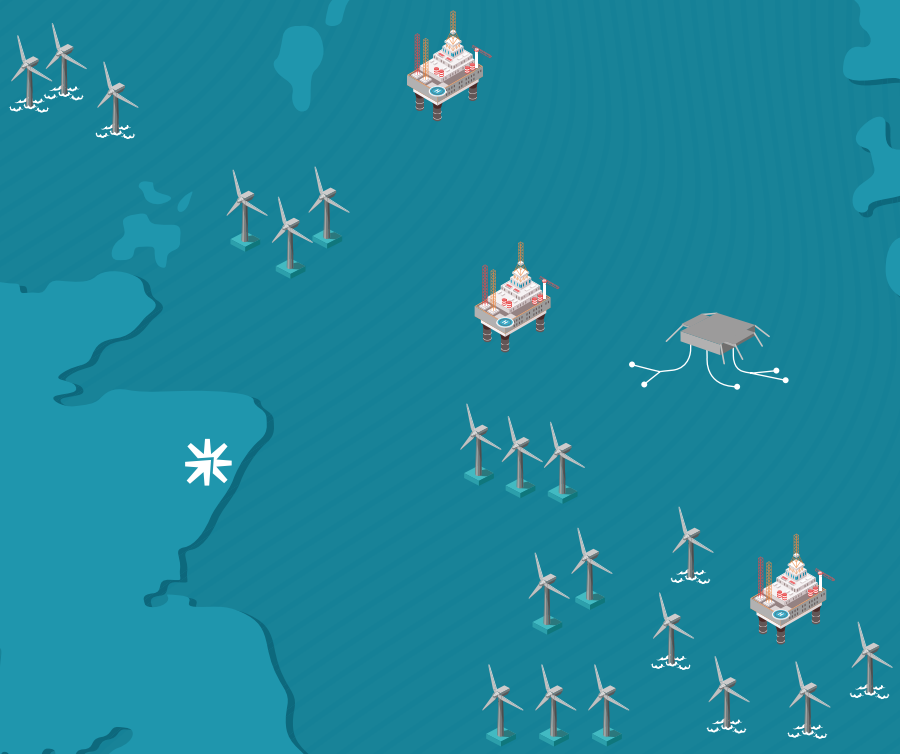
TNO innovation for life

Net Zero Technology Centre

Technology Driving Transition

One North Sea



Cross-border collaboration in the North Sea energy transition

Cross-border partnerships, alignment and joint planning in the North Sea region are key to make the energy transition a success.

Contents

1.0

Introduction

The Paris Agreement and other national climate agreements require quick actions and open opportunities in the search for smart synergies between existing and new energy systems. Having a strong offshore oil and gas sector and large ambitions in offshore renewables in several North Sea countries, there is a huge potential for creating value from these synergies. Several integration options between the oil & gas sector and the renewables sector, such as platform electrification, CO_2 storage and hydrogen production, are currently being investigated in various North Sea countries. This is a relatively new field, requiring strong leadership in both research and industry to fully utilise the existing window of opportunity.

The North Sea energy system does not stop at borders. International collaboration on the ONS database of oil & gas and renewables can bring forth optimal synergies, as well as opportunities to share experiences and knowledge that can accelerate the energy transition. Cross-border partnerships, alignment and joint planning in the North Sea region are key to make the energy transition a success.

With this in mind, TNO and Net Zero Technology Centre have set up One North Sea – a platform that focusses on stimulating international collaboration by bringing together the ideas and initiatives of research organizations, industry and governments. We are looking to extend this partnership to include likeminded organisations and maximise the opportunities for a successful transition in the North Sea.

This document describes the outcomes of a first joint study under the One North Sea flag. Section 2 focusses on the current status of the North Sea energy transition, and more specifically within the ONS database of oil & gas and renewables in the North Sea. Section 3 describes our joint international vision of the North Sea energy transition, highlighting cross-border opportunities and challenges. Finally, Section 4 summarizes a set of recommendations to accelerate international collaboration.

One North Sea focus

Enhancing knowledge sharing capability.

Collaborating to attract international funding to support these initiatives and projects.

Contributing to the improvement and maintenance of the projects and website database.

Identify common barriers and developing initiatives to tackle issues where cross-country collaboration would clearly benefit the outcome.

2.0

State of Play in the North Sea: the One North Sea Database

Exhibit 1 The ONS project database

As the energy transition develops in the North Sea, the scope of activities at sea is changing significantly. Oil and gas production is in decline while renewable energy production increases steadily, changing the energy landscape, enabling synergies between different forms of energy production, and creating potential to leverage legacy infrastructure in new ways.

To create a catalogue of the integration projects that are already underway, One North Sea has developed a database where ongoing energy projects with a component of re-use of existing infrastructure are mapped out. The following themes are included:

- CO_2 Transport & Storage
- Electrification
- Hydrogen Transport
- Hydrogen Production Offshore
- Hydrogen Storage Offshore
- Geothermal Energy Production

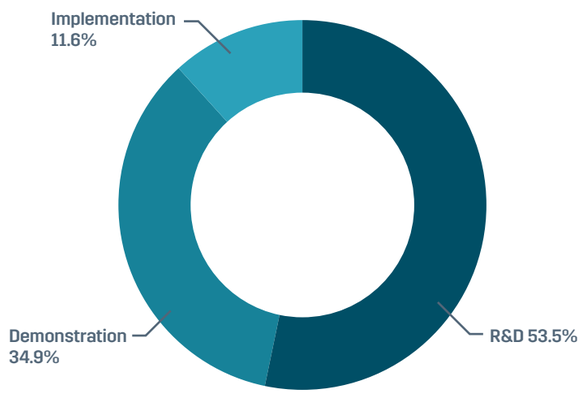


Figure 1. Project type.

Close to 90 projects were identified, most of them taking place in the Netherlands, followed by UK and Norway. Ongoing projects were identified at various stages of development, although a significant portion are in the earlier stages, which is expected within an emerging field. Over half of the projects in the database are at R&D stage, with about a third of projects at demonstration stage and only around 10% targeting implementation. Most projects fall within the themes of CO_2 transportation and storage, electrification, hydrogen transport and hydrogen production offshore. A breakdown of the projects within the database is shown in Figures 1 and 2.

Integration and reuse projects are often collaborative, involving companies from different sectors. International collaborations are also increasing in frequency, which opens doors to larger work scopes and contributes to the alignment of regulatory aspects. The information available on the One North Sea website and database also includes which organisations are involved within each project and where the funding is predominantly sourced from.

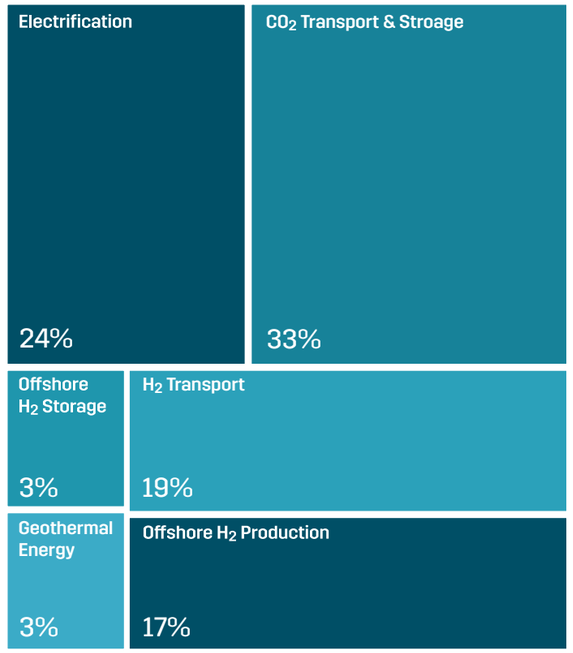
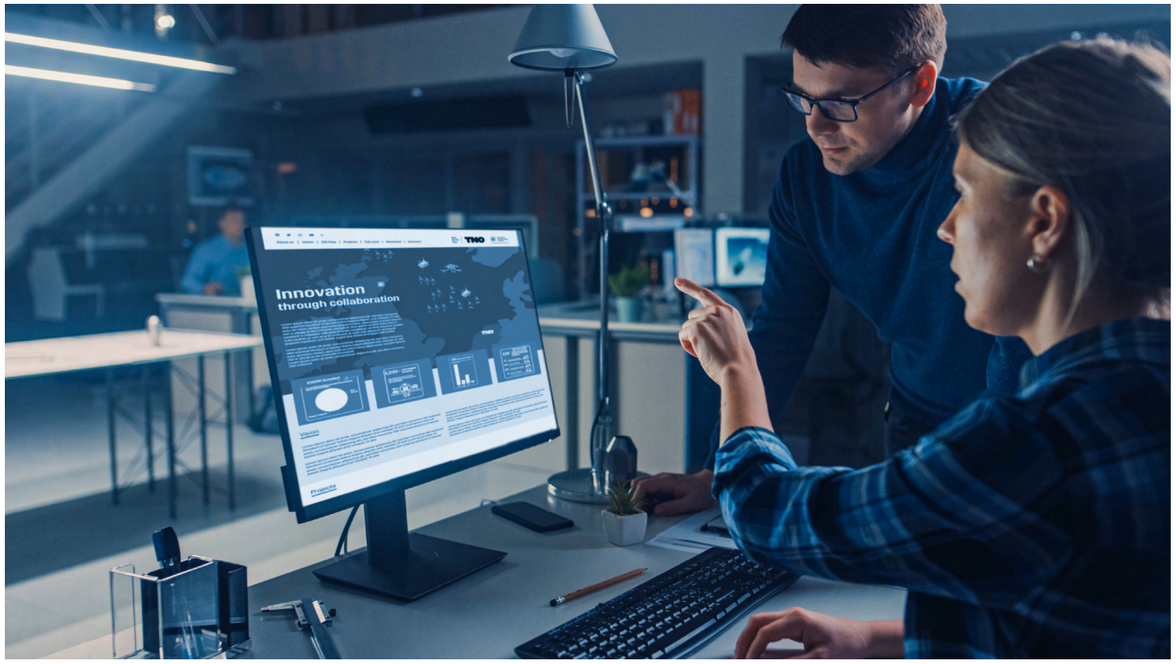


Figure 2. Project distribution by theme.



State of Play in the North Sea: the One North Sea Database

Exhibit 2 One North Sea website

The One North Sea website provides a place where people can access and contribute to the One North Sea platform and database, and all the outcomes of this initiative are shared here. The project database is visualized as a GIS application and visitors can download a copy of the database and other publications. The aim is to continue developing this database by turning it into a crowdsourced knowledge base, kept relevant and up to date through the contributions of stakeholders and visitors, who will have the option to contribute by posting any missing relevant projects.

The One North Sea website provides a place where people can access and contribute to the One North Sea platform and database.

Exhibit 3 Funding cross-border research

There are a number of potential funding opportunities available for the North Sea Energy transition at both National and EU levels, and these were reviewed as part of the One North Sea initiative. In particular, the new Horizon Europe programme, replacing Horizon 2020, offers significant funding potential for cross border collaboration between 2021 & 2027. Within the €85 billion Horizon Europe programme, around €15 billion is to be directed towards "Climate, Energy & Mobility". The UK has confirmed its intention to associate with Horizon Europe and as such UK entities will have equivalent rights and obligations as other countries associated to the Programme. Funding schemes are available across a range of TRL levels and cover early feasibility studies through to large scale demonstration at National and International level.

3.0

A cross-border vision on the North Sea energy transition

To enable successful cross-border collaborations, a joint vision on what the North Sea Energy Transition may look like is vital. One North Sea has developed an initial framework for what such a joint North Sea Energy Transition vision could look like and what interdependencies and challenges still need to be addressed to make future collaborations truly effective. Five pillars have been identified that represent important aspects of the framework for a successful transition (see Figure 3):

1. The North Sea driving the European energy transition
2. Offshore Energy systems integration
3. Cross-border coordination and collaboration
4. Leadership, policy & investment
5. Technology & innovation

The pillars are not standalone, but rather interconnected and heavily interdependent. For example, pillars 1 to 3 strongly depend on progressing technology & innovation, which cannot take place without the contribution of relevant networks and partnerships. In the next section, the different pillars are described in more detail.

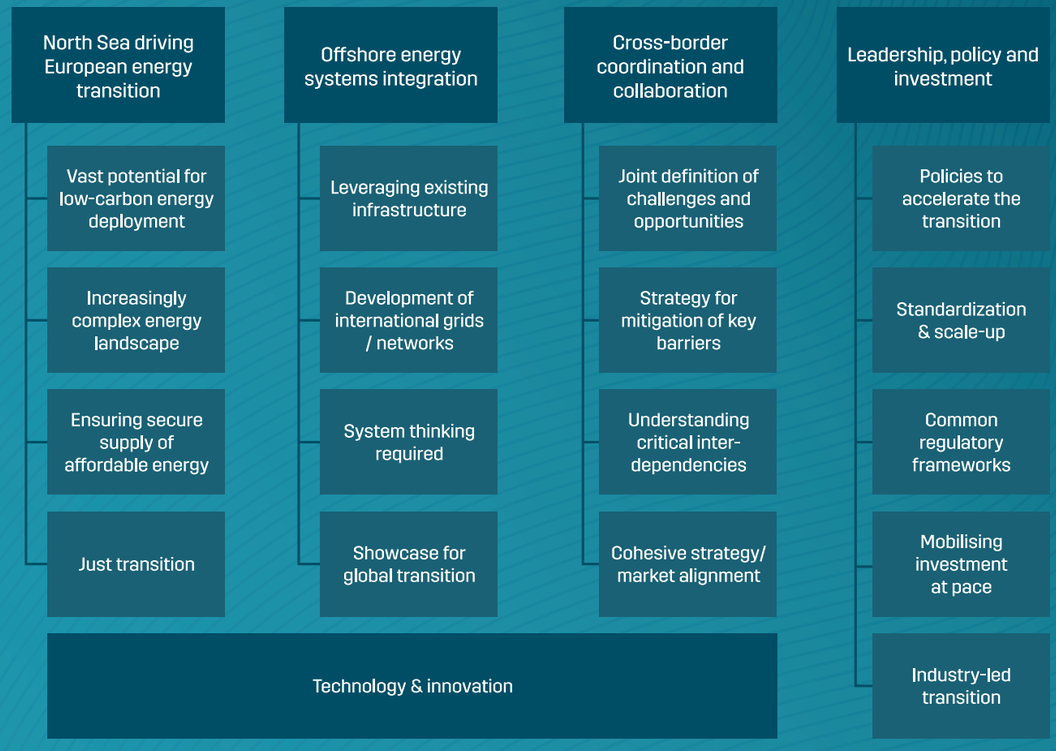


Figure 3 A joint vision on the North Sea Energy transition explained in five interconnected, interdependent pillars.

3.1

The North Sea driving the European energy transition

Opportunities for an increasingly complex energy system

For decades the North Sea has been an energy provider in the form of exploration and production of oil and gas. With the Paris Climate Agreement goals for Europe, a new direction is required to achieve significant emission reduction goals. This requires a different view on the North Sea, focussing on a transition towards becoming a low carbon energy provider. This need for sustainable energy has resulted in a strong move towards the build-up of offshore wind production capacity in all countries in the North Sea basin, where nearly 80% of all installed capacity in Europe is located.

The UK currently owns 42% of offshore wind capacity in Europe (10.5GW in 2020) and the ambition stated in the Government '10 Point Plan', and in the Energy White Paper is to increase to 40GW by 2030, almost quadrupling existing capacity over this decade. The Netherlands more than doubled its capacity in 2020 by bringing online 1.5GW (over half of all capacity brought online in Europe over the year), reaching a cumulative 2.6GW capacity[1]. The Offshore Renewables Energy Strategy, by the European Commission, sets out to build 300 GW of offshore wind by 2050, a 25-fold capacity increase.

This move is not only the result of a need for more sustainable energy, but moreover for a reliable and affordable new energy system to ensure security of energy supply for Europe. This energy transition is however not without its challenges. At first, the new energy system will be based on intermittent energy sources, which require a far more flexible energy system than ever before. This shift to intermittent sources is greatly increasing the demand for flexibility, such as increased demand-response and storage of energy at both second and seasonal timescales. The energy landscape in the North Sea has therefore become increasingly complex, with a broadened portfolio of activities at sea (e.g. oil and gas production, offshore wind production, aquafarming, fisheries, shipping, military zones, nature conservation areas, etc.). In order to fully utilise the North Sea's potential for the energy transition in Europe, we will need to learn how to combine all those activities within the available space and work on the development of smart solutions, ensuring a level playing field is created for scaling up new activities.

Fortunately, there is an extensive amount of offshore experience in the oil and gas sector which new activities can benefit from. Similarly, part of the assets and infrastructure that is currently available at sea, may be of value for the new energy system. An example that has recently received a lot of interest is the potential for repurposing of parts of the existing gas network for hydrogen transport. By making use of this type of smart synergies between different activities, we may be able to tackle the increasing competition for space offshore and ultimately turn it into a mutually beneficial development for a variety of industries.

Offshore wind power in Europe (2020)

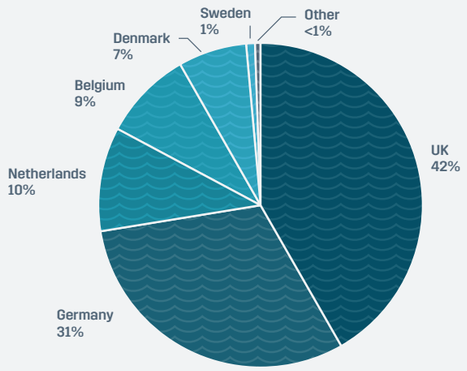


Figure 4. Grid-connected offshore wind power capacity at the end of 2020. Source: WindEurope.

[1] WindEurope (2020), Offshore Wind in Europe – Key trends and statistics 2020

Vast potential for low-carbon energy

The North Sea hosts a vast potential for low-carbon energy deployment. With the decline in oil and gas production, worries may arise on the actual market value of the North Sea area. However, we foresee that the new energy system activities such as offshore wind and CO_2 transport and storage, may hold a similar or even higher market value than the hydrocarbon exploration and production sector in the long-term. Considering offshore wind alone, it is feasible that 212GW may be deployed in the North Sea by 2050[2]. The market value from these activities is significant. The Net Zero Technology Centre's Integrated Energy Vision study found that an energy system in which both floating wind and green hydrogen play a major role with CCS playing a moderate role, would enable a decrease in reliance on imported gas and have a total economic impact of £125bn on the UK by 2050, along with the creation of 232,000 direct and indirect jobs. The energy transition creates new perspectives and business opportunities for the industry while challenging the current sector to achieve low-emission targets. The market potential for low-carbon energy inherently accommodates a vast decrease in emission reductions, supporting the move towards Net Zero.

212GW may be deployed in the North Sea by 2050

Economic impact of £125bn on the UK by 2050

Creation of 232,000 direct and indirect jobs

Just transition

The potential for low-carbon developments in the North Sea are vast, and these should be developed inline with the concept of a 'just transition' for everyone. With the changing energy landscape at sea, a large number of new jobs will arise, but a large number of existing jobs may become obsolete. The opportunity to retain offshore experience within the energy sector should be one of the main concerns in the development of a just transition. The transition phase towards new energy systems offers strong opportunities in the field of shared operation and maintenance as well as manufacturing. Making use of these opportunities is vital to ensure that everyone can benefit from the energy transition.

In a similar manner, public acceptance and support for the offshore energy transition is key. We need to explain why certain choices are made and gain public support for the development of new activities at sea. The transition towards the new energy system cannot take place behind closed doors but should be approached as a joint effort for the next generations.

With the changing energy landscape at sea, a large number of new jobs will arise.

[2] WindEurope - Our energy, our Future

3.2

Offshore energy systems integration

Unlocking potential of the North Sea through offshore systems integration

The importance of thinking in terms of systems is becoming increasingly acknowledged in the energy transition sector. As was already mentioned in the previous section, smart systems integration offers opportunities to solve some of the space challenges foreseen in the North Sea. The 'North Sea Energy' program, a public-private research programme funded by industry and the Dutch government, highlights that strategic offshore energy systems integration is the only way to fully unlock the potential of the North Sea. Strategic integration will provide options to reduce CO_2 emissions, use space more efficiently, enable & accelerate the energy transition and reduce its cost[3].

Systems integration at sea can take different shapes and forms, but at its core, it couples activities around distinct energy carriers such as electricity, CO_2, hydrogen, oil and gas. This will result in a cost-efficient system, with increased output or higher efficiency than its individual components. Some clear examples of systems integration opportunities are:

- Electrification of ongoing oil and gas production to reduce emissions (CO_2, NOx);
- CO_2 transport through existing re-purposed gas pipelines and/or storage of that CO_2 in depleted gas reservoirs; and
- Production of hydrogen on or around existing gas assets and/or transport of hydrogen through repurposed gas pipelines (including blending of hydrogen in the existing natural gas stream).

The creation of an integrated energy system in the UK Continental Shelf alone is expected to require an investment of £430 billion between 2020 and 2050. Until 2035, investment profiles are expected to focus predominantly on oil and gas and offshore wind, with 50% of expected investment targeting these areas. Direct investment can also play a significant role in launching both CCUS and low-carbon hydrogen industries, although most investment is expected from 2035 onwards. An integrated energy system in the UK Continental Shelf is expected to generate up to £36 billion yearly revenue by 2050 through transaction of products and services[4].

Re-use of infrastructure as an example of systems integration

The repurposing and re-use of existing infrastructure where needed and where possible offers a good example of the benefits of efficient systems integration. In the Netherlands, there are several examples where re-using a selection of the existing gas transport infrastructure is currently seen as a good way to enable efficient transport of energy carriers for the new energy system, such as for CO_2 and hydrogen. Pipeline re-use is already underway in the Netherlands, with a previously state-owned natural gas pipeline has been repurposed for hydrogen transportation (from Dow to Yara). Although permitted, some barriers still remain to expand this pipeline re-use to a more commercial scale. In the Netherlands, the development of an onshore hydrogen backbone will likely consist of a combination of re-used sections of the existing low-caloric gas grid and new sections where needed. Similarly, studies from the Dutch North Sea Energy programme have highlighted opportunities for re-using parts of the existing offshore gas grid, including some of the major trunk lines. Alongside this, a selection of platforms associated with depleted gas fields are currently under consideration to be re-used for CO_2 injection and permanent storage (e.g. in the Porthos, Athos and Aramis projects). In the UK, an early assessment of oil and gas infrastructure has been performed to identify infrastructure with the potential for CCUS re-use[5]. Several pipeline systems have been identified (Goldeneye, Atlantic and Cromarty, Miller Gas system and Hamilton-HyNet) but comprehensive technical and safety validation is still required.

It is important to note that reuse of infrastructure should only be deployed where it adds value, and that some challenges are associated with infrastructure to ensure that it will be safe and cost-efficient to re-use. For specific projects, this means that we still need to find out in detail which parts of the existing infrastructure can be repurposed and re-used, both technically as well as economically. Additionally, regulatory questions may also arise for specific aspects of repurposing the gas grid. For example, the combined transport of natural gas and hydrogen in a transition phase from natural gas production towards production of other energy carriers in the new energy system still runs into regulatory barriers. Since resolving these types of challenges may require long lead times and the window of opportunity for some infrastructure may be short, this emphasizes the need to act now to enable timely deployment of future activities. Infrastructure re-use can help ensure that the market ramp-up around the North-Sea area takes place within the current timeline ambitions for the energy transition.

The following recommendations require action in the short-term to allow for timely cross-border infrastructure developments:

A consistent long-term legal framework regarding renewable and low carbon gases. This should include more coordinated, uniform, clear definitions and terminology regarding power to gas processes and hydrogen;

Cross-border alignment in the development of technical standard for CO_2 and hydrogen network operations; and

The development of detailed requirements at a national level for underground storage of hydrogen, specifically in geological formations.

The importance of international offshore systems integration

The North Sea does not stop at national borders. This means that the development of an offshore energy grid and other developments in the North Sea energy transition cannot stop at borders either. The Dutch North Sea Energy program already highlighted the importance of cross-border collaboration and coordination and the North Sea Wind Power Hub[6] developed an international hub-and-spoke concept reflecting the need for international collaboration. We expect that international networks will allow the greatest potential to be developed from an integrated energy system. Joining international expertise, databases and tooling for offshore systems integration may be a first step in bringing together the unique selling points of the different areas. Finally, we foresee that this may lead to an interconnected, international offshore energy system which will increase the affordability, reliability and flexibility of the new North Sea energy system.

The North Sea as a showcase for the world

The North Sea area offers a unique location for the showcase of opportunities and barriers for going through the energy transition worldwide. As a well-developed basin where the energy transition is accelerating, the North Sea can be a showcase for the world on how to transition an oil and gas basin to a Net Zero energy hub, and how cross-border offshore energy systems integration and technology innovation can be leveraged to accelerate an affordable energy transition. The development of innovative technologies can also provide options for the implementation of integrated systems in other regions, accelerating the transition of other basins and increasing the economic value of supply chains in North Sea facing countries.

[3] North Sea Energy (2020), Unlocking Potential of the North Sea – Interim Program Findings June 2020
[4] Net Zero Technology Centre (2020), Closing the Gap – Technology for a Net Zero North Sea.
[5] BEIS (2020), Re-use of Oil and Gas Assets for Carbon Capture and Storage Projects (Consultation)

[6] Northseawindpowerhub

3.3

Identified knowledge gaps: hydrogen backbone

The development of a Europe wide hydrogen network has been highlighted as one of the key net zero technologies where cross-border collaboration is essential.

As part of One North Sea, knowledge gaps have been identified regarding the development of a hydrogen backbone in the North Sea region. The pace at which a future hydrogen backbone can be realised depends not only on technical challenges but also on societal and commercial challenges. This gap analysis has therefore identified both technical and non-technical challenges by collecting available information from projects that both TNO and Net Zero Technology Centre have been involved in.

Various hydrogen value chains and studies were analysed to identify knowledge gaps. From the hydrogen backbone projects identified, a literature review was conducted where open questions that are not addressed in these projects have been identified. The open questions were discussed with various experts within TNO & Net Zero Technology Centre and at workshops with relevant stakeholders in the North Sea. This workshop was hosted by One North Sea and a summary of the findings are provided in Table 1. The knowledge gaps identified have been divided into 3 broad categories: Integrated Energy System, Hydrogen (production, demand, storage, transport, business cases) and Regulatory Aspects.

Table 1 Summary of knowledge gaps regarding hydrogen backbones identified by One North Sea

Domain	Knowledge gaps & developments needed
Integrated energy system	**Joint data repository** • Is required for countries surrounding the North Sea; • Should consist of transport infrastructure capacity, routing and compatibility, industrial demands, RES potential, etc; • Is needed for joint modelling, spatial design, consistent market insights, stakeholder workshops. **Techno-economic analysis of different modes of hydrogen transport** • Such as pipeline, road, rail, and ship; • Their role in various use cases around the North Sea needs to be investigated; • A thorough analysis including viability, relevance, costs, capacities of different modes of hydrogen transport is currently lacking. **Exploration of cross-border synergies in an integrated energy system of the North Sea** • A limited number of cross-border studies exploring role of integrated energy system are currently available. **Role of energy carrier interconnections** • E.g. for hydrogen, electricity, e-fuels, etc. in an integrated energy system needs to be explored. **Interconnected system design criteria** • The design of an interconnected energy system relying on multiple energy carriers to allow meeting of demand via multiple combinations needs to be better understood.
Hydrogen	**Production and demand** • What is the production potential of EU, the UK & Scotland and how does this compare to the demand predicted? **Storage** • Geological storage capacity is needed to increase the systems flexibility, e.g. in salt caverns, depleted gas fields; • The geo -chemical/-mechanical, microbiological effects relevant for hydrogen storage needed to be better investigated; • The impact of storage on the security of supply and opportunities for developing strategic reserves needs to be better understood; • Social acceptance of onshore hydrogen storage needs to be better understood. **Transport** • The interaction of import versus system design needs to be investigated; • The import supply value chain needs to be better understood. **Business case** • The development of a sustainable business case for building new caverns is needed; • The impact of re-use vs. new storage infrastructure on hydrogen markets needs reviewing; • Funding mechanisms for large infrastructure storage investments and their consequences on hydrogen prices are required. **Other technical questions** • Research is still needed on the impacts of hydrogen storage ion infrastructure integrity.
Regulatory aspects	• Cross-border regulation for hydrogen transport and storage is lacking; • Standardization of legislation and safety aspects for transport and storage is also lacking and would benefit cross-border factors; • Governmental support is required to incentivize for cross-border collaboration.

3.4

Cross-border coordination & collaboration

Advantages of cross-border coordination & collaboration in R&D

Cross-border coordination in the North Sea energy transition starts with a joint definition of challenges and opportunities. This may sound trivial, but in practice, there is a tendency to focus on the continental shelf at a national level. The One North Sea initiative is an example of such coordination and collaboration, but this needs to be developed further. One North Sea aims to develop its collaboration with other North Sea countries to help to accelerate the development of technology and innovation through sharing experiences and lessons-learned in research and development, demonstration and even implementation projects for the North Sea energy transition. Similarly, by joining forces internationally, we can benefit from a larger workforce with greater flexibility in addressing key challenges and bridging the knowledge gaps identified in Section 3.3 . Collaboration may for example increase the likelihood of securing European Projects of Common Interest, which are key in scaling up energy transition initiatives. To fully illustrate the benefits of a cross-border approach to the energy transition, success stories need to be identified and their learnings utilised. Several positive examples are available, although they are all in early stages of deployment. We need to build towards more international demonstration projects to be able to fully oversee the advantages and challenges in cross-border collaboration.

One North Sea aims to be a platform for these discussions, providing knowledge sharing opportunities and a comprehensive overview of ongoing activities, as well as highlighting current gaps and challenge areas.

The role of collaboration in mitigating key barriers

We see a need for an international approach to the North Sea energy transition strategy to mitigate key barriers. Two well-known and significant barriers for the North Sea energy transition are the misalignments in regulatory frameworks and standardization, and the growth and alignment of a market for sustainable energy carriers (such as hydrogen). Cross-border collaboration is key to mitigate these challenges. The harmonization of regulations is needed to enable the implementation of an international energy system. Similarly, international market alignment and collaboration leads to a larger market to start from. These are just some examples of where international coordination is needed to accelerate the North Sea energy transition.

To allow for effective collaboration, we need to fully understand the critical interdependencies for the future planned activities. Existing research activities (such as North Sea Energy in the Netherlands and Zero Emission in the UK) already provide a good basis, but international knowledge sharing and alignment is needed at all levels to bring this one step further. This requires that all relevant stakeholders, including e.g. governments, TSOs, DSOs and industry, are able to collaborate, cross-border, which One North Sea aims to facilitate and provide a platform for.

We believe that the only way to achieve this goal is if research and technology organizations take up the gauntlet to map these interdependencies in collaboration with the relevant stakeholders, and work on the development of innovative solutions for the key barriers and knowledge gaps identified. One North Sea aims to be a platform for these discussions, providing knowledge sharing opportunities and a comprehensive overview of ongoing activities, as well as highlighting current gaps and challenge areas.

3.5

Leadership, policy & investment

International collaboration is a key factor for a successful North Sea energy transition, and is enabled by actions on leadership, policies and investments.

Policies as incentive for the energy transition at the North Sea

Policies on an international level are needed to really accelerate the international energy transition. These policies should provide incentives, where they are not available yet, to make the international transition work. To fully understand how policies on different levels could enable this, a clear explanation and analysis on how they can enable cross-border collaboration for the energy transition and more specifically technology innovation is needed.

Standardization & scale-up for transition projects

As was already mentioned in the previous section, standardization and harmonization of the regulatory framework is key as a first step to actual cross-border transition projects. A next step should be how we can ensure the scale-up of cross-border transition projects. Scaling up depends on a large range of boundary conditions – both dependent and independent of cross-border coordination. However, we foresee that international alignment from the start will not harm the success of scale-up projects.

Mobilising investment at pace

Because a net-zero economy is expected to be capital-intensive, the delivery of the Paris Agreement and other national targets is dependent on increasing the availability of climate-aligned finance. Net-zero investments are expected to generate considerable savings, but the existing opportunities are not sufficiently clear for investors. It is essential to ensure win-win opportunities are clearer, to guarantee investor support from an early stage. The connection of climate targets with an increase in resilience and fairness, tied with government objectives, can also drive regulatory action and build public support.

The sharing of opportunities and challenges for both testing and field trials can help investors better understand risk and drive a higher predictability of cash flows. Additionally, the development of effective international frameworks is crucial to guarantee the sustainability of cross-border collaborations.

As the transition is expected to transform energy production, it is essential that investment plans are supportive of the entire scope of decarbonisation activities and of the integration of energy systems, including the oil and gas sector and existing supply chain in decarbonisation efforts. This approach will safeguard existing jobs and create new opportunities, contributing to the development of skills and accelerating the sector's transformation. The UK's North Sea Transition Deal, announced in March 2021, is the first setting out a plan for the maturation of the offshore oil and gas sector in the UK, outlining targets and measures to tackle the challenge of repositioning capabilities while supporting the transition of the energy industry in the UK and globally.

Networks & partnerships as fuel for the energy transition at the North Sea

Relevant national and international networks and partnerships are vital in making the North Sea Energy transition work. We believe in an industry-led transition. This means that the role of companies in the energy transition is very important and cannot be neglected. In industry, international collaboration and enterprises are very common and we believe that the energy transition can strongly benefit from that. To ensure good corporation between industry, research organizations and public bodies such as the government, One North Sea will support the development of international public-private partnerships to link funders, stakeholders and problem owners to the relevant challenges and solve them jointly. By having representatives from different countries, organizations can address the relevant partners on a corporate level in their home countries. In public-private partnerships we also strongly recommend bringing together governmental departments of various countries. In this way partnering up as well as alignment could occur on every needed level – the only way to ensure an integrated approach for the North Sea energy transition.

3.6

Technology & innovation

Technology, innovation and willingness to work collaboratively will be fundamental elements in achieving net zero targets.

A successful energy transition will depend on the energy sector's ability to address the technical and non-technical challenges related to systems integration. Efficient cross-sector and cross-border collaboration around topics of strategic interest can also drive the establishment of cohesive international strategies and targets and contribute to the alignment of legislation.

Clear and coordinated cross-border perspectives provide a platform to the acceleration of technology deployment, a key driver for incremental cost reduction by economies of scale and development of skills. By promoting the wider exchange of knowledge and experiences, diverse consortia can accelerate innovation-driven growth and increase competitiveness in global networks. Partnerships between deployment and innovation projects focused on field testing innovative solutions can greatly accelerate development. At an international level, this articulation would allow for technological interchange, preventing the duplication of efforts and improving technology selection mechanisms.

4.0

Recommendations to accelerate cross-border collaboration

North Sea driving the European energy transition

With an increasingly complex energy landscape and vast potential for the deployment of low-carbon energy, the North Sea can play a fundamental role in the timely progression of the European energy transition, allowing for the development of skills and creation of new jobs.

Integration of offshore energy systems

As the energy sector transitions, opportunities for synergies between existing and new forms of energy production will provide significant value creation potential. As the field develops, strong leadership is required to secure a strong global position and a system-view approach will help make the most of the window of opportunity.

Need to step up collaboration across industries and borders

Partnerships are an essential element of a successful energy transition at the North Sea and beyond. Through active knowledge exchange on themes of strategic importance, international networks can accelerate the scaling up of new technologies. A focus on cross-sector and cross-border interconnectivity can contribute to the standardisation of regulatory aspects and reduce the cost of offshore systems integration.

Innovation & technology to accelerate the transition

The coordinated development of technology solutions can drive cost reduction by economies of scale and promoting the exchange experiences. Innovation will be an essential component in securing competitiveness within global networks.

4.1

The vision for ‘One North Sea’

One North Sea plans to expand its platform to encompass more countries around the North Sea and include more likeminded organisations to maximise the opportunities for a successful transition in the North Sea. The One North Sea platform will focus on stimulating international collaboration by bringing together the ideas and initiatives of research organizations, industry and governments.

One North Sea is looking for more partners to identify common barriers where cross-country collaboration would clearly be beneficial. The main focus of the collaboration will be to identify and develop cross-border initiatives and attract international funding to support these future projects.

TNO innovation for life

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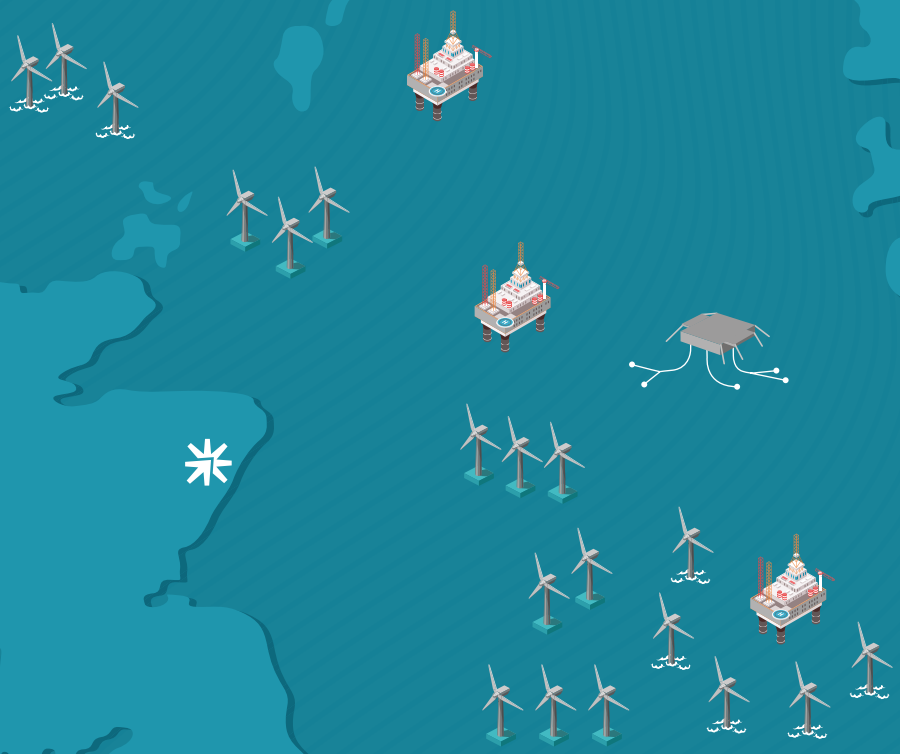

Cross-border collaboration in the North Sea energy transition