and 320 installations (at the time of assessment), this results in an average cost per installation per annum of between £140k and £170k, with a best estimate of £150k.
5. Summing the two components of ongoing cost results in an estimated annual cost per installation of between £180k and £210k, with a best estimate of £200k.

*Corporate major accident prevention policy (CMAPP)*

1. Dutyholders are required to produce and maintain a CMAPP, which establishes the overall aims and arrangements for controlling risk of a major accident and how those aims are achieved. Each company operating offshore is required to have a CMAPP.
2. As these are produced at the company level, and most companies operating CCUS and hydrogen installations are expected to be companies already operating offshore, this should incur minimal to no additional cost to the company. Furthermore any cost that is incurred will cover all installations that the company operates.
3. The estimated cost of producing an entire CMAPP is between £25k and £95k per company, with a best estimate of £60k. This would be a one-off cost. There would also be an ongoing maintenance cost of between £1.7k and £7.6k per company per annum, with a best estimate of £4.6k.
4. It is not considered appropriate to convert these costs to a ‘per installation’ basis, as this would depend on whether the company already operates and how many installations they operate. Additionally, analysis of existing cost estimates suggests that even if companies operating CCUS and hydrogen installations needed to produce whole new CMAPPs the total cost would likely be negligible relative to the full set of costs associated with the proposed requirements. For these reasons the cost of CMAPP has been left out of the ‘per installation’ cost estimates in this OA.

*Notifying HSE of installations entering or leaving relevant waters*

1. Operators are required to notify HSE where an installation enters or leaves relevant waters. HSE inspector opinion is that this is not likely to happen frequently during the early years of the offshore CCUS and hydrogen sectors as the sort of large scale maintenance that often triggers these notifications is less likely. Furthermore the cost of notifying HSE in these cases is considered to be very little, therefore the overall cost of these notifications is considered negligible for the purpose of this OA.

*Cost Recovery*

1. A fee is payable by the operator for the recovery of costs incurred by the competent authority for the assessment of safety cases and the relevant notifications as listed under Schedule 10 of the Health and Safety and Nuclear (Fees) Regulations 2022.
2. Cost recovery data held by HSE has provided data for the number of chargeable hours. This has then been multiplied by the current fee for offshore recoveries of £307 per hour to estimate the amount charged to industry.
3. HSE holds data for upfront cost recovery for assessment of new safety cases and design notifications, dating from 2015 to 2024. Across this data, the average amount of time spent on a design notification assessment is 120 hours; this is taken as a best estimate. A 20% range has been added to capture uncertainty in either direction, this is an arbitrary range intended to capture the variation and uncertainty and offset spurious accuracy. This results in a range of between 92 and 140 hours. For new safety cases the average time spent is 144 hours, with the same 20% assumption applied to give a range of between 120 hours and 170 hours. Applying the cost of £307 per hour result in an upfront cost recovery of between £64k and £96k, with a best estimate of £80k.
4. The average annual amount of time cost recovered for ongoing costs over the years 2021, 2022, and 2023 is 8,200 hours; this is taken as a best estimate for annual ongoing cost recovery across industry. A range has been formed taking in the highest and lowest amount across the three year period; this is between 8000 and 8400 hours. These estimates are then divided across the estimated 320 hydrocarbon installations to give an estimate of between 25.0 and 26.4 hours of cost recovery per installation per annum, with a best estimate of 25.6 hours per annum. Applying the £307 per hour hourly charge rate gives an estimate of between £7.7k and £8.1k per installation per annum, with a best estimate of £7.9k.

MAR95

*Training an offshore installation manager*

1. The dutyholder is required to ensure that the installation is under the charge of a competent person. The salary of the manager is not included as cost of compliance as the operator would require a manager for the installation in the absence of MAR. It is likely that a more competent manager would cost a premium in wages but this is not currently proportionate to measure, instead training costs have been included as per previous cost assessments in order to capture the cost of maintaining the appropriate level of competence.
2. Estimates produced in previous assessments indicate that the cost of training would be between £19k and £23k, with a best estimate of £21k per manager. Based on figures from the 2012 baseline assessment we assume there could be 3.1 to 3.8 managers per installation, with a best estimate of 3.4. This results in a training cost per installation of between £57k and £85k, with a best estimate of £70k. This cost would be incurred upfront, and then at three-year intervals for refresher training.

*Employing and training a helicopter landing officer*

1. Dutyholders are required to have a competent helicopter landing officer (HLO) in control of helideck operations on an installation. Previous assessments determined that an installation will have between 4 and 6 HLOs, with a best estimate of 5.
2. The 2012 IA noted that full salary costs for HLOs would not be an appropriate measure of the true opportunity cost of complying with the regulation, as when the helicopter landing officers were not employed in the capacity of this regulation, they would be conducting other duties onboard the installation. It was therefore suggested that a percentage of their time should be attributed to this regulation. It was deemed reasonable that a HLO would spend between 20% and 40% of their time on duties that comply with this regulation, with a best estimate of 30%.
3. The full economic cost (FEC) of a HLO salary is estimated in previous assessments to be between £69k and £165k, with a best estimate of £96k per annum. Taking into account the above assumptions, the cost to each installation is estimated to be between £55k and £400k, with a best estimate of £140k per annum.
4. On top of the salary costs it was also estimated that there would be annual training costs of between £6.2k and £7.5k, with a best estimate of £6.9k per annum. Across all HLOs on an installation, this is a cost of between £25k and £45k, with a best estimate of £34k per installation per annum.

*Displaying the installation name and other identifying marking*

1. Dutyholders are required to display the installation name and identifying marking in order to make their installation readily identifiable on approach by sea and air.
2. Estimates produced in previous assessments indicate that the cost of this requirement would be between £34k and £140k, with a best estimate of £82k per installation. This would be a one-off upfront cost.

*Putting instructions and procedures into writing*

1. Dutyholders are required to ensure that comprehensible instructions on procedures to be observed on the installation are put in writing and the relevant part of the instructions brought to the attention of any person who is to do anything to which that part relates. This is a task carried out at company level and disseminated to the installations.
2. Estimates produced in previous assessments indicate that the annual cost of this requirement would be between £340k and £1m, with a best estimate of £690k per company per annum. Accounting for the average number of installations managed per company of 4.4, this results in a per installation upfront cost of between £77k and £230k, with a best estimate of £150k per annum.

DCR96

*Well examination by a competent person and subsequent reviewing of arrangements*

1. Operators are required under DCR to have well examinations carried out by a competent person and the arrangements subsequently reviewed. Estimates produced in previous assessments indicate that the cost of a well examination is between £2.7k and £27k, with a best estimate of £14k per examination.
2. It was also estimated that each well examination and subsequent review would require between 68 and 83 person hours of work with a best estimate of 75 hours. This would be carried out by a worker on an estimated FEC of £113 per hour, resulting in a cost of between £7.7k and £9.4k, with a best estimate of £8.5k per examination.
3. Based on the number of well notifications per installation per annum, outlined in paragraph ‎53 (2.2 per installation per annum), this results in a total cost of between £23k and £83k, with a best estimate of £50k per installation per annum. Note that these will be carried out by CCUS installations, but not hydrogen installations.

*Provision of appropriate accommodation*

1. Operators are required to provide two-berth cabins with facilities to be shared between two cabins in order to ensure adequate accommodation. HSE expert advice indicated that operators may find it economically advantageous to provide accommodation that falls short of this standard should DCR not apply. For this reason the cost of providing appropriate accommodation has been included as a cost of compliance.
2. In the 2012 assessment, it was estimated that between 3.2 and 9.7 cabins had needed to be upgraded to meet standards per installation on average, with a best estimate of 6.4 cabins. For CCUS and hydrogen this figure is likely to be lower given that installations will be largely ‘normally unmanned’ but these will still require multiple cabins of emergency accommodation. To err on the side of increased cost the assumption from the 2012 IA has been maintained.
3. It was estimated that the cost of upgrading a cabin from a four-berth to two-berth is between £48k and £140k, with a best estimate of £100k per installation. Taking into account the above assumption, this results in a cost of between £150k and £1.3m, with a best estimate of £660k per installation. This is incurred as an upfront one-off cost.

PSR96

1. The following costs incurred by major hazard pipelines under PSR would apply only to CCUS CO2 pipelines under legislative options. Hydrogen is already classified as a dangerous fluid and as such these requirements already apply to hydrogen pipelines, meaning that none of these would be new costs for hydrogen production under the proposed options. As described in the sources section, this cost information has been derived via a survey of members of the trade-body UKOPA.
2. Estimates in this section are derived from a limited sample and do contain some substantial outliers that could not be robustly ruled out. These estimates will be validated and improved through public consultation.
3. Some of the CO2 pipelines to be used for CCUS are expected to be repurposed existing pipelines that may have been used for carrying natural gas for example. HSE pipeline experts advised that this should not substantially impact the cost of compliance. This is because the operators would still need to carry out the same processes as they would for a new pipeline, and they would require similar resource. The requirements of ‘Part 3’ of PSR are predominantly around identifying hazards, planning and notifying HSE which would need to be done again for the new use. There is currently no better evidence available on how costs could differ between new and repurposed pipelines, so compliance costs are assumed to be the same.

*Emergency shut-down valves (ESDVs)*

1. Operators are required to fit ESDVs to all risers of major hazard pipelines if over 40mm in diameter at offshore installations. This is assumed to apply to all CCUS trunklines running CO2 offshore. While some of the repurposed pipelines may already have these fitted, they would likely require some retrofitting for the use of CCUS. HSE pipeline experts advised that this process should be assumed to be as costly as fitting a new ESDV and in some cases could be more complex and costly a process.
2. Initial evidence gathered in a survey of UKOPA indicated that these can cost between £10k and £1.0m, with a best estimate of £240k in capital costs per pipeline, and between £10k and £200k, with a best estimate of £78k in labour costs per pipeline. These costs would be one-off upfront costs.
3. In addition, there would be an ongoing component for maintaining and testing the ESDV. Survey evidence indicated that this would cost between £400 and £20k, with a best estimate of £7.5k in capital costs per pipeline, and between £500 and £5k, with a best estimate of £3.5k in labour costs per pipeline. This would be an annual cost.

*Notification of construction*

1. Operators are required to notify HSE prior to construction of a major accident hazard pipeline. This is assumed to apply only to new pipelines, not repurposed existing pipelines. It isn’t currently clear what proportion of CO2 pipelines will be new, therefore an illustrative assumption of between 25% and 75%, with a best estimate of 50% has been used. This assumption has a minimal impact on overall costs, so has been deemed appropriate at this stage given the lack of evidence available.
2. Survey evidence indicates that the labour input required to produce a notification would cost between £300 and £20k, with a best estimate of £10k per pipeline. Taking into account the assumption in paragraph ‎104 the average cost across CO2 pipeline would be between £75 and £15k, with a best estimate of £5.1k per pipeline. This would be an upfront one-off cost.

*Notification before use*

1. Operators are required to notify HSE prior to use of a major accident hazard pipeline. This applies to both new and repurposed pipelines.
2. Survey evidence indicates that the labour input required to produce a notification would cost between £300 and £20k, with a best estimate of £6.9k per pipeline. This would be an upfront one-off cost.

*Notification in other cases (change in use)*

1. Operators are required to notify HSE of any changes to the pipeline that would affect the level of risk. It is assumed that any repurposed pipelines would be captured by this notification. As per paragraph ‎104, this is assumed to be between 75% and 25% (the inverse of the assumption in paragraph ‎104), with a best estimate of 50%.
2. Survey evidence indicates that the labour input required to produce a notification would cost between £300 and £10k, with a best estimate of £4.0k per pipeline. Taking into account the assumption in paragraph ‎104 the average cost across CO2 pipelines would be between £230 and £2.5k, with a best estimate of £1.8k per pipeline. This would be an upfront one-off cost.

*Major accident prevention document (MAPD)*

1. Operators are required to prepare and maintain a MAPD demonstrating that hazards and risks have been identified and evaluated, and the safety system is adequate.
2. Survey evidence indicates that the upfront capital cost of preparing the MAPD is between £5k and £50k, with a best estimate of £21k per pipeline. The upfront labour cost is estimated to be between £1k and £10k, with a best estimate of £6.5k. These are one-off costs.
3. In addition, there would be an ongoing component for reviewing and updating the MAPD. Survey evidence indicated that this would cost between £100 and £2k, with a best estimate of £1.0k in capital costs per pipeline, and between £100 and £10k, with a best estimate of £3.3k in labour costs per pipeline. This would be an annual cost.

*Emergency procedures*

1. Operators are required to ensure appropriate organisation and arrangements are established and recorded for the event of an emergency. These should be maintained and kept up to date over time.
2. Survey evidence indicates that the upfront capital cost of preparing the emergency procedures is between £1k and £60k, with a best estimate of £28k per pipeline. The upfront labour cost is estimated to be between £1k and £25k, with a best estimate of £15k. These are one-off costs.
3. In addition, there would be an ongoing component for reviewing and updating the procedures. Survey evidence indicated that this would cost between £100 and £25k, with a best estimate of £7.8k in capital costs per pipeline, and between £200 and £25k, with a best estimate of £8.8k in labour costs per pipeline. This would be an annual cost.

*Local Authority (LA) emergency plans*

1. LAs are required to prepare and maintain an emergency plan for each major accident hazard pipeline in the LA area. Operators are required to liaise and assist the LA in this process.
2. Survey evidence indicates that there is an upfront labour cost of assisting the LA with the emergency plans of between £800 and £20k, with a best estimate of £7.9k per pipeline.
3. In addition, there is an ongoing component for maintaining the plans. Survey evidence indicated that this would cost between £400 and £10k, with a best estimate of £3.4k in capital costs per pipeline, and between £400 and £10k, with a best estimate of £3.1k in labour costs per pipeline. This would be an annual cost.
4. LAs are also able to charge operators a fee for costs incurred by the LA in preparing and maintaining the emergency plans. Survey evidence indicated that LAs charge between £0 and £800, with a best estimate of £400 in upfront costs per pipeline, and between £0 and £4k, with a best estimate of £1.4k in ongoing annual costs per pipeline.

Familiarisation

1. We anticipate, based on engagement with DESNZ and the emerging sectors, that the majority of businesses operating hydrogen production installations, CCUS installations and CO2 pipelines will be businesses already operating within SCR15, DCR, MAR and PSR. As such, we anticipate that they will already be familiar with their requirements to a significant extent. Initially, this led us to estimate that the costs of familiarisation were therefore likely to be minimal. However, the RPC suggested that dutyholders would still have to consider the requirements “as they now will apply to hydrogen production installations, CCUS installations and CCUS CO2 pipelines”.
2. This conception of familiarisation seems sensible. We would expect that dutyholders would have to consider the physical characteristics of hydrogen and CO2 and how they will interact with their assets to understand how to interpret and apply the requirements to these novel operations. Usual models of familiarisation, such as dutyholders sitting down to read the guidance, costed at the full economic cost of that time, are not applicable to this conception of familiarisation, which could include physical chemistry tests, stress testing of equipment etc. We will work during consultation to gather qualitative and quantitative data on the types of activities that could be necessary here and what costs might arise to include in the final stage impact assessment.

**Options Under Consideration**

**Option 1 – Business as Usual Baseline**

1. The business as usual option involves no additional interventions being made by HSE. This is a notional baseline against which the alternative options are being assessed. Net impacts under the baseline are therefore nil.
2. At this stage it is not clear how the CCUS and offshore hydrogen industries would behave under business as usual due to the fact that there is no offshore hydrogen or CCUS infrastructure currently operating. Informal discussion with industry suggest that businesses are likely to prefer to voluntarily comply with offshore major hazard and onshore pipeline regulations as this would be the most familiar and cost effective means of complying with the requirement under the Health and Safety at Work Act (HSWA) to manage risk to ‘as low as reasonably practicable’ (ALARP). However as HSE does not currently have robust evidence for voluntary compliance currently or in future, and to ensure cautious appraisal of the cost of intervention, actions required by SCR15, MAR95, DCR96 and PSR96 are assumed not to be being carried out under the business as usual option.
3. Even without voluntary compliance there would be a cost to dutyholders under HSWA in order for them to exercise judgement and manage risk to ALARP in the way they deem suitable, as is required by HSWA. It is not currently clear how dutyholders would achieve this and not proportionate at this stage to estimate the ALARP burden robustly. Additionally this assessment intends to fully cost compliance, erring on the side of overestimate of costs. Therefore this baseline cost has not been quantified.
4. More information around baseline activity and voluntary compliance with major hazard regulations under business as usual will be gathered in ongoing evidence gathering and stakeholder engagement.

**Option 5 – Partial Regulation**

1. Option 5 proposes regulatory changes that would bring CCUS activities into scope of major hazard regulations (SCR15, MAR95, DCR96, PSR96) for both offshore installations and onshore pipelines, but would not bring hydrogen production into scope of the offshore regulatory regime.
2. A full cost breakdown for the impact of each individual provision has been provided in the costs section (from paragraph ‎38). Option 5 would incur the full set of costs outlined, but only for CCUS installations and pipelines. **For option 5 the net impact for hydrogen production installations would be nil.**

Total cost per CCUS CO2 Pipeline

1. Under this option, CO2 CCUS pipelines will incur the onshore pipeline costs outlined in the above costs section for PSR. As discussed in section ‎5.3, we are not able to disaggregate costs by business size at this stage. The estimated 10-year present value of the cost of compliance for a *single* CO2 CCUS pipeline and the EANDCB is as follows:

|  |  |  |  |
| --- | --- | --- | --- |
| **Cost per CCUS pipeline** | **Low** | **Mid** | **High** |
| **10-year net present cost** | £47 | £710 | £2,300 |
| **EANDCB** | £5.4 | £83 | £260 |

*\*Costs in £’000s. Rounded to 2s.f.s*

Total cost per CCUS Installation

1. A CCUS installation will incur the full set of offshore costs outlined in the above costs section (SCP, DCR and MAR) for this option. Onshore pipeline costs under PSR do not apply to CCUS installations. As discussed in section ‎5.3, we are not able to disaggregate costs by business size at this stage. The estimated 10-year present value of the cost of compliance for a *single* CCUS installation and the estimated annualised net direct cost to business (EANDCB) is as follows:

|  |  |  |  |
| --- | --- | --- | --- |
| **Cost per CCUS installation** | **Low** | **Mid** | **High** |
| **10-year net present cost** | £6,800 | £14,000 | £21,000 |
| **EANDCB** | £800 | £1,600 | £2,400 |

*\*Costs in £’000s. Rounded to 2s.f.s*

Total cost aggregated across the Offshore CCUS Sector

1. Based upon the assumption of 27 installations commencing operations spread evenly across the appraisal period, as outlined paragraph ‎25 and demonstrated in Figure 2, the estimated 10-year present value of the cost of offshore compliance and EANDCB across the offshore CCUS sector is as follows. As discussed in section ‎5.3, we anticipate that perhaps 40% of this cost will fall to medium-sized operators and around 60% to large ones.

|  |  |  |  |
| --- | --- | --- | --- |
| **Total cost to offshore CCUS** | **Low** | **Mid** | **High** |
| **10-year net present cost** | £100,000 | £220,000 | £340,000 |
| **EANDCB** | £12,000 | £26,000 | £40,000 |

*\*Costs in £’000s. Rounded to 2s.f.s*

Benefits

1. A qualitative outline of the anticipated benefits associated with the options has been given in the earlier benefits section (paragraph ‎28). Under Option 5, the benefit of avoided risk of a major accident would be delivered for CCUS but not for hydrogen production. This captures a proportion of the potential benefits but leaves a significant gap where the risk of incident in the hydrogen production industry is not controlled as effectively as it could be.

**Option 6 - Regulatory Intervention**

1. Option 6 proposes that offshore major hazard regulations (SCR15, MAR95, DCR96) are applied to both onshore CCUS and hydrogen production, and onshore pipelines regulations (PSR96) are applied to onshore CO2 CCUS pipelines. A breakdown of the estimated cost of compliance with each provision is provided in the costs section (from paragraph ‎41). Costs under SCR15, MAR95, and DCR96 apply to both offshore CCUS and hydrogen installations unless specified otherwise. Costs for PSR96 apply only to CCUS pipelines under this option.

Total cost per Hydrogen Production Installation

1. A hydrogen production installation will not incur the costs relating to undersea wells (well notifications, well examinations) as outlined in the cost section, but will incur all other offshore costs outlined under this option. Hydrogen installations are not in scope of PSR. As discussed in section ‎5.3, we are not able to disaggregate costs by business size at this stage. The estimated 10-year present value of the cost of compliance for a *single* hydrogen production installation and the estimated annualised net direct cost to business (EANDCB) is as follows:

|  |  |  |  |
| --- | --- | --- | --- |
| **Cost per hydrogen installation** | **Low** | **Mid** | **High** |
| **10-year net present cost** | £5,000 | £12,000 | £18,000 |
| **EANDCB** | £590 | £1,300 | £2,100 |

*\*Costs in £’000s. Rounded to 2s.f.s*

1. **These are the additional costs incurred in this option over and above those incurred under Option 5.**

Total cost per CCUS CO2 Pipeline

1. Under this option CO2 CCUS pipelines will incur the onshore pipeline costs outlined in the above costs section for PSR96, this is the same set of costs as under Option 5. As discussed in section ‎5.3, we are not able to disaggregate costs by business size at this stage. The estimated 10-year present value of the cost of compliance for a *single* CO2 pipeline and the estimated annualised net direct cost to business (EANDCB) is as follows:

|  |  |  |  |
| --- | --- | --- | --- |
| **Cost per CCUS pipeline** | **Low** | **Mid** | **High** |
| **10-year net present cost** | £47 | £710 | £2,300 |
| **EANDCB** | £5.4 | £83 | £260 |

*\*Costs in £’000s. Rounded to 2s.f.s*

Total cost per CCUS Installation

1. A CCUS installation will incur the full set of offshore costs outlined in the above costs section for this option. Onshore pipeline costs under PSR96 do not apply to CCUS installations. This is the same set of costs as under Option 5. As discussed in section ‎5.3, we are not able to disaggregate costs by business size at this stage. The estimated 10-year present value of the cost of compliance for a *single* CCUS installation and the estimated annualised net direct cost to business (EANDCB) is as follows. As discussed in section ‎5.3, we anticipate that perhaps 40% of this cost will fall to medium-sized operators and around 60% to large ones.

|  |  |  |  |
| --- | --- | --- | --- |
| **Cost per CCUS installation** | **Low** | **Mid** | **High** |
| **10-year net present cost** | £6,800 | £14,000 | £21,000 |
| **EANDCB** | £800 | £1,600 | £2,400 |

*\*Costs in £’000s. Rounded to 2s.f.s*

Total cost aggregated across the Offshore CCUS Sector

1. Based upon the assumption of 27 installations commencing operations spread evenly across the appraisal period, as outlined paragraph ‎25 and demonstrated in Figure 2, the estimated 10-year present value of the cost of offshore compliance and EANDCB across the offshore CCUS sector is as follows. As discussed in section ‎5.3, we anticipate that perhaps 40% of this cost will fall to medium-sized operators and around 60% to large ones.

|  |  |  |  |
| --- | --- | --- | --- |
| **Total cost to offshore CCUS** | **Low** | **Mid** | **High** |
| **10-year net present cost** | £100,000 | £220,000 | £340,000 |
| **EANDCB** | £12,000 | £26,000 | £40,000 |

*\*Costs in £’000s. Rounded to 2s.f.s*

Benefits

1. Option 6 is expected to fully capture the qualitative outline of benefits described in the earlier benefits section (paragraph ‎28). This goes above and beyond the benefits offered by Option 5 as it captures the benefits for hydrogen production as well as CCUS.

**Option 7 – Industry Standards**

1. Option 7 proposes the use of industry standards to require a good practice approach to health and safety, as opposed to use of legislation. It is not clear exactly what the industry standards would entail. In this case it is likely that industry standards would contain requirements near identical to those outlined in the regulatory option (Option 6) but would not be accompanied by the enforceability that comes with legislation.
2. It has been assumed for the purpose of assessing the potential cost of this option that businesses will fully comply with the industry standards, despite the fact that the standards would be voluntary. This is for two reasons; firstly, to fall in line with usual standards for analysis and err on the side of higher cost. In previous cases when providing cost analysis for scrutiny by the Regulatory Policy Committee (RPC), HSE has been encouraged to assume compliance with any requirements set out. Secondly, there is no available evidence to inform an assumption for what the level of compliance would be. Any attempt to quantitatively estimate cost based on a lower level of compliance would rely on an entirely arbitrary assumption of the compliance level.
3. In practice, without the power to enforce specific legislation (as in Option 6), it would more challenging for HSE to ensure compliance. Therefore the cost to business of compliance could well be lower under this option as a result of some non-compliance with the industry standards or where the standards fall short of what HSE requires under Option 6. As discussed in the following section this would result in a reduction in the potential benefits delivered by the standards.
4. There is also potential for additional cost to business under this option as industry would incur costs in order to set out the standards. These standards would likely be developed by existing standards bodies or trade associations. This cost covers the resources required from industry to participate in developing and commit to a set of standards and would be additional costs under this option beyond the costs incurred under Option 6, as under Option 6 HSE is using its existing regulatory framework. This additional cost is not quantified as, due to the fact that these are new industries, it is not yet clear what these standards would look like or how the industry would go about setting them. Further research will be undertaken to better understand this cost and develop the analysis on this option.
5. As the standards are likely to be largely the same as those requirements outlined in Option 6, it has been assumed that the potential cost of compliance (under full compliance) with Option 7 would be similar to, and potentially greater than, that of Option 6.

Benefits

1. Option 7 has the potential to capture the full benefits outlined in the qualitative benefits section (paragraph ‎28). However, this only occurs where industry standards are complied with fully across both CCUS and hydrogen production. While under Option 6 HSE can legally enforce full compliance through legislation - using an approach consistent with other major hazards - under Option 7 compliance with the standard is voluntary and this may mean In practise this means that there would likely be a lower level of compliance, and so the benefits would not be captured in full. Furthermore this would result in inconsistent standards across industry, between those operators adopting the standard and those adopting alternative approaches to compliance. Relative to the legislation proposed in Option 6, this option results in less assurance and transparency around actions taken by dutyholders.
2. Additionally, Option 7 diverges from the existing interventions HSE makes in sectors deemed to have major hazard potential by not regulating legislatively. This creates an inconsistency that could be seen to reduce clarity on the necessary actions for dutyholders, especially when compared to Options 3 and 6.
3. Overall the benefits of Option 7 are qualitatively assessed as likely to fall short of those outlined for Option 6.

**Sensitivity Analysis and Risks**

1. Sensitivity analysis has been considered for this OA. However there are some limitations on what it is capable of demonstrating. Because the benefits are not monetised, it is not possible to identify a point at which costs outweigh benefits; the net present value only reaches zero where costs are nil. Similarly, the costs of the proposed options are scaled versions of one another, meaning that there are no ‘crossover’ points where the NPV of one option surpasses that of another.
2. Some illustrative sensitivity analysis has been carried out to demonstrate the inputs to the model that have the greatest impact on the outputs. This has been done using the CCUS installation costs as these have been successfully aggregated in the cost model. The costs in the CCUS model also apply to hydrogen production, with the exception of well notifications and examinations. Therefore the analysis should highlight sensitivities that also apply to hydrogen production.
3. Pipeline costs are also not yet aggregated, and the unit cost is significantly less than the cost to offshore installations. For pipelines a simple ranking of cost inputs has been provided to demonstrate which parts of PSR96 drive the greatest proportion of the cost.

Sector Size - CCUS installations

1. A key assumption in developing the net cost estimate for the offshore CCUS industry is the number of installations expected to begin operating over the appraisal period. It has been assumed that there will be 27 installations operating during the period, based on NSTA licenses granted. This is a highly uncertain assumption and HSE intend to improve this by engaging with DESNZ and industry through consultation. Refining assumptions around industry size will be a key focus of further research and analysis.
2. In order to test this assumption EANDCB thresholds of £10m and £100m have been used for the best estimate of cost to offshore CCUS, which is estimated by the model to be £26m. The analysis checks the number of additional or fewer installations required to move the best estimate to these thresholds.
3. In order to reach the £10m threshold, the number of installations would need to decrease to approximately 10, representing a 61% decrease on the current assumption. In order to reach the £100m threshold, the number of installations would need to increase to approximately 105, representing a 290% increase on the current assumption.
4. While this suggests that a large change in the number of CCUS installations would be required to move costs out of the order of magnitude of 10’s of £millions, the high level of uncertainty means this could occur; a scenario where fewer than 10 installations are operating could be a realistic possibility. As such, variation in this figure poses a significant risk to the validity of the analysis. HSE aim to mitigate this with further communication with industry and DESNZ through consultation. This should ensure the IA contains the best available data, but inherent uncertainty around the development of the industry means that this will remain a key priority for monitoring and evaluation.

Sector Size – Hydrogen Production and& CO2 Pipelines

1. Uncertainty around the development of the sector has prevented aggregation of costs for both offshore hydrogen production and onshore CO2 pipelines. This also poses a risk to the completeness of the analysis. As with offshore CCUS, HSE aim to mitigate this with further communication with industry and DESNZ through consultation, as well as through ongoing monitoring and evaluation.

Input Costs – Offshore

1. The following table outlines the weighting of the costs of each requirement in SCR15, MAR95 and DCR96 using best estimate figures. The cost areas that make up the greatest proportions of overall cost are the inputs that the model outputs are most sensitive to. There is some uncertainty around the quality of these estimates, particularly those that draw on the 2012 baseline IA. These estimates will be reviewed in further analysis and the table below can be used to prioritise costs for review based on their estimated impact.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Cost per installation** | **Proportion of total** | |
| **Requirement** | **EANDCB (£)** | **CCUS** | **Hydrogen** |
| Verification | £550,000 | 34% | 41% |
| Well Notifications | £210,000 \*\* | 13% | 0% |
| Appointing Operators | £200,000 | 13% | 15% |
| Helicopter Landing Officers | £180,000 | 11% | 13% |
| Procedures in Writing | £150,000 | 10% | 12% |
| Safety Cases | £110,000 | 7% | 8% |
| Accommodation | £77,000 | 5% | 6% |
| Well Examinations | £50,000 \*\* | 3% | 0% |
| Training Installation Manager | £28,000 | 2% | 2% |
| Cost Recovery | £16,000 | 1% | 1% |
| Material Change to SC | £9,800 | 1% | 1% |
| Identifying Marking | £9,600 | 1% | 1% |
| Combined Operations | £5,500 | 0% | 0% |
| Design Notification | £4,400 | 0% | 0% |
| SEMS | £1,500 | 0% | 0% |
| Entering/Leaving Waters | £ *Negligible* | 0% | 0% |
| CMAPP | £ *Negligible* | 0% | 0% |

*\*Rounded to 2s.f.s. \*\*Cost to CCUS installations, not applicable to hydrogen.*

1. In order to demonstrate the level of sensitivity to changes in the cost inputs, sensitivity analysis using the £10m and £100m thresholds introduced in paragraph ‎151 has been undertaken using the cost estimates for the verification scheme, which is the largest individual requirement by cost. The analysis checks what the one-off and ongoing cost of verification would need to be for the best estimate of the total EANDCB (estimated at £26m) to move to the thresholds.
2. In order to reach the £10m threshold, the upfront cost of establishing the verification scheme would need to decrease to approximately -£4.3m, representing a 370% decrease on the current estimate of £1.6m. The verification scheme having a negative set up cost should not be possible in practise. In order to reach the £100m the upfront cost of establishing the verification scheme would need to increase to approximately £29m, representing an increase of 1700%.
3. A similar exercise has been undertaken for the ongoing cost of maintaining the verification scheme. In order to reach the £10m threshold, the ongoing cost of maintaining the verification scheme would need to decrease to approximately -£780k per annum, representing a 330% decrease on the current estimate of £340k. The verification scheme having a negative maintenance cost should also not be possible in practise. In order to reach the £100m the ongoing cost of maintaining the verification scheme would need to increase to approximately £5.6m per annum, representing an increase of 1500%.
4. This analysis demonstrates that a very large underestimate, or an impossibly large overestimate of the cost of any individual requirement would be needed to result in a change in the order of magnitude of the total cost. For all other cost inputs the required change in cost increases proportionate to the proportion of overall cost that requirement makes up.
5. There remains some risk around the cost estimates in this OA. The majority of the estimates for offshore costs were developed for compliance of hydrocarbon installations and used as a reasonable proxy for CCUS and hydrogen. This means that systematic under or overestimation of cost is a possibility. The cost estimates will be tested for their validity and applicability to CCUS and hydrogen at consultation stage.

Input Costs – Onshore Pipelines

1. As with the offshore costs, the proportion of overall onshore pipeline cost that each requirement of PSR96 makes up has been assessed. This demonstrates which requirements are most impactful and which costs the model is most sensitive to. These are outlined in the following table:

|  |  |  |
| --- | --- | --- |
|  | **Cost per pipeline** | **Proportion of total cost** |
| **Requirement** | **EANDCB (£)** |
| ESDVs | £46,000 | 56% |
| Emergency Procedures | £20,000 | 24% |
| Local Authority Plans | £8,300 | 10% |
| MAPD | £7,000 | 9% |
| Notifications | £1,600 | 2% |

*\*Rounded to 2s.f.s.*

1. There remains some risk around the estimates for the cost of complying with PSR96 as they are based on a small sample of survey responses which contained some outliers. These cost estimates will be tested for their validity at consultation stage.

**Summary**

1. Early stage cost-benefit analysis for the preferred option indicates that the likely annualised cost of compliance per offshore hydrogen installation is between £590k and £2.1m, with a best estimate of £1.3m per installation. Annualised costs for CCUS installations are estimated to be between £800k and £2.4m, with a best estimate of £1.6m per installation. CCUS costs are higher as a result of the use of wells, necessitating well examinations and well notifications.
2. The likely cost of compliance per onshore CO2 CCUS pipeline is lower, although there is significant uncertainty around this cost estimate with a range of annualised costs between £5.4k and £260k, with a best estimate of £83k per pipeline. The range of potential costs for pipelines is particularly wide because they are drawn from a survey of operators which received a limited response rate. These estimates will be improved through the consultation process.
3. The key uncertainty in this analysis is the number of installations and pipelines expected to begin operating over the appraisal period. Even with the highest quality data available this would remain highly uncertain as these industries are not yet operating and their ability to scale up depends on a vast range of unpredictable practical and economic factors.
4. At this stage a reasonable assumption for industry size has only been made for offshore CCUS and sensitivity analysis has been undertaken around this assumption. This results in a likely annualised cost to industry of compliance of between £12m and £40m, with a best estimate of £26m.
5. These costs trade off against unquantified benefits which have been described qualitatively in the cost-benefit analysis. Based on prior examples, a major hazard incident could cost in the region of £1bn in impacts upon households, businesses and government. It isn’t known the degree to which compliance with offshore and onshore pipeline major hazard regulations reduce the risk of such a costly incident
6. Analysis suggests that the benefits are best captured by Option 6 which offers enforceability to better ensure compliance and covers fully both CCUS and hydrogen production.

**Figure 1. Schedule of best estimate of costs per CCUS installation**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **Present Value** |
| Verification | £1,900 | £340 | £340 | £ 410 | £ 340 | £ 340 | £410 | £340 | £340 | £410 | £4,700 |
| Well Notifications \*\* | £210 | £210 | £210 | £ 210 | £210 | £210 | £210 | £210 | £210 | £210 | £1,800 |
| Operators | £240 | £200 | £200 | £200 | £200 | £200 | £200 | £200 | £200 | £200 | £1,700 |
| HLO | £180 | £180 | £180 | £180 | £180 | £180 | £180 | £180 | £180 | £180 | £1,500 |
| Procedures | £150 | £150 | £150 | £150 | £150 | £150 | £150 | £150 | £150 | £150 | £1,300 |
| Safety case | £710 | £0 | £0 | £0 | £0 | £240 | £0 | £0 | £0 | £0 | £910 |
| Accommodation | £660 | £0 | £0 | £0 | £0 | £0 | £0 | £0 | £0 | £0 | £660 |
| Well Exam \*\* | £50 | £50 | £50 | £50 | £50 | £50 | £50 | £50 | £50 | £50 | £430 |
| Installation Manager Training | £70 | £0 | £0 | £70 | £0 | £0 | £70 | £0 | £0 | £70 | £240 |
| Cost Recovery | £80 | £7.9 | £7.9 | £7.9 | £7.9 | £7.9 | £7.9 | £7.9 | £7.9 | £7.9 | £140 |
| Material Change | £9.8 | £9.8 | £9.8 | £9.8 | £9.8 | £9.8 | £9.8 | £9.8 | £9.8 | £9.8 | £85 |
| Identifying Marking | £82 | £0 | £0 | £0 | £0 | £0 | £0 | £0 | £0 | £0 | £82 |
| Combined Ops | £5.5 | £5.5 | £5.5 | £5.5 | £5.5 | £5.5 | £5.5 | £5.5 | £5.5 | £5.5 | £47 |
| Design Notification | £38 | £0 | £0 | £0 | £0 | £0 | £0 | £0 | £0 | £0 | £38 |
| SEMS | £13 | £0 | £0 | £0 | £0 | £0 | £0 | £0 | £0 | £0 | £13 |
| **Total** | **£4,400** | **£1,200** | **£1,200** | **£1,300** | **£1,200** | **£1,400** | **£1,300** | **£1,200** | **£1,200** | **£1,300** | **£14,000** |

*\*Costs in £’000s. Rounded to 2s.f.s \*\*Costs that would not apply to hydrogen installations*

**Figure 2. Best estimate of costs aggregated across CCUS sector**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| New installations per annum | **0** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Present Value |
| 2.7 | £12,000 | £3,100 | £3,100 | £3,500 | £3,100 | £3,800 | £3,500 | £3,100 | £3,100 | £3,500 | £37,000 |
| 2.7 | £0 | £12,000 | £3,100 | £3,100 | £3,500 | £3,100 | £3,800 | £3,500 | £3,100 | £3,100 | £33,000 |
| 2.7 | £0 | £0 | £12,000 | £3,100 | £3,100 | £3,500 | £3,100 | £3,800 | £3,500 | £3,100 | £30,000 |
| 2.7 | £0 | £0 | £0 | £12,000 | £3,100 | £3,100 | £3,500 | £3,100 | £3,800 | £3,500 | £27,000 |
| 2.7 | £0 | £0 | £0 | £0 | £12,000 | £3,100 | £3,100 | £3,500 | £3,100 | £3,800 | £23,000 |
| 2.7 | £0 | £0 | £0 | £0 | £0 | £12,000 | £3,100 | £3,100 | £3,500 | £3,100 | £20,000 |
| 2.7 | £0 | £0 | £0 | £0 | £0 | £0 | £12,000 | £3,100 | £3,100 | £3,500 | £17,000 |
| 2.7 | £0 | £0 | £0 | £0 | £0 | £0 | £0 | £12,000 | £3,100 | £3,100 | £14,000 |
| 2.7 | £0 | £0 | £0 | £0 | £0 | £0 | £0 | £0 | £12,000 | £3,100 | £11,000 |
| 2.7 | £0 | £0 | £0 | £0 | £0 | £0 | £0 | £0 | £0 | £12,000 | £8,800 |
| **Total** | **£12,000** | **£15,000** | **£18,000** | **£22,000** | **£25,000** | **£29,000** | **£32,000** | **£35,000** | **£38,000** | **£42,000** | **£220,000** |

*\*Costs in £’000s. Rounded to 2s.f.s*

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30. NSTA Interactive Map https://www.arcgis.com/apps/webappviewer/index.html?id=cb3474a78df24139b1651908ff8c8975 [↑](#footnote-ref-31)
31. This means the initial preparation and submission of the design notification and safety case. This is the point at which the operator begins incurring costs relating to the regulations under consideration. The installations would not necessarily become fully operational in this period. [↑](#footnote-ref-32)
32. Piper Alpha: Lessons Learnt, 2008. Oil & Gas UK, https://web.archive.org/web/20131004232924/http:/www.oilandgasuk.co.uk/cmsfiles/modules/publications/pdfs/HS048.pdf [↑](#footnote-ref-33)
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34. A ‘well kill’ involves stopping a bore hole with heavy fluids to prevent further release. [↑](#footnote-ref-35)
35. Elgin gas leak in North Sea costing Total $1.5m a day - BBC News https://www.bbc.co.uk/news/uk-scotland-north-east-orkney-shetland-17581994#:~:text=The%20North%20Sea%20gas%20leak%20is%20costing%20oil [↑](#footnote-ref-36)
36. A material change is likely to be one that changes the basis on which the original safety case was accepted. Possible material changes could include significant changes to hydrocarbon inventory, additional equipment and structure weight, equipment layout or staffing philosophy. [↑](#footnote-ref-37)
37. Material changes are changes to particulars in the original well notification that affect the hazards as described e.g. changes to the particulars of fluids, plant, equipment, well path, well design, procedures or management arrangements. [↑](#footnote-ref-38)