ESPON

North Sea STAR
Spreading Transnational Results

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This report presents the interim results of an Applied Research Project conducted within the framework of the ESPON 2013 Programme, partly financed by the European Regional Development Fund.

The partnership behind the ESPON Programme consists of the EU Commission and the Member States of the EU27, plus Iceland, Liechtenstein, Norway and Switzerland. Each partner is represented in the ESPON Monitoring Committee.

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This basic report exists only in an electronic version.

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EXECUTIVE SUMMARY

The North Sea STAR project is an ESPON targeted analysis project designed to help the North Sea Programme Secretariat reflect on the effectiveness of energy related projects in the current (2007-13) programme and prospects for including such activities in future programmes. More specifically the project aims to:

- Provide a deeper understanding of the most likely future energy scenarios for the North Sea Region;
- Evaluate the effectiveness of European, national and regional energy policies;
- Assess the role of transnational cooperation projects in this process, and ascertain the added value of a project clustering approach; and
- Provide recommendations on accelerating the take-up of renewable energy technologies and supporting relevant green economic activities in the North Sea Region.

This Interim Report seeks to provide a synthesis of the work completed to date. It provides further methodological details on two of the five work packages, describing in more detail how the scenarios and case studies are being operationalized as thinking has developed from the Inception Report. The Report also provides a synthesis of some of the initial findings in relation to other work packages including: a review of the European and national energy policy contexts for the countries within the North Sea region: an overview of data availability (or perhaps more pertinently none-availability) in terms of identifying the extent to which the North Sea Region is progressing towards the 20-20-20 goals; the development of energy scenarios for the North Sea Region, thinking particularly about the drivers and constraints that may help or hinder the transformational change required for the North Sea Region to become a low carbon economy; and the results of stakeholder sparring session to date We also provide some initial policy options for the North Sea Programme Secretariat to consider in the development of their new Operational Programme. These are provisional and informed by our initial findings and in particular the concerns and aspirations revealed through the stakeholder sparring workshops that were held at the North Sea Programme Annual Conference in Halmstad in June 2013.

A key conclusion so far is that the European policy context within which this project is set is complex and rapidly evolving. At the time of presenting this interim report the European Parliament is still debating the future of European funding programmes for the 2014-2020 period. However, many of the key principles around concentration, focus and the effectiveness of project delivery in promoting ‘smart, sustainable and inclusive growth’ have been agreed, meaning that many future European funding programmes are already

working towards these higher level principles while waiting for operational details to be finalised.

From an energy perspective the triple goals of 20-20-20 are still a European priority. Although some energy policy drivers such as energy security may not be as politically prominent today as they have been in the recent past – for example as the UK looks to exploit shale gas and further fossil fuel resources are uncovered in the Arctic, raising the prospect of reduced energy costs - issues of competiveness, the shift to a greener economy and climate change remain high on the EU agenda.

Our interim policy recommendations are based around two themes:

Energy within the next North Sea Operational Programme

1. **If the take up of renewable energy is to be accelerated then energy must be explicitly included as a cross-cutting theme in the next North Sea Operational Programme. Serious consideration will need to be given to how energy projects are facilitated in the next programme, possibly in terms of explicitly highlighting where energy projects fit within the thematic priorities of the operational programme.**

   Within the current programme there have been 17 energy related projects within the 71 projects funded. However, we have noted how the political imperatives and drivers of the energy transition are potentially slipping down the political agenda as jobs, growth and economic recovery predominate. In the new Operational Programme a balance will need to be struck between safe projects that might deliver clear and measurable outputs, such as demonstrating energy efficient practices and technologies in the construction sector (as in the Build with Care project) compared to more risky experimental ideas that might promote transformational change, this for example might relate to the move towards a more bio-based economy.

   It is noted that energy has not emerged as a thematic priority in its own right in the current discussions about the shape of the future North Sea operational programme. However each of the selected themes – Innovation, Environment and Transport do have significant energy considerations embedded within them and it is envisaged that energy will continue to be important within the EU policy context. Although for some North Sea countries the recent detection of new fossil fuel reserves may mean that concerns about energy security could decline as a motivation for energy project development, concerns about competiveness and climate change are likely to remain at the fore. However evidence from the United States is suggesting that renewable energy or energy efficiency businesses are increasingly struggling as more traditional energy costs are reducing, meaning that market conditions are not so conducive to energy related innovation. Its potential inclusion as a cross-cutting theme would therefore be an imperative to help ensure that

appropriate and continuing prominence is given to energy matters in the next programme.

2. **Under the Innovation thematic priority the following types of energy related projects could be promoted: local energy storage; building local flexibility into energy systems; encouraging integration across different sources of energy; technology transfer between research institutions and the market; and institutional innovation related to supply and demand.**

   While the North Sea Region offers significant scope for continuing technical innovation particularly in relation to wave and tidal power and in other aspects of energy production, developments here are highly capital intensive and matters to be addressed by national governments and the EU in tandem with the private sector. Instead it is suggested that it is more appropriate to focus the resources of the future North Sea programme on encouraging innovative decentralised energy projects related to increasing green energy supply and demand at the local level. In this context there is much potential for institutional innovation with new roles for public and community-led initiatives in the energy field.

3. **Under the Environment thematic priority the following types of energy related projects could be promoted: projects that facilitate a shift away from a fossil fuel based economy to a bio-based economy; climate change mitigation such as projects encouraging resource efficiency; and climate change adaptation including projects developing green infrastructure.**

   Key challenges under the Environment thematic priority relate to industrial transition towards resource efficiency and promoting green growth. Again energy issues lie at the heart of this agenda not least in terms of the fundamental shift that is likely to take place over the next century as we try to move from a fossil fuel based economy to a more sustainable and environmentally benign bio-based economy. Support for small scale bio-based energy projects like BIOCHAR and ENERCOAST developed under the current programme will continue to be important in this context. In addition climate change mitigation and adaption will remain core concerns and energy related projects connected to both spheres could be closely connected to the promotion of green growth in the North Sea region.

4. **Under the Transport thematic priority the following types of energy related projects could be promoted: projects that encourage energy efficiency and green energy use within different transport modes (shipping, rail, road, etc.); transport logistics projects that promote intra and intermodal integration and efficiency; and projects that encourage businesses and individuals to the shift to greener transport modes.**

   The North Sea Region is the premier maritime land/sea gateway of Europe and this could be a key unique feature of the region to focus

energy projects around. Transport and logistics projects related to green shipping such as OPS systems, multimodal use of the emerging LNG infrastructure available at ports, and innovative approaches to city logistics illustrate the potential of the programme to play an important part in stimulating improvements in the energy performance of one of the key areas of energy consumption in the North Sea Region. As the stepping stone to most other parts of Europe, this could be extended to include integrated approaches with neighbouring regions such as the Baltic aimed at achieving wider benefit.

Design, governance and administration of projects within the next North Sea Operational Programme

5. The concept of project clustering and cooperation should be maintained and enhanced as part of the next North Sea Operational Programme

As part of the North Sea STAR's "project sparring" three workshops were organised in Halmstad, Sweden as part of the North Sea Region Programme Secretariat's Joint Annual Conference (11th-13th June 2013). The outputs of the Halmstad workshop on clustering, together with the early interviews that have been undertaken as part of the Case Study work package indicate broad support for the idea of clustering projects and other forms of project cooperation. Project partners feel that clustering can add value by helping projects talk to each other, learn from others' experience, develop wider synergies and a more holistic perspective; and provide greater collective weight and influence for project results. As a consequence it is suggested that the approach should be retained as a feature in the new programme.

6. Consideration could be given to developing different models of clustering/cooperation in the new programme reflecting different roles that such arrangements might play.

The outputs of the Halmstad cluster workshop indicate that there is scope however to develop the idea of clustering further. For example different models of clustering/cooperation could be included involving clustering on a thematic and geographic basis and /or at a range of different scales - national, transnational, and cross transnational regions. Equally, a spectrum of formal and informal arrangements could be envisaged perhaps reflecting different purposes and offering all projects the opportunity of some level of wider engagement /cooperation. It is also felt that there could be benefits in combining top-down cluster formation with bottom up approaches where project partners can extend or build cluster themselves. In addition thought could be given to the organisation of clusters in terms of the timing of formation, nature of added value and legacy.

7. **In order to promote on-going impact and a sustained legacy of projects, it is suggested that closer attention to these matters in project design and evaluation could be included in the new programme.**

   The output of the Halmstad workshop on the on-going impact of projects suggested that in many instances this was an important issue and could be promoted through project design and selection processes. For example, project activities can help to embed project ideas within partner organisations and in the wider community (at a range of different scales) and encourage subsequent uptake in policy and practice by building thoughtful stakeholder engagement and dissemination strategies into the project design. Effective stakeholder engagement and ownership of project ideas beyond the life of a project could be built into assessment criteria for projects as a mechanism for encouraging greater attention to these issues in the next programme.

8. **In order to promote on-going impact and a sustained legacy of projects, consideration could be given to more consistent approaches to project dissemination of project results in the new programme.**

   Delegates at the Halmstad workshop on on-going impact noted that another way to support the legacy of completed projects would be to encourage a more systematic approach to dissemination of project results. At present project websites can disappear soon after projects close and collation of information on the North Sea Operational Programme website is variable. This means that wider and on-going learning from project results can be compromised. To improve this situation consideration could be given to requiring all projects to produce a synthesis report which can be made available on the programme web portal.

9. **In order to help accelerate the uptake of renewable energy technologies and supporting green economic activities better sub-national information is required across the North Sea region in order to monitor performance and provide an base for targeting projects.**

   The research has confirmed that at a European scale much of the available energy related data is only available at NUTS 0, the scale of the nation state. Within countries there is a growing availability of energy related data at different spatial scales, however because it is collected in slightly different ways in different national jurisdictions it is impossible to consolidate into a picture of what is happening across the region as a whole. Developing scenarios that are more quantitatively informed will require more consistent data inputs at different scales.

MAIN REPORT

1. Introduction and Outline of Methodology

At the time of writing this Interim Report the European Parliament is still debating how future European funding can be best used to facilitate European, national and regional recovery from the economic crisis that has impacted on many areas in the last few years. On-going ESPON research, in particular the "Economic Crisis - Resilience of Regions (ECR2)" project is indicating that countries and regions have been affected very differently by the crisis both spatially and temporally. Some have proved to be more resilient and recovered faster while other parts of Europe have been harder hit and are recovering more slowly. What is clear however is that mantra of 'smart, sustainable and inclusive growth' will still be the primary goal of economic development strategies for the next period of European funding from 2014-2020. The Commission, in its proposals, is expecting that available resources will need to be more focused and better targeted towards those specific characteristics of a particular national, transnational or regional economy that are likely to make the most significant difference towards the agenda outlined above. Hence Operational Programmes are being asked to frame their actions, drawn from a list of eleven thematic priorities identified in the Common Strategic Framework.

The North Sea STAR project, an ESPON targeted analysis based on user demands, is focusing on the experience of energy related projects in the current North Sea 2007-2013 Operational Programme with a view to providing advice and guidance as to how energy related activities could be included in the next funding programme.

The current and future North Sea Region Programme Area is characterised by the high density of population and activities in the southern North Sea, largely connected with the existence of large ports such as Rotterdam, Antwerp and Hamburg and its connectivity to Europe's "core" region. The more northerly parts of the North Sea, in particular the coasts of North East England and Scotland, Sweden and Norway are more sparsely populated and remote. Whilst the North Sea has suffered due to pollution caused by discharge of organic pollutants into the Sea from large estuaries such as the Rhine and Elbe, climate change remains the greatest challenge to the area as rising sea levels and the threat of increased coastal flooding and tidal surges affect the many low lying areas of the east coast of England and in the Netherlands. Connected to this is the North Sea's recent economic history as one of Europe's main energy producing regions. According to the ESPON ESaTDOR project, large-scale oil and gas production mostly in Norwegian, UK and Dutch waters has been significant over the past 40 years but output is declining and there is a shift to more, smaller fields. The region is also home to the greatest concentration of offshore wind farms in the world and further expansion is planned, particularly in UK and German waters. In Scotland, the

European Marine Energy Centre (EMEC) based in the Orkney Islands is a centre of excellence for testing wave and tidal energy devices. In addition, the North Sea Countries Offshore Grid Initiative, a major infrastructure project proposed by the EU and supported by Norway aims to develop an integrated offshore energy grid to connect wind, wave and tidal power with the North Sea region, making use of Norway's hydro-electric power stations to store energy until it is needed. Looking to the future, the North Sea is well placed to make the transition from being a centre of fossil fuel production to a renewable energy region.

This Interim Report was prepared in June 2013. At the same time considerable effort is being made to prepare the next North Sea Operational Programme which is anticipated to be completed in the autumn of 2013, prior to the completion of this particular research project. Given the targeted nature of this ESPON project, and the needs and deadlines of the stakeholder, this Interim Report will provide an overview of the work completed to date combined with some initial thoughts as to how energy related projects and associated project design, governance and administration issues might be included in the next Operational Programme.

Our findings are provisional but we hope they offer evidence based reflections that can be usefully incorporated into the development of the new North Sea Operational Programme at this stage. They have been shaped by the thoughts of the North Sea Region Programme Secretariat as reflected in public consultation workshops at the North Sea Region Programme's Joint Annual Conference in Halmstad, Sweden, June 10-12th 2013. At this meeting three strategic priorities were identified as having the greatest significance for the North Sea Region. This is not to say other priorities are not important, but that these are seen as having the most relevance to particular challenges of the transnational area.

The three selected strategic priorities for the North Sea Region were:

1. Strengthening research, technological development and innovation,
2. Protecting the environment and promoting resource efficiency, and
3. Promoting sustainable transport and removing bottlenecks in key network infrastructures.

These have been reframed into three thematic priorities and key challenges for each have been suggested (see Table 1). These are currently the subject to a stakeholder consultation exercise which closes on July 1st 2013. Following the 'Public Consultation Meeting' at Halmstad meeting it seems likely that some of the key challenges may be modified.

Table 1: Draft Initial Thematic Priorities and Key Challenges for the next North Sea Operational Programme

Thematic Priorities	Key Challenges*
Innovation	1. Improve private sector research levels and the take-up of research results by the business sector 2. To address fragmentation and duplication in the innovation system 3. Assist businesses to increase competitiveness and enter international markets 4. To use the strong potential of the public sector in e.g. energy, water, health, public transport and education to bring new solutions to market 5. To support innovation within the public and voluntary sectors
Environment	1. Supporting the shift towards a low carbon economy in all sectors through promoting research, innovation and adoption of low-carbon technologies 2. Promoting climate change adaptation, risk prevention and management through supporting investment for adaptation to climate change 3. Promoting investment to address specific risks, ensuring disaster resilience and developing disaster management systems 4. Protecting the environment and promoting resource efficiency through protecting and restoring biodiversity, soil protection and restoration and promoting ecosystem services including NATURA2000 and green infrastructures 5. Promoting innovative technologies to improve environmental protection and resource efficiency in the waste sector, water sector, soil protection or to reduce air pollution 6. Supporting industrial transition towards a resource efficient economy and promoting green growth
Transport	1. Enhancing regional mobility through connecting secondary and tertiary nodes to TEN-T infrastructure 2. Developing environment-friendly and low-carbon transport systems including river and sea transport, ports and multimodal links

*As outlined in the Europe 2020 Strategy

The purpose of this Report is to provide initial findings and reflections on how the work has developed to date and how the research will be taken forward in the future. However as a start it is worth restating the aims and objectives of the project.

This North Sea STAR project seeks to:

- Provide a deeper understanding of the most likely future energy scenarios for the North Sea Region;
- Evaluate the effectiveness of European, national and regional energy policies;
- Assess the role of transnational cooperation projects in this process, and ascertain the added value of a project clustering approach; and
- Provide recommendations on accelerating the take-up of renewable energy technologies and supporting relevant green economic activities in the North Sea Region.

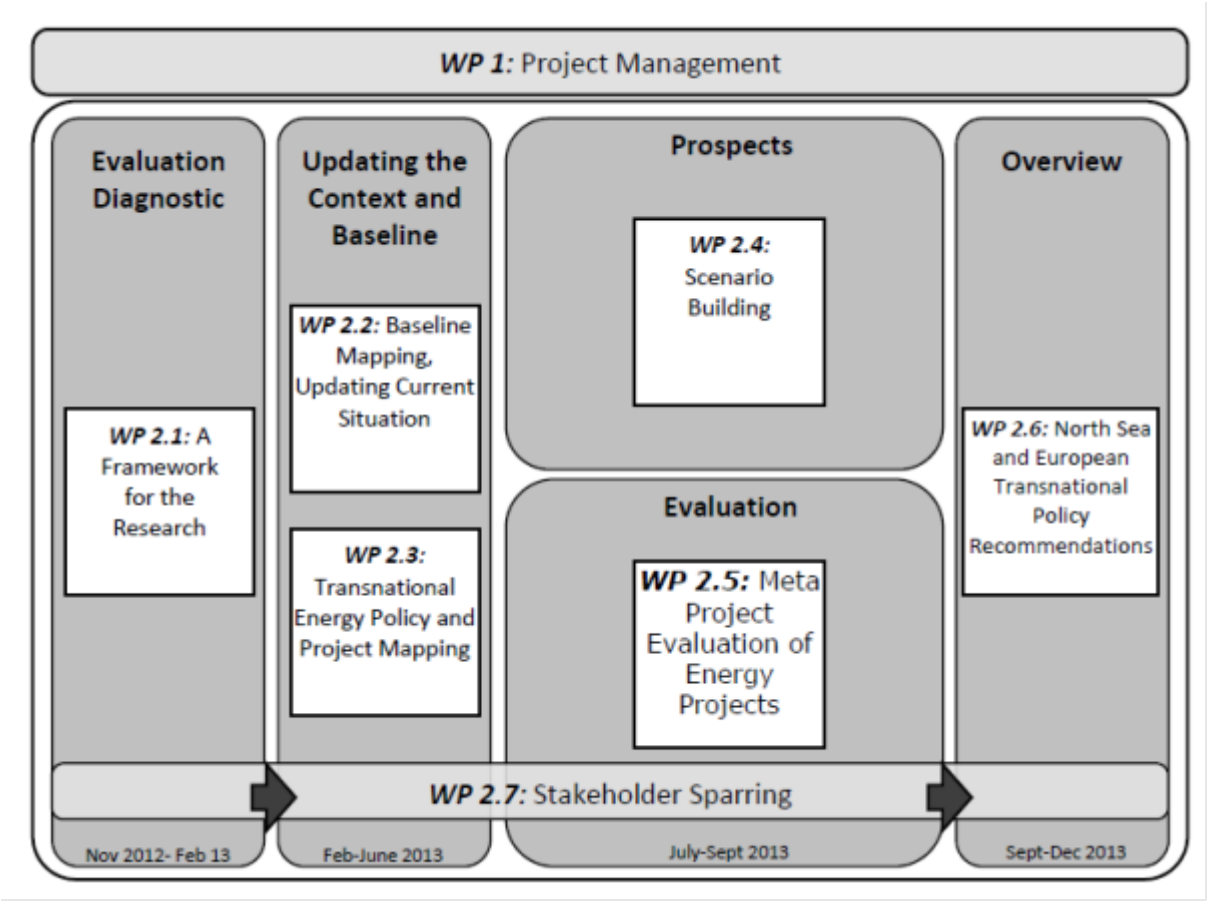
In order to achieve these objectives the research team perceives that the following tasks need to be undertaken:

- To update and map the current energy situation in the North Sea Region (if possible both on land and within the marine environment) in terms of both the demand and supply of energy as a mechanism for beginning to build future energy scenarios;
- To evaluate the current European, national and regional action plans being developed in trying to achieve the 20-20-20 energy goals by 2020;
- To evaluate the effectiveness of policy delivery from a transnational perspective in terms of both individual energy related projects and the project clustering approach.
- To provide policy recommendations related to how both the governance arrangements for transnational co-operation and the delivery of regional energy self-sufficiency can be improved in relation to the prospective post 2013 funding period.

However we recognize from the outset that the North Sea Region is not self-contained and behaves as a ‘prosumer’ in that it produces energy, it consumes/uses energy for regional development and it imports/exports its energy from/to other regions. To this extent the concept of regional self-sufficiency is likely to be contested.

Hence the approach follows five key perspectives. First we engage in a context setting and baseline mapping exercise to better understand the European, national and regional policy context in relation to the Europe 20-20-20 energy debate, and secondly to identify and map the existing regional energy situation. This baseline mapping perspective is then used to help develop future energy scenarios for the region, which is the prospect stage. A third dimension involves evaluating the efficiency and effectiveness of energy related projects under the current North Sea Star Operational Programme and in particular questioning whether the clustering approach to project management adds significant benefits. Running alongside these work packages the research team is keen to engage stakeholders through what is known as stakeholder sparring. These elements in turn lead to a synthesis of the findings and policy recommendations. Figure 1 provides a schematic perspective of this approach which is elaborated further in the following sections.

Figure 1: Overview of Research Approach



In this Interim Report we have provided more detail on the methodological approach associated with on-going work packages only. The report itself synthesises and reports on WP 2.2 Data Collection and Mapping, WP2.3 Transnational Energy Policy Review and Project Mapping and the WP 2.7, Stakeholder Sparring Events that have occurred to date. Therefore both in the main report and Annexes further details only are provided about the approach to the case studies, the development of scenarios and proposals for the third stakeholder sparring event to be held in September in Delft.

1.1 Mapping Activities

Following on from an initial search for energy data sources at international, European and national scales, (which is included in Annex 2 of the North Sea STAR Inception Report), an evaluation of data comprehensiveness and compatibility was undertaken in order to assess which data sets would be most relevant and suitable for mapping, providing an overview of emerging energy trends over time and between regions/nations within the North Sea Region. A more detailed overview and evaluation of the data sets is provided in Annex B, whilst the use of other ESPON results and tools to provide further contextual information and new data that might be relelvant to the North Sea

Region Secretariat is discussed in Annex D. Overall, the evaluation of data sources revealed that there are a number of constraints in attempting to map the current energy situation. These mainly relate to the geographical scale at which information is provided, being either too broad (i.e. data reported at national level only, and not disaggregated for those countries which only are only partially in the North Sea Region, such as the UK and Germany) or unequal units at lower levels (e.g. UK data for Scotland as a whole and separate English regions). In addition, different terminologies make it difficult to combine information from different countries into one data set, for example *final energy consumption* is not the same as *energy available for final consumption.*

For the purposes of this report, to provide some basic contextual data, a series of maps have been produced from Eurostat information. Based on the publication *EU Energy in Figures, Statistical Pocketbook* (2011, 2012 and 2013[1]) and formulas used to calculate the energy indicators provided by Eurostat, 4 indicators have been generated and represented in maps:

- Primary production for Europe and Primary production by fuel for North Sea Region
- Import dependency by fuel for North Sea Region
- Gross inland consumption by fuel for North Sea Region
- Final energy consumption by fuel for North Sea Region

The selection of indicators was performed by energy and policy experts based on the range of indicators provided by Eurostat.

In addition, mapping of North Sea Region (NSR) project partners involved in energy related projects has been undertaken, using lists of project partners from the North Sea Region Programme website and NUTS2 regions as a common basis for locating partners that may be regions, municipalities, academic or other public institutions and private sector bodies. This map is shown in Chapter 1.2 in relation to the selection of potential case studies.

The provision of energy data at sub-national level and for areas falling within the North Sea Region is an on-going issue for the North Sea STAR project. In this regard the project team will look to supplement the maps used in this report with information on a country-by country basis to be included in the Draft Final Report. Whilst considering energy data for each country in isolation is not ideal, this can still provide some useful indications of regional trends and strengths in particular energy dimensions, for example in increasing energy efficiency, or leading in the use of particular renewable fuels.

[1] EU Energy in figures, Statistical Pocketbook (2011, 2012 and 2013). http://ec.europa.eu/energy/publications/doc/2012_energy_figures.pdf

1.2 Scenario Building

Scenario building is one essential part of the research agenda of the North Sea STAR project. Based on two other studies (i) the baseline evaluation of the current situation and (ii) project outputs, this study on ´scenario building´ is a gap analysis with the objective of exploring the differences between the existing situation and the 2020 and reasonable 2050 aspirations. This will provide a framework for other studies of North Sea STAR on recommendations for sustainable energy strategies for the North Sea Region. A critical aspect of this work will focus on the spatial dimensions.

To support the scenario building exercise, the following research question and associated sub questions have been devised

How can the take-up of renewable energy technologies be managed considering different spatial development options?

a. What are the basic characteristics and drivers in shaping the energy landscape of the North Sea region?
b. What are reasonable assumptions on the status in 2020 and 2050?
c. Which barriers need attention in policy making?

Tasks

The following tasks are considered to approach the objectives:

- Identify driving forces
- Rank importance & uncertainty
- Select scenario logics
- Flesh-out the scenarios
- Select indicators for monitoring
- Assess impacts for different scenarios
- Evaluate alternative strategies

In order to arrive at comparable scenarios for further discussion and consideration we have to follow a common approach. We foresee the following steps:

1. Describe the characteristics of three reasonable development pathways and compile comprehensive narratives.
2. Propose an analytical framework for the evaluation of crucial aspects and drivers.
3. Communicate crucial aspects with key actors. Additionally, a number of interviews can be arranged with representatives.
4. Synthesise and assess the scenarios. Identification of key elements of future spatial energy development plans.

1.3 Case Studies

A critical part of the research is to evaluate the effectiveness of energy related projects in the North Sea Region in relation to meeting the broader (energy) policy goals of both the North Sea Region and the EU through a case study approach.

The objectives of the case studies are therefore:

- To provide a critical reflection on the impact of energy related projects in the North Sea Region;
- To explore the effectiveness of project partnerships and evaluate the sustainability of the projects, exploring success stories and barriers to delivery, and considering the contribution of the projects to wider policy objectives; and
- To assess the role of transnational cooperation projects in this process, and ascertain the added value of a project clustering approach.

This will contribute to the broader aim of the North Sea STAR project, to provide recommendations on accelerating the take-up of renewable energy technologies and supporting relevant green economic activities in the North Sea Region.

The NSR programme has grouped many energy projects in so called clusters. The expectation of this clustering approach is:

- To stimulate knowledge dissemination: the organisational dimension.
- To stimulate territorial integration: the territorial dimension.
- To stimulate technological innovation: technological dimension.

The above leads to the following main research question:

> *How can the take-up of policies aiming at the production of renewable energy be accelerated through effectively clustering projects, next to stand alone projects?*

Sub-questions are:

- What have been the basic characteristics of projects?
- What has been the territorial, technological and organisational impact of projects?
- Which dimensions were strengthened by organisational innovation and cooperation, i.e. learning and on which level?
- Which benefits were strengthened through the clustering approach in particular?

<u>Selection of Case Studies</u>

In the North Sea STAR Inception Report, 17 energy projects from the North Sea Region Programme were identified as having an energy dimension, alongside two energy clusters, LOWCAP and Energy Vision North Sea Region (EVNSR). The distribution of these projects and individual project partners (by NUTS2 region) are shown in Map 1. From this list, eight projects and the two energy clusters were selected as case studies. Projects fall within

two categories, that is, projects under a cluster approach (part of LOWCAP or EVNSR) and standalone projects.

In order to critically select standalone projects the following criteria have been used (in order of priority):

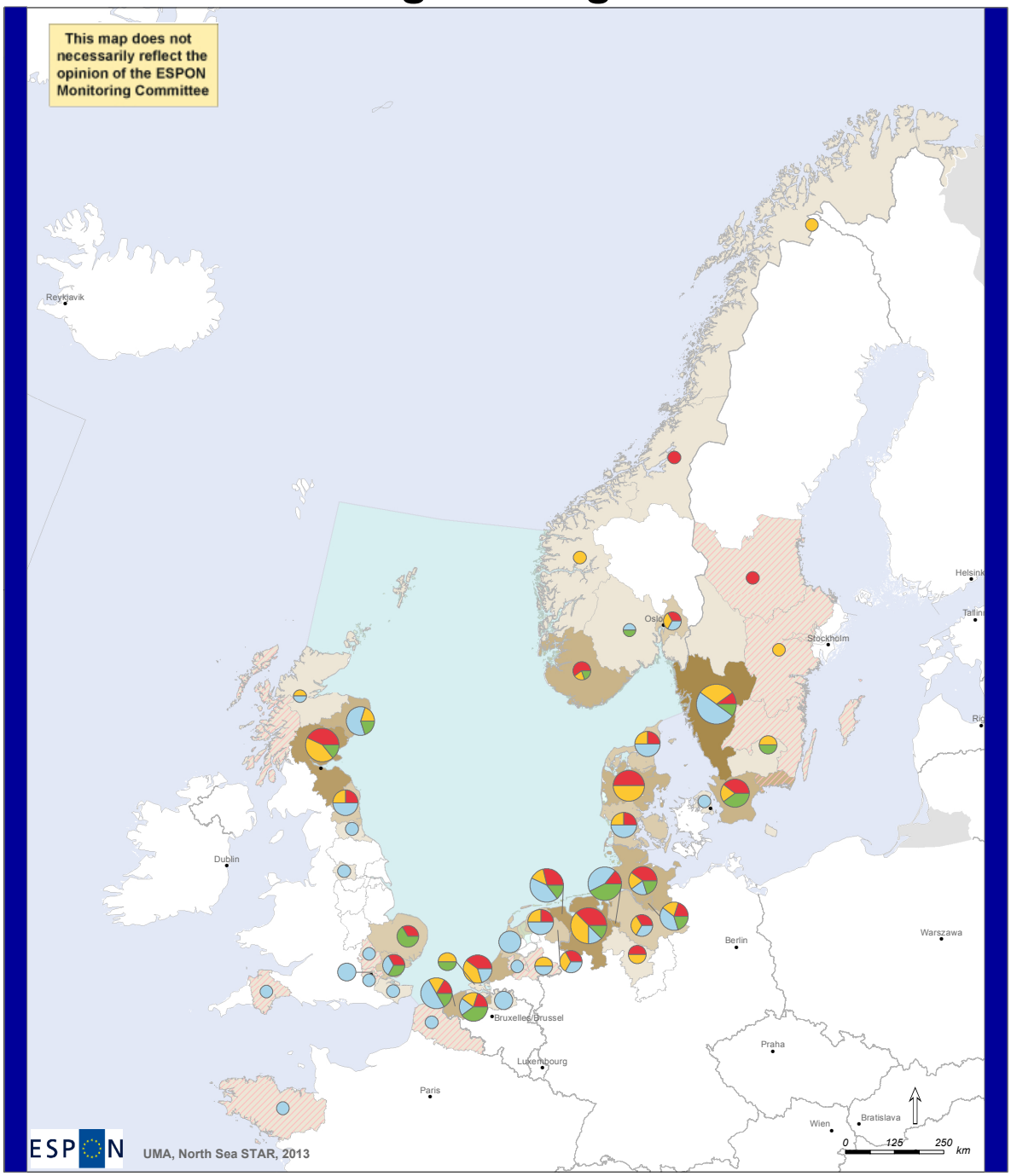
- Thematic scope: similar as clustered projects - carbon reduction and energy efficiency projects or renewable energy projects.
- End date: before 1 January 2014 in order to detect identifiable results.
- Geographic scope: similar as clustered projects (comparing primarily lead beneficiaries, but also other beneficiaries).
- Objectives: similar as clustered projects (various: Territorial integration and/or Knowledge dissemination).

The two clusters and eight projects that have been selected are listed in Table 2 below.

Table 2: List of selected North Sea Region Case Study Projects

	Project		**Thematic Scope**
Clusters	1a	Low Carbon Regions in the North Sea (LOWCAP Cluster)	Carbon reduction and energy efficiency projects
	1b	Energy Vision North Sea Region (ENVSR Cluster)	Renewable energy projects
Clustered Projects	2a	Built With Care (BWC (ENVSR + LOWCAP))	Energy-efficient building design
	2b	Carbon Responsible Transport Strategies for the North Sea Region (CARE-North (LOWCAP))	Carbon reduction, transport, economic competitiveness
	2c	North Sea Sustainable Energy Planning (SEP (ENVSR + LOWCAP))	Energy consumption
	2d	Innovative Foresight Planning for Business Development (IFP (ENVSR))	Competitiveness of regions.
	2e	North Sea Supply Connect (Supply Connect (ENVSR))	Competitiveness, structural change
Standalone	3a	Climate changing soils (Biochar)	Biomass-to-energy processing systems
	3b	BlueGreen Coastal Energy Community (enercoast)	Regional production of biomass
	3c	E-Logistics in NSR Harbour Cities (E-harbours)	Sustainable energy logistics

Distribution of Energy Projects in the North Sea Region Programme



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Thematic data: North Sea Region Programme energy projects by NUTS2 regions
Land boundaries: © EuroGeographics Association and ESRI. Regional level: NUTS2.
Sea boundaries: OSPAR Convention, EU Integrated Maritime Policy and EEZ.

Number of North Sea Region Programme energy projects

- 0
- 1 to 2
- 3 to 4
- 5 to 6
- 7 to 8
- 9 to 10

Project Theme

- Innovation
- Environment
- Accessibility
- Sustainable Communities
- Regions Outside the North Sea

Map 1: Distribution of Energy Projects (Main Beneficiaries) in the North Sea Region

The full case study methodology is provided in Annex C. By means of documentary analysis, interviews with key stakeholders and evaluation of the individual projects and clusters, it should be possible to:

- distinguish types of expected and realized impact associated with co-operation (spatial integration, technological innovation and organisational/policy innovation),
- analyse if and how knowledge dissemination in the form of learning at different levels has contributed to organisational/policy change, and
- assess the effectiveness of a cluster approach, i.e. its ability to facilitate learning processes, in particular.

The results of the case study analyses will form the basis of a synthesis report and provide evidence for the effectiveness of clustering (and/or other arrangements) for accelerating the take-up of renewable energy policies. A brief outline of each of the case studies is provided below.

1a. Low Carbon Regions in the North Sea (LOWCAP) Cluster

The LOWCAP Cluster is led by Aberdeen City Council and comprises four carbon reduction and energy efficiency projects. The cluster aims to develop and enhance the results from each project through finding synergies and "high impact" projects with the potential to be transferred. The main aspects of carbon reduction and efficiency that are addressed include buildings, transport, carbon capture and storage (CCS), behaviour and consumption, land use and finance. The final output of the cluster will be to deliver policy advice to local, national, regional and European levels.

1b. Energy Vision North Sea Region (EVNSR) Cluster

The EVNSR cluster, led by Energy Valley Foundation (Netherlands) aims to bring together the results of ten energy related Interreg projects to formulate a vision for the transition from fossil-fuel dominated energy systems to a more sustainable energy supply system, based on multiple sources of low carbon and renewable energy. A key challenge for the NSR will be to integrate these new sources of energy, some of which operate intermittently (e.g. solar, wind) with other sources such as biomass, and this requires collaboration between NSR Member States, regions and businesses to ensure the right energy infrastructure is in place. The EVNSR will contribute to this through the evaluation of lessons learned from existing projects, developing regional energy plans and supporting strategic networks of business, research and the public sector.

2a. Build With CaRe

The Build with CaRe (Carbon Reduction) ran from 2008 to 2011 and was focused on achieving energy efficiency in new buildings through innovative planning, design and building techniques. 18 partners from across the NSR, led by Region Västra Götaland (Sweden) have collaborated on marketing and publicity for low energy buildings, education and training for the construction sector, engaging with planners and policy makers, data gathering and the

development of low energy buildings to support the mainstreaming of low energy building techniques and technologies. Build with Care is also part of the LOWCAP Cluster.

2b. Care-North (Carbon Responsible Transport Strategies for the North Sea Area)

The Care-North project aims to develop a comprehensive, strategic and practical approach to urban and regional transport/accessibility in the NSR in the context of climate change and declining oil supplies. Through the development of CO_2 reduction strategies, the implementation of pilot projects (e.g. electric vehicles, route planning and public campaigns to support modal shifts) and connecting project partners, governments, businesses and transport users, Care-North will identify the most appropriate strategies to develop low-carbon transport solutions in the NSR.

2c. North Sea Sustainable Energy Planning (SEP)

North Sea Sustainable Energy Planning aims to foster future oriented development in cities and regions by providing new methods and tools for regional energy planning. This has required the involvement of all relevant stakeholders and decision makers in finding ways to link energy policy (in particular renewable energy and energy efficiency) with local development. Project activities have focused on developing methods for decision making and innovation transfer, implementing new structures for planning and decision making processes, capacity building (education) for furthering developments and sustainability and finding new models for collaboration between the private, public and research sectors.

2d. Innovative Foresight Planning for Business Development (IFP)

IFP aims to support business development through actively using the knowledge and competence of universities, research institutes and the public sector, together with different businesses and companies to plan for the future in an interactive manner, thereby creating a basis for innovative solutions. Using foresight planning techniques for specific industrial sectors and on a transnational basis and building on interactions between the public and private sectors, it is envisaged that recommendations for strategic planning will be developed with relevance for both business clusters and regional development agencies.

2e. North Sea Supply Connect

Small markets and barriers to SMEs accessing supply markets (therefore putting them at a competitive disadvantage) are the main challenges addressed by the North Sea Supply Connect project, which aims to create SME Supply Clusters for all the countries surrounding the North Sea as an innovative instrument for effective regional economic development and SME promotion. North Sea Supply Connect has set up a number of virtual clusters in maritime, food and energy industries, helping SMEs to better understand procurement processes, increasing business opportunities and competitiveness. The project has also established links with the Baltic Sea Region to extend access to regional markets.

3a. Biochar: Climate Changing Soils

The Biochar project aims to raise awareness of biochar (charcoal), a by-product of biomass incineration, which can be used either as a soil supplement for raising quality and stability, or as a method of carbon capture and storage. The project has two major goals, the first being to establish a transnational strategy for biochar production and application. The second is communicating with and educating people about biochar, including authorities, producers and end-users. The Biochar project builds on the latest research and implementation of biochar applications and will present its findings to each of the seven countries in the North Sea Region, creating national platforms for developing competence in biochar applications and increasing its use in the future.

3b. BlueGreen Coastal Energy Community (Enercoast)

The EnerCoast project focuses on sustainable supply chain management as a way to develop the potential of regional bioenergy markets, which face challenges due to the decentralised nature of bioenergy production and fragmented supply chains. Project activities focus on the market implementation of the Sustainable Supply Chain Management tool to defined, diversified bioenergy material streams within NSR regional energy clusters. These will include existing material streams in need of additional SCM promotion or emerging technologies, for which supply chains need to be identified in order to reduce time to market. Both classical bioenergy materials and marine bioenergy sources will be included. At the transnational level, cooperation on the application of supply chain management methodology to bioenergy initiatives is the main focus, while at regional level, activities will concentrate on delivery of functional bioenergy supply chains.

3c. E-Logistics in NSR Harbour Cities (E-harbours)

The aim of E-Harbours is to transform the energy networks of NSR harbour cities to a more sustainable and accessible energy model. This will be achieved through innovative, intelligent energy networks and three main strands of activity: increasing the supply and use of renewable energy in harbour cities - utilising the potentials offered by existing industrial areas, increasing the use of smart energy grids to support flexible demand management and energy storage, and increasing the use of electric transport. By combining the use of smart grids and electric mobility, a more efficient and environmentally friendly logistics solution can be produced.

Outputs

In total there will be 10 case study reports, including two cluster overview reports. A separate case study synthesis will be produced as part of the North Sea STAR Final Report.

2. Synthesis: European and North Sea Region Energy Policies

This synthesis report gives an overview of the energy policies – context, drivers and trends – in the countries bordering the North Sea. It first outlines the main issues in the policy debate based on essential documents and regulations in the EU. Secondly it presents the current situation in energy production and consumption focusing on context and drivers. Thirdly, it looks into future energy policies in the North Sea region. The section ends with some concluding remarks.

2.1 European Energy Policy – Policy Debates

Energy has been at the centre of EU policy since the European Coal and Steel Community (1951) and the Treaty of Rome (1957), which established the European Atomic Energy Community (Euratom) alongside the European Economic Community (EEC). A major step was taken by the Treaty on European Union (the Maastricht Treaty) in 1992 by giving the Community the task of creating 'trans-European networks' in energy, telecommunications and transport. In 1994 eight priority energy projects of European significance were identified. More recently, the Treaty of Lisbon (2007) has enhanced the EU's objectives for energy policy.

EU law and policy on the energy sectors of oil, gas and nuclear, electricity transmission, energy efficiency, renewable energy and other matters is set out in more than 170 directives, regulations and decisions together with many communications and other statements. The current policy framework is set out in two main documents: 'Energy 2020 A Strategy for Competitive, Sustainable and Secure Energy' (CEC 2010) and the 'Energy Roadmap 2050' (CEC 2011).

The immediate goal is '20-20-20'. By 2020 in the EU, there should be at least a 20 % reduction in greenhouse gas emissions compared to 1990; a saving of 20 % of energy consumption compared to projections for 2020; and 20 % share of renewable energy in consumption. These policies are made in light of the need to provide for Europe more security of energy supply and recognising the contribution that energy production makes to climate change.

Energy 2020 sets out the 'urgent need for far-reaching changes in energy production, use and supply' (CEC 2010, p5). Some member states will have to renew up to a third of energy generation capacity by 2020 because of redundancy of existing installations. This will require an investment of one trillion Euro to replace and diversify existing sources. Europe is in a particularly vulnerable position in the face of 'peak oil' given that it is the world's largest energy importer.

Evaluations show that implementation of these aspirations is weak, with energy systems adapting slowly, notably in the switch to low-carbon renewable energy sources and more energy efficient transport. In addition energy legislation is slow to be enacted locally, forcing the Commission to take action against many member states for failures to implement EU law.

Among the reasons for the slow progress, the Commission highlights the fragmented European market which is hindered by 'different national rules and practices', barriers to competition, and national subsidies that are environmentally harmful.

The new EU Energy 2020 strategy focuses on five priorities:

1. Achieving an energy efficient Europe by reducing waste and achieving a 20% saving by 2020, with emphasis on the building stock and transport sector, making industry more energy efficient and gaining more efficiency in supply and consumption;

2. Building a truly pan-European integrated energy market: dismantling existing national monopolies, supporting the 20% target for renewable energy supply by 2020, and facilitating pan-European infrastructure to support the free flow of energy across Europe, and to support streamlined 'permit procedures' for projects of 'European interest';

3. Empowering consumers so that they can access energy at the most affordable prices, and achieving high levels of safety and security;

4. 'Extending Europe's leadership' in energy technology and innovation; with technology roadmaps in wind, solar, bio energy, smart grids and nuclear fission; and four major pan-European projects on linking European electricity grids, electricity storage, sustainable biofuel production and energy saving technology in 'smart cities'; and

5. Strengthening the external dimension of the EU energy market by reaching agreements with neighbours who adopt the EU market model.

In the Roadmap 2050 it is acknowledged that uncertainty about policy and conditions beyond 2020 is not conducive to making investments now, but at the same time there is an urgency to make changes that will take many years to deliver improved performance in the energy sector. The Roadmap proposes that a 'decarbonised European energy system by 2050' is possible and required, though requiring 'structural changes' in terms of much higher capital expenditure to replace and change sources; increasing the role of electricity including in transport; higher consumer costs; an important contribution from renewables and low carbon sources, particularly nuclear; and a strong linkage between energy and 'climate action', though not at the risk of economic competitiveness.

The trade-offs between goals of energy security, climate action and economic competitiveness illustrate the many tensions and dilemmas in implementing EU energy policy. There is little attention paid to the 'territorial dimension' in the policy. Yet the impacts of the policies will vary considerably across Europe, depending on the specific conditions and potentials of regions. Furthermore, implementation is largely a matter for member states and regions acting cooperatively in transnational groupings, where cross-border cooperation can assist in achieving objectives. This has been recognized by the Commission which established in 2006 'regional initiatives' 'to provide a

forum for regulators, network operators and other stakeholders of neighbouring countries' (CEC 2010, p. 2).

This then sets the broad direction in policy terms, and individual nation states will be pursuing their own programmes of activities depending on their country specificities. Through a number of more directed policy initiatives, usually in the form of directives, the EU is seeking to provide further guidance on how the direction of travel outlined above can be effectively operationalized. Much depends on effective and consistent reporting of data, often at the level of the nation state, and the three key objectives have been subject to various forms of European policy initiative.

The examples given below are illustrative rather than exhaustive. First, longstanding concerns regarding the polluting impacts of large scale fossil fuel combustion plants has led to restrictions and limits on the pollution such activities can generate. The Large Scale Combustion Directive of 2001 seeks to control the emissions of sulphur dioxide, nitrogen oxides and dust of these plants, which alongside other initiatives such as emissions trading, have helped to move Europe towards the target of reducing the greenhouse gas emissions by 20% from this form of energy production. The 2009 Renewable Energy Directive requires nation states to produce a certain proportion of their total energy consumption (including transport) from renewables by 2020. These targets, set against a 2005 baseline, vary depending particular circumstances and range from 10% of energy consumption from renewables in Malta to a 49% target for Sweden. Key to delivering these targets is the requirement to produce national action plans and to report on performance on a national basis following a common template.

The Commission, in reviewing progress towards the 20-20-20 targets remains confident that reductions in gas emissions and the renewable targets are likely to be achieved, but have serious reservations regarding the objective of improving energy efficiency, which in turn should reduce demand for energy. To provide momentum and encouragement to this part of the agenda, the Energy Efficiency Directive was adopted in October 2012. The Directive seeks to liberalize energy markets; requires energy producers and suppliers to become more efficient in delivering resources and national governments to report on progress. It also emphasises improving the energy efficiency of residential and commercial buildings, with a special focus on public buildings being used as an exemplar of what could be achieved. With such direction it seems likely that future European funding programmes might particularly support this form of activity, although it is worth noting that a recent European Court of Auditors report has questioned the cost effectiveness of investing in public buildings when the payback period could be anything from 50-150 years. The report was based on evidence gained from Cohesion Countries and the expectation was that greater scrutiny of such projects should be made before they are approved.

Hence within Europe, energy production and consumption is seen as being a critical component of the potential for global competitiveness, economic development and social cohesion and well-being. Much of the European wide statistics are provided at a national scale only and looking at the countries that

border the North Sea as a whole some interesting trends become visible, and these are briefly outlined here as providing a broad context of the current situation.

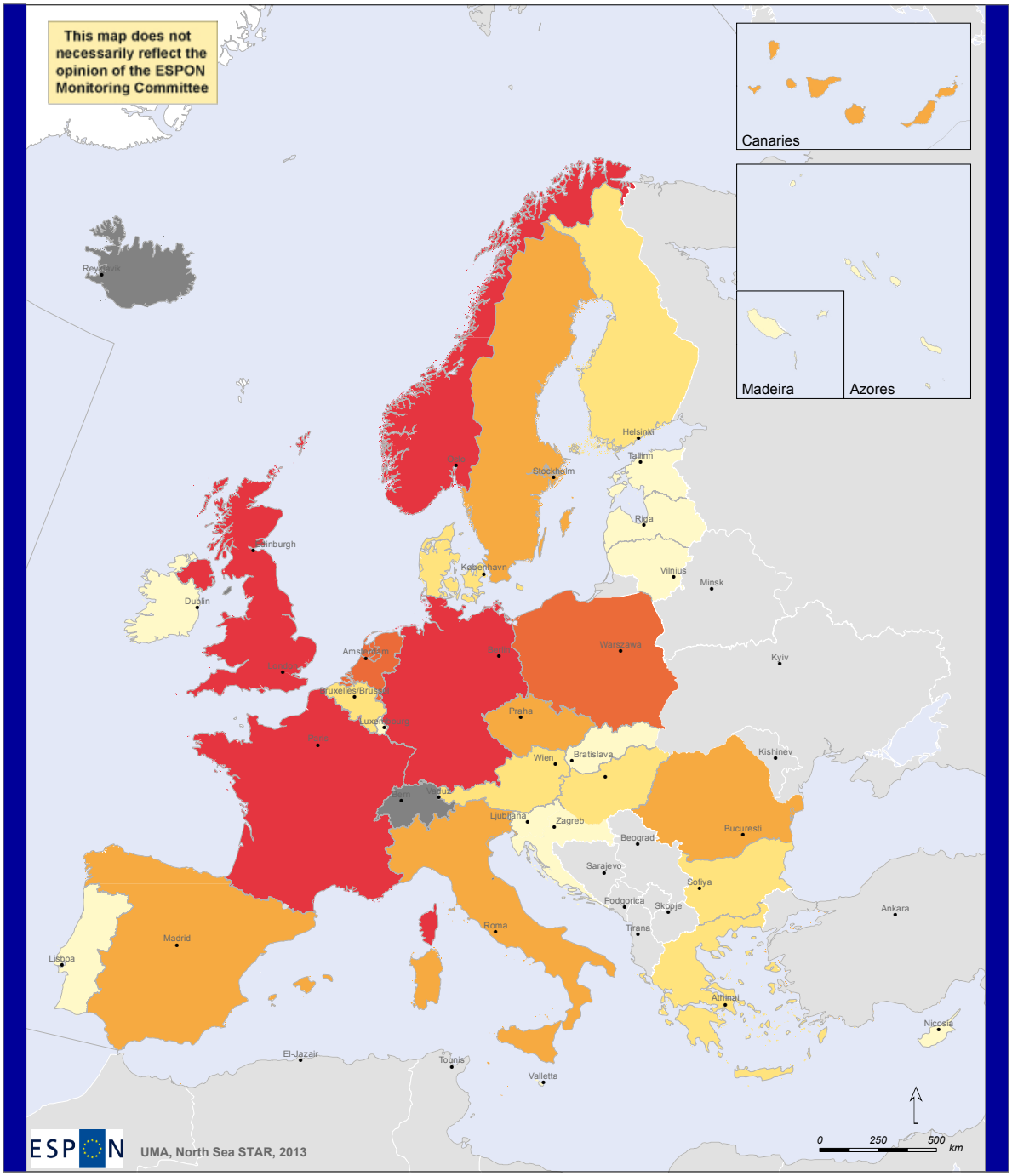
Although the countries of the North Sea Region are major contributors to energy production within Europe, with Norway and the UK particularly high primary energy producers (as is shown in Map 2 and 3), their overall dependency on the import of energy is growing over time, from 46.7% in 2000 to 52.7% in 2010. Against this back drop it could be argued that the countries that border the North Sea are performing reasonably well. Norway (-517.4%) and Denmark (-18.2%) are net exporters of energy, based around their exploitation of oil and gas reserves in the North Sea (see Table 3 and Map 4). The availability of such reserves also means that other North Sea countries, (with the exception of Belgium) are less dependent on energy imports than the rest of Europe. However it is evident from the available statistics that this level of self-sufficiency is declining and that dependency on imported energy is increasing for countries in the region.

Table 3: Energy Dependency Ratios by Countries Adjacent to the North Sea (all products)

	2000	2006	2007	2008	2009	2010
EU27	46.7	53.7	53	54.6	53.7	52.7
Belgium	78.1	79.7	77.1	79.9	74.3	76.8
Denmark	-35.3	-35.9	-24.7	-22.9	-20.6	-18.2
Germany	59.5	60.7	58.1	60.5	61.5	59.8
Netherlands	38.7	37.4	38.9	34.4	36.5	30.7
Sweden	39.2	37.8	36.3	37.9	37.1	36.5
UK	-17	21.2	20.4	26.2	26.2	28.3
Norway	-731	-664.8	-654.4	-612.3	-639.1	-517.4

(Source: DG Energy, 2012)

Primary Energy Production, 2011
(Tonnes of Oil Equivalent)



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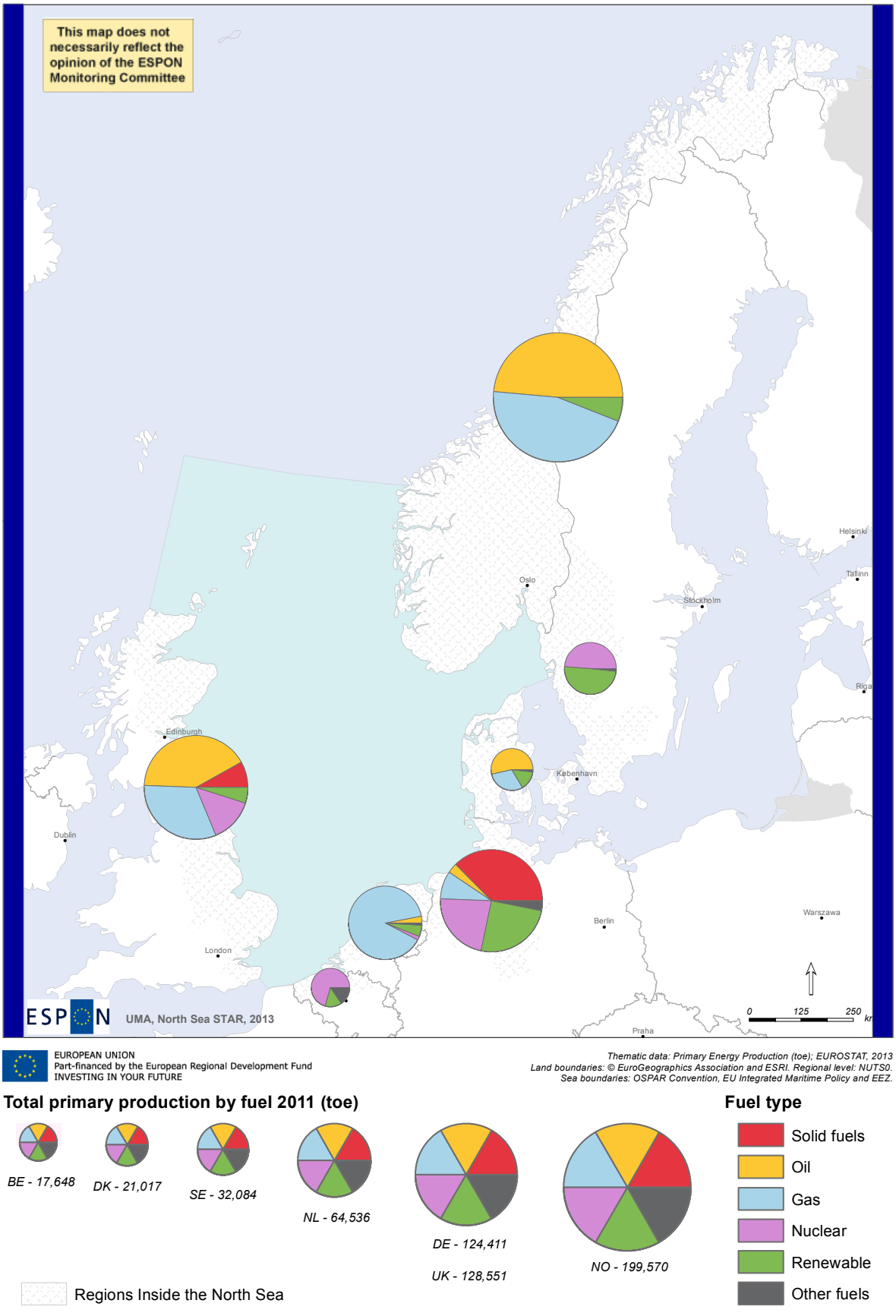
Thematic data: Primary Energy Production (toe); EUROSTAT, 2013
Land boundaries: © EuroGeographics Association and ESRI. Regional level: NUTS0.
Sea boundaries: OSPAR Convention, EU Integrated Maritime Policy and EEZ.

Total Primary Production 2011 (toe)

- 1 to 6,171
- 6,171 to 21,017
- 21,017 to 32,134
- 32,134 to 68,083
- 68,083 to 199,570
- No Data

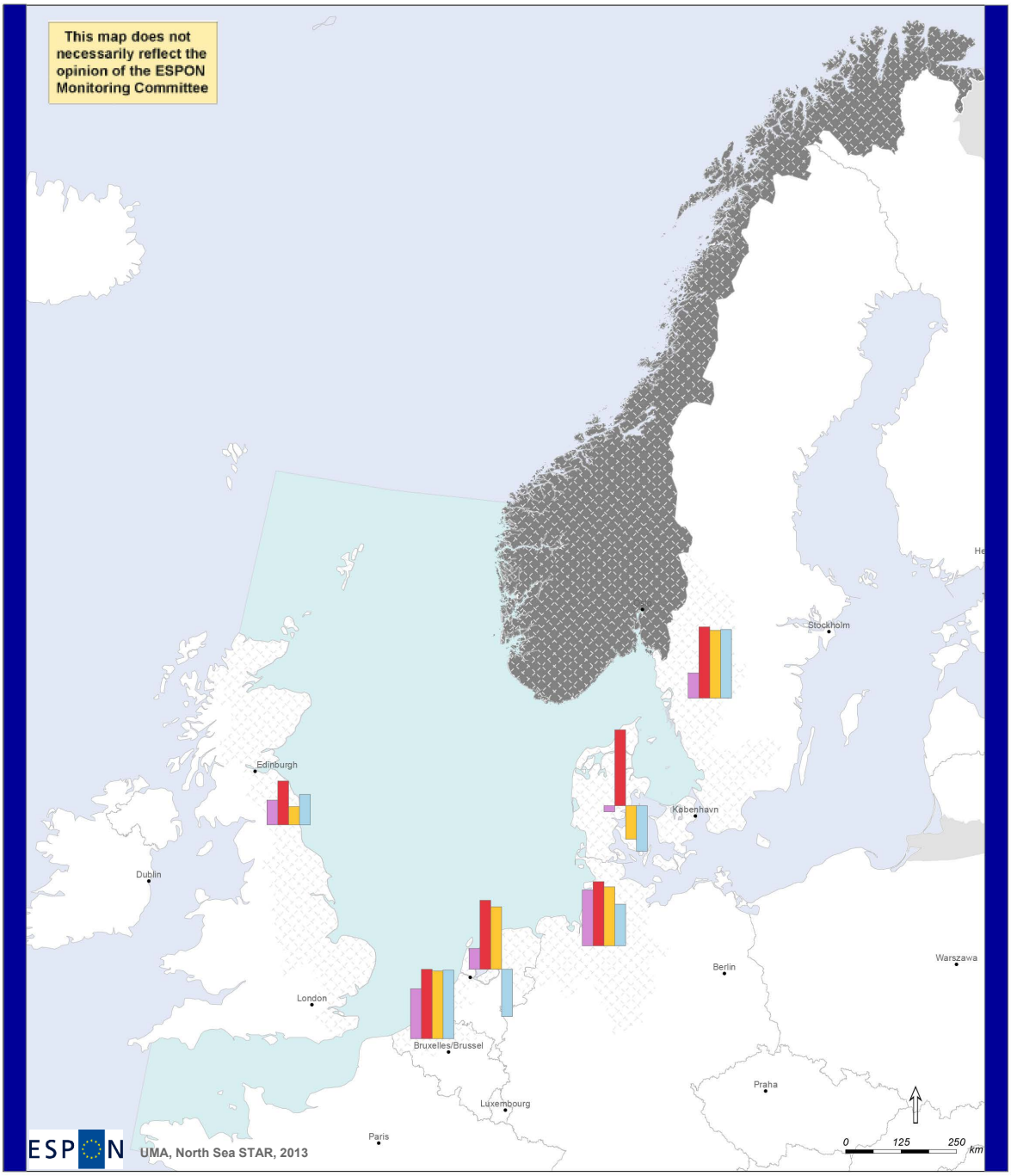
Map 2: Primary Energy Production in European Countries, 2011

Primary Energy Production in the North Sea Region, 2011 (TOE)



Map 3: Primary Energy Production by Fuel in the North Sea Region

Energy Import Dependency by Fossil Fuels in the North Sea Region, 2011



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Thematic data: Imports Dependency by fossil fuels; EUROSTAT, 2013
Land boundaries: © EuroGeographics Association and ESRI. Regional level: NUTS0.
Sea boundaries: OSPAR Convention, EU Integrated Maritime Policy and EEZ.

Imports Dependency by fossil fuels 2011 (%)

Country (Nuts 0 code)	BE	DE	DK	NL	NO	SE	UK
All fossil fuels	72.9	81.8	-8.5	30.4	-	36.8	36.0
Hard coal	101.3	94.2	111.0	101.0	-	103.7	64.2
Petroleum Products	98.7	86.1	-48.7	91.5	-	98.6	26.8
Natural Gas	100.1	61.1	-66.3	-68.6	-	100.0	44.2

Negative rate indicates a Net Exporter

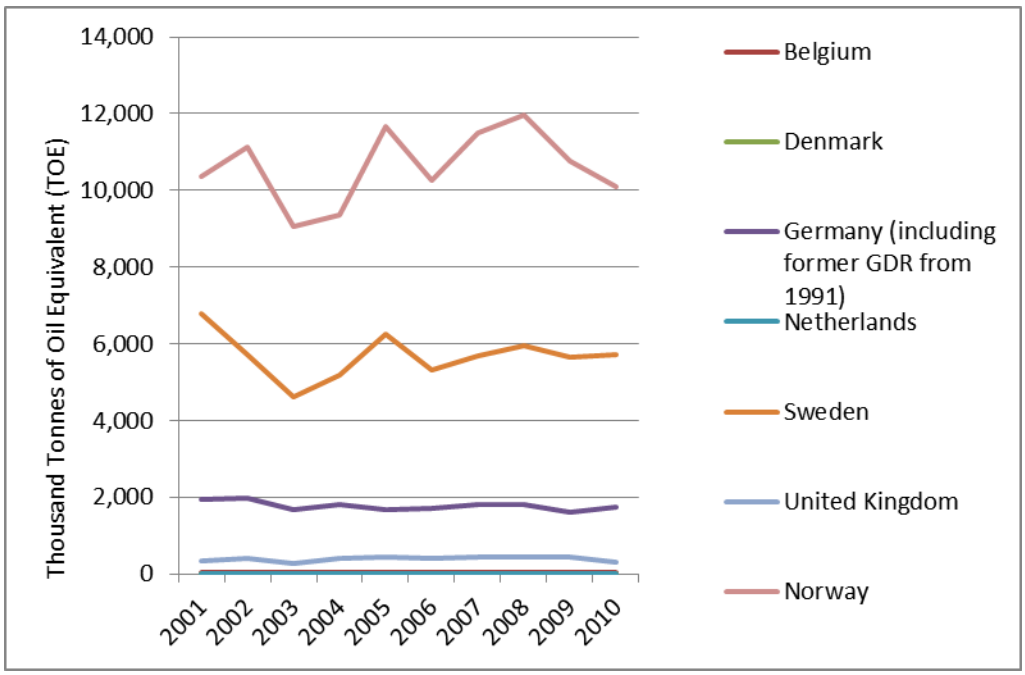
Values over 100% indicate stocks build up during the period

Regions Inside the North Sea No data

Map 4: Imports Dependency by Fossil Fuels in the North Sea Region, 2011

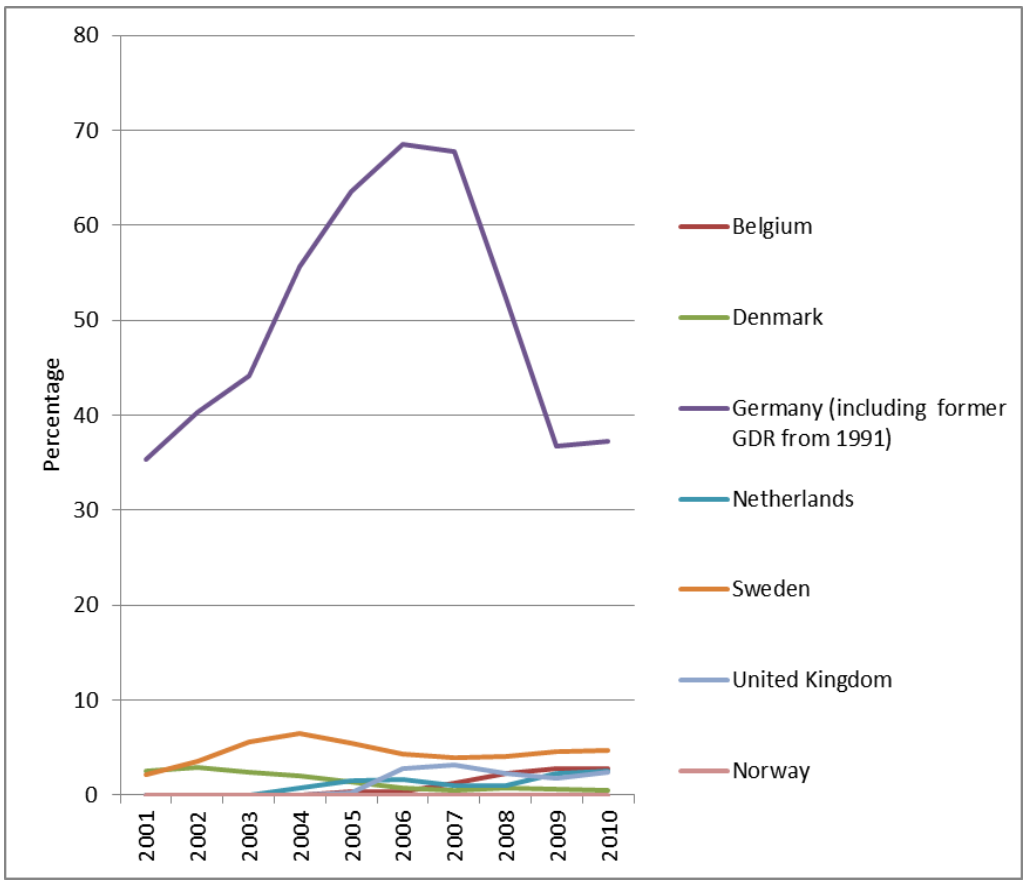
Furthermore a regions propensity to meet its energy needs from renewable resources in part depends on its natural resource asset base. Renewable energy is divided into two broad categories, renewables utilizing natural assets (wind, water and photovoltaic) and renewables that have been produced or manufactured, such as bioenergy and biofuels. Figures 2 and 3 provide an overview of renewable energy production for the countries bordering the North Sea. The availability of natural resource assets, particularly in Norway and Sweden means that a significant proportion of their primary electricity needs are generated from hydro resources. Elsewhere there is greater reliance on wind and photovoltaic sources which, albeit from a very small base, are becoming more significant as an energy source. They generally remain limited in overall energy dependency terms, although their significance in terms of electricity generation is growing. Biofuels are a very small contributor to total energy production across Europe, although it is interesting to note how Germany is a big producer of biofuels and this could be quite an important fuel for transportation.

Figure 2: Production of Energy from Renewable Sources by Countries Adjacent to the North Sea, 2001-2010 (TOE, tonnes of oil equivalent)



Source: Eurostat (2013) Supply, transformation, consumption - renewables (hydro, wind, photovoltaic) - annual data [nrg_1072a]

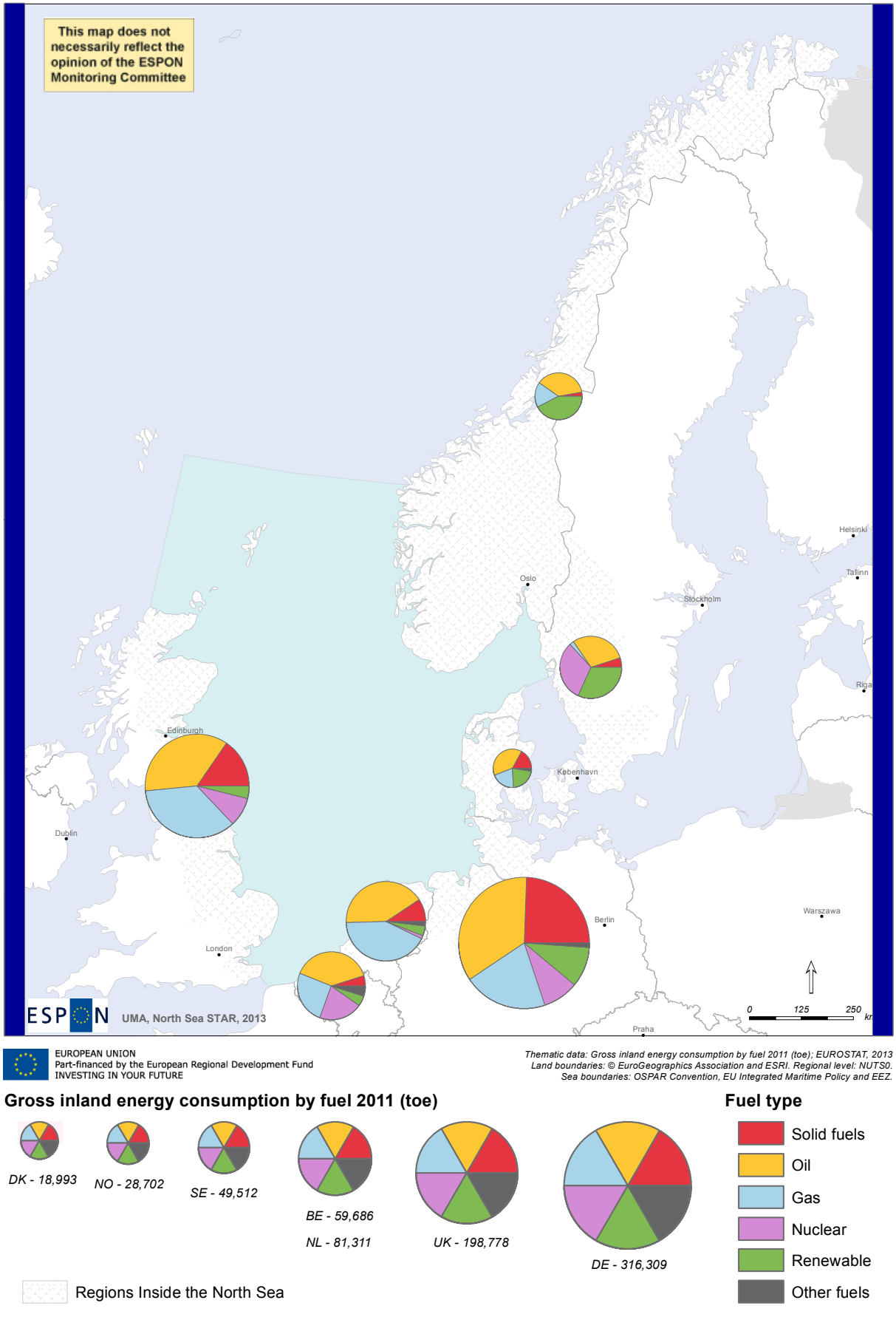
Figure 3: Production of Biofuels as a Percentage of Total EU Biofuel Production by Countries Adjacent to the North Sea, 2001-2010



Source: Eurostat (2013)

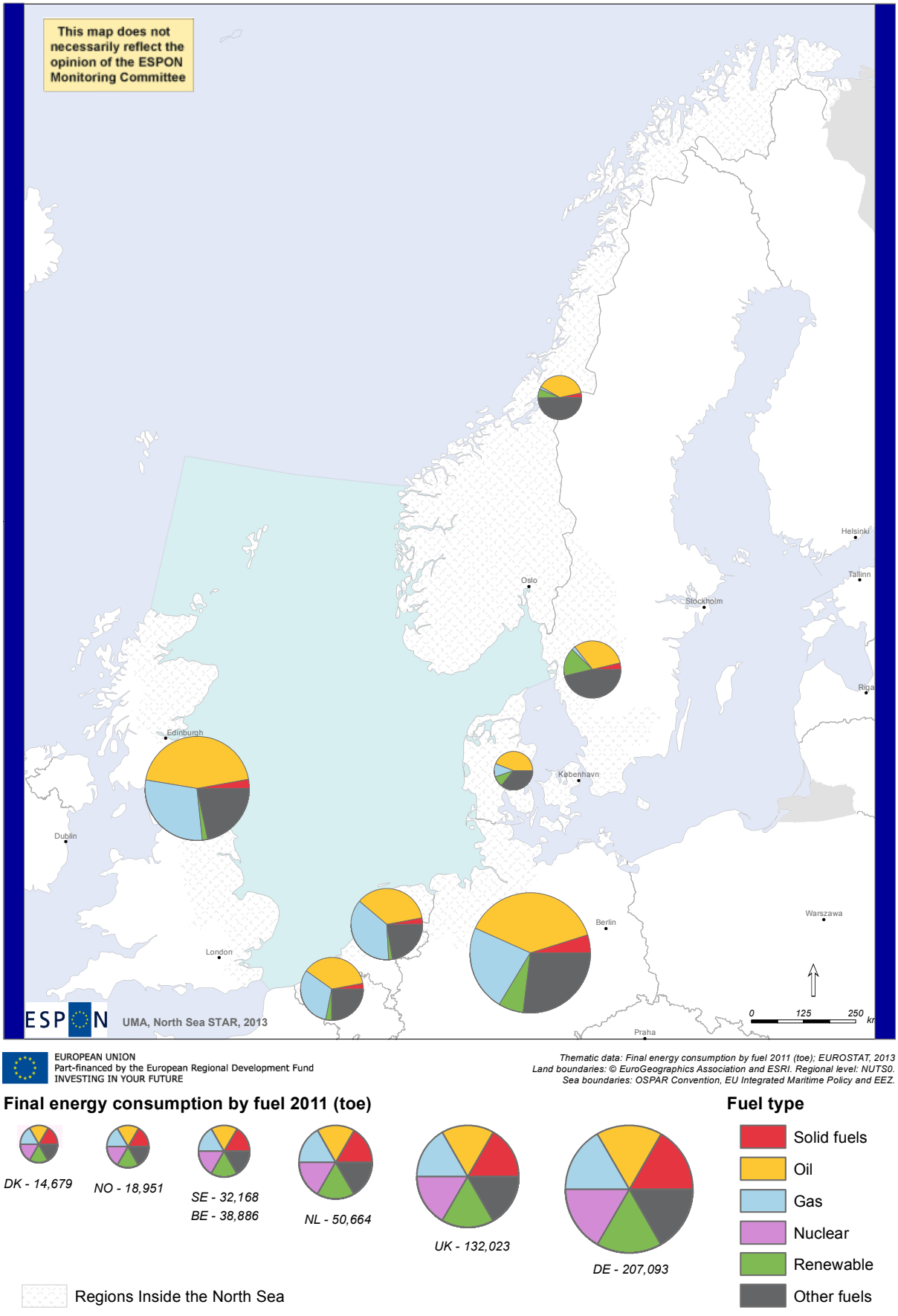
The share of renewables in meeting energy demands in the North Sea Region is also shown in maps 5 and 6. Gross inland energy consumption, the total energy demand of a country or region (or the quantity of energy necessary to satisfy inland consumption) is depicted in map 5, with renewable sources contributing significantly to meeting demands in Norway and Sweden whilst other countries are still more reliant on oil, gas or nuclear. However final energy consumption – consumption by end users, not including the energy sector itself (map 6), shows a much smaller contribution of wind, water and photovoltaic renewables to the energy mix, but a larger use of “other” fuels, which includes processed renewables such as biofuels.

Gross Inand Energy Consumption in the North Sea Region, 2011 (Tonnes of Oil Equivalent)



Map 5: Gross Inland Energy Consumption in the North Sea Region, 2011

Final Energy Consumption in the North Sea Region, 2011 (Tonnes of Oil Equivalent)



Map 6: Final Energy Consumption in the North Sea Region, 2011

2.2 European Energy Policy – Key Challenges

The policy debate in Europe has changed somewhat in recent years. The economic crisis has redirected political attention from climate change issues to economic recovery. The Emission Trading Scheme (ETS) is in turmoil and global investments in renewable energy fell in 2012, carbon Capture and Storage (CCS) has not taken off and there was a shortfall in delivering the EU's 2020 energy efficiency target. However, the 20-20-20 targets seem to be surpassed by 2020 but mainly due to economic recession. Reducing patterns of consumption and the goal of 80-95% decarbonisation by 2050 is still in force (Hanrahan, 2013).

The key challenges for European energy policy are related to target setting for 2030, balancing national and European dimensions, competiveness, energy security, the EU position for a 2015 global deal, policy coherence and getting the policy right.

What kind of target regime is appropriate to 2030 is perhaps the most contested issue in the current policy debate. How many targets should Europe have and how should they be applied? The emission target for 2030 aiming at 40% reduction is in line with the Low Carbon and energy Roadmap 2050. The renewable target is more uncertain due to negative prices and internal market impacts. Neither is the energy savings target pursued in the current situation when economic growth needs to be stimulated. Stakeholders are divided on the target regime. Many environment and development NGOs are in favour of a three-target approach whereas the power industry associations support a single-target approach. The renewables and energy efficiency industries have a strong preference for a two-target approach – renewables and energy efficiency – in order to promote growth and innovation in the sectors.

The second issue (after targets) relates to the tension between a re-nationalisation of energy and protecting the integrity of the Internal Energy Market. EU Member States are given a rather free scope on how they should implement the headline targets. There exist numerous instruments and support schemes for renewable energy across the Member States. These create barriers to cross-border operation and several unilateral decarbonisation strategies generate risk for fragmenting the Internal Energy market.

A third challenge for the 2030 package is how to ensure the best outcome from a competitiveness point of view and how to minimise price impacts for domestic consumers. This is a significant issue, particularly since the energy competitiveness gap between Europe and the US is widening. In 2012, industry gas prices in Europe were four times higher than in the US. Similarly, real electricity prices for industry in Europe increased by 38% between 2005 and 2012, whereas they decreased in real terms in the US by 4%. (Hanrahan, 2013). This affects particularly energy-intensive industries but also private consumers and makes it harder to implement support schemes for renewable energy, where the market is either directly subsidised by national

governments or consumer prices with both seeking to stimulate private investment in these areas.

Enhancing energy security is a fourth challenge that will have to be addressed. Europe is the world's biggest energy importer and its dependency could increase from 54% to 70% in 2030. In addition, the imports come from just a few countries; Russia, Norway and Algeria together account for 85% of Europe's natural gas imports, and 50% of the crude oil imports (Hanrahan, 2013). This calls for more integrated and efficient energy markets and more indigenous European energy resources, i.e. more renewables. With regard to energy security a three target regime seems to be most appropriate.

A fifth challenge is balancing the EU's outward-facing negotiations on a 2015 global deal with its inward-facing negotiations on targets for 2030 and looking ahead to 2050. The international community is heading towards an agreement on a global climate deal in 2015 which should come into force in 2020 (Durban Platform for Enhanced Action). Such a deal must be both economically feasible and politically palatable from a European perspective.

The sixth challenge is to enhance policy coherence in the energy framework and to limit the overlap between the three targets and their underpinning instruments. Multiple targets are more complex to handle than a single- or two-targets approach. A single emissions target is optimal from a policy coherence perspective and ETS functioning. An emissions target supplemented by an efficiency target would be preferable to a trio approach with a renewables target.

A final challenge in the 2030 debate is to "getting the politics right". The politics around the ETS reform do not generate confidence that even a long-term solution will be achieved. The European Commission and the Parliament are pulling in opposite directions on several issues. Between the Member States there seem to be two camps - those advocating a single emissions target (the UK), and those advocating at minimum a renewables target in addition (Denmark and France). A complex electoral landscape in 2013/14 and the stagnant economic situation make it very difficult to reach a common agreement for the European energy policy.

2.3 North Sea Regional Energy Profile (Current Situation)

There are large differences in production and consumption between the countries that border the North Sea. Norway is a large net exporter of energy based on oil and gas, just as Denmark. The other countries are net importers with Belgium and Germany at the top with the UK at the other end of the range. The national/regional variations in energy consumption are mainly due to use of different energy carriers (energy types): hydro power dominates in Norway, renewables are relatively big in Germany and Denmark, bio-fuel and waste is significant in Sweden, gas in The Netherlands and oil and natural gas in the UK.

Context – production and consumption

Belgium: The production of energy from primary sources in Belgium was at 740 PetaJoules (PJ) in 2011. The majority (70%) of this production stemmed from nuclear heat, roughly 100 PJ (14%) from renewable and waste resources, of which industrial waste contributed a 94% share. In the same year, gross inland energy consumption in Belgium lay at 2,500 PJ and final energy consumption (excluding energy used by power producers) lay at 1,600 PJ. Industry (34%) and transport (28%) were the largest consumers of the available energy in Belgium (Eurostat, 2013a). The consumption of energy by industry exceeded the European average which lay, in 2010, at 25% (Eurostat, 2013b). In 2011 Belgium relied on 73% of its energy production coming from imports (Eurostat, 2013c).

Germany: Power production in Germany relies on non-renewable and renewable sources. Renewable energy from wind, biomass etc. makes up for 20 % of gross power production. Lignite is the largest non-renewable source with 25 % followed by hard coal 19 % and nuclear energy 18%. Germany's share in Global Primary Energy Consumption is decreasing and projected to be become even smaller over the next decades. The production and consumption of electric energy in Germany has increased over the last 35 years, while the shares of the different exploited energy sources varied due to the incorporation of nuclear fuels and renewable sources. Renewable energy now makes up to 12.5% of total final energy consumption in Germany (BMU 2012).

The Netherlands: In 2011 the primary production of energy in The Netherlands lay at roughly 2,700 PJ. 90% of this production stemmed from gas, 5% from renewable sources with biomass (3.5%) being the most important among these (Statline, 2013a). In the same year the gross inland energy consumption was 3,250 PJ (Statline, 2013b). Consumption patterns, when looking at the percentage with which sectors participated in the final consumption (2,100 PJ), resembled European averages, with the exception of consumption by agriculture (6% compared to a European average of 2%). Dutch households consumed, compared to European averages, relatively little energy (19% versus 27%). When distinguishing consumption by energy source, gas (45%), oil (38%) and coal (10%) had the largest shares. The export of gas from Dutch gas fields grants The Netherlands, in comparison to other European countries, low energy dependency. The Dutch economy relied in 2011 for 30% upon imports in order to meet its energy needs (Eurostat, 2013).

Norway: The Norwegian energy system utilises both renewable and non-renewable resources. Renewable energy is converted from resources such as water, wind, bio mass and tidal water to electricity or heating. Norway is a net exporter of energy, but mainly of non-renewable energy such as fossil fuel. Norway is also the sixth largest producer of hydro power in the world and the largest in Europe (NOU 2012:19). According to the Energy balance sheet for Norway the production of primary energy commodities was 2,314 Terawatt hours (TWh) in 2011. The main bulk of this - 2 058 TWh - which is mainly oil

and gas, was exported. Extraction of crude oil and gas on the Norwegian continental shelf amounts to more than 90 per cent of the total production of primary energy carriers in Norway. The third largest energy source is waterfall and wind, but wind power represents only about 1% of the electricity supply in Norway (http://www.vindportalen.no). There is no energy production from nuclear power in Norway.

The total energy consumption in Norway amounted to 282 TWh in 2009. Much of this energy is used in manufacturing industries, households, oil and gas extraction and road transport. In the period 1990-2009, the total energy consumption in Norway rose by 28 per cent. An important reason for the large increase in energy consumption in Norway is the increased activity in oil and gas extraction and road transport (SSB 2011). Around 50 per cent of the end consumption of energy is electricity and hydropower accounts for about 98-99 per cent of the total electricity production. Petroleum products are the second largest user category with 35 per cent. Transport, energy-intensive industry and households represent the three largest energy consumption user groups. Energy-intensive industry and households are also responsible for the largest electricity consumption.

Sweden: In 2011, Sweden's total primary energy supply (TPES) was 48.9 million tonnes of oil equivalent (Mtoe), a level which has remained fairly stable over the last three decades, growing 2.8 % since 2000 and with a sharp drop in 2009 amid the global financial and economic crisis. Fossil fuels, oil, coal and natural gas, represented 31.8% of TPES in 2011, in addition to 35.5% renewables and 32.5% nuclear. Sweden is the International Energy Agency (IEA) member country with the lowest share of fossil fuels in its energy mix (without nuclear). The average share in IEA member countries was 81% in 2011. Sweden's share of coal accounted for 4.1% and natural gas for 2.4%, compared to the IEA average of 20% and 25% respectively. The TPES per capita was 5.2 toe compared to the IEA average of 4.7 toe. Oil accounts for the lion's share of the fossil fuels supplied to Sweden, amounting to 25.3% of TPES and 78.2% of all fossil fuels. Nuclear makes a large contribution to the Swedish electricity mix, accounting for 15.9 Mtoe or 40.5% of its total electricity generation at the level of 150.5 TWh in 2011. Other larger contributors are hydropower which represents 44.1% and biofuels and waste with 8.5%. Additional contributors are wind 4%, natural gas 1.2%, coal 0.8%, oil 0.5% and peat 0.4%. Sweden's share of nuclear in TPES was the second-highest among IEA member countries after France. Inland energy production in 2011 was 33.9 Mtoe, approximately 69.3% of TPES while the country relies on 15 Mtoe import, approximately 30.7% of TPES. The industry sector consumed the largest share of energy, accounting for 13.3 Mtoe or 39.3% of the country's final consumption. It was followed by transport (24.1%) and the residential sector (22.5%), while the commercial, public services and agricultural sectors amounted to 14.1% of total final consumption in Sweden in 2011.

Denmark: Domestic energy production in Denmark is based on crude oil (470 PJ), natural gas (265 PJ) and renewables (152 PJ) (all numbers: 2011). Denmark is a net exporter of energy, mainly of fossil fuels such as crude oil,

oil products and natural gas. Nonetheless Denmark also imports energy. These imports mainly encompass processed oil products, crude oil to operate Danish refineries with full capacity, and coal. Nearly one quarter (42 PJ) of the renewable energy consumed in Denmark in 2011 was imported. Denmark's energy consumption rests upon a small number of energy carriers. Before transformation (e.g. production of electricity and heat) oil has the largest share with 39% in 2011 followed by renewables with 22%, natural gas with 20% and coal with 17%. After transformation oil remains the largest energy product with 37% followed by electricity with 32 %, natural gas with 12% and district heating with 11% (all numbers: 2011). Renewables have a share of 8% in these statistics which considers the consumption of renewables by end-users, mainly households. About one half of the energy provided by renewables is transformed into heat and electricity.

The total consumption of energy in Denmark has been relatively stable over the last three decades. However, the share of single uses in total energy consumption has partly changed. In particular the transport sector has shown an increase from 18% (1980) to 26% (2011) (144 vs. 213 PJ). This development is mainly driven by increasing consumption in road traffic. Another driving sector for increasing energy consumption is the energy sector itself. Its share in total energy consumption increased from 2% (1980) to 6% (2011) (17 vs. 45 PJ). The increase in energy consumption in these two sectors is compensated by a slightly decreasing consumption in agriculture and industry, where the share has fallen from 28% (1980) to 23% (2011) of which about 2% seem to be caused by the global economic slowdown since 2008 (228 vs. 183 PJ). Energy savings have been achieved mainly at households whose share decreased from 34% (1980) to 28% (2011) (277 vs. 228 PJ). While the progress in energy savings in households has been achieved mainly prior to the year 2000 this situation is different in the agricultural and industrial sectors. Here energy savings are noticeable in national consumption statistics mainly from the year 2002 onwards while savings in households stagnate. These numbers are based on total consumption. Under consideration of growth of both the Danish economy and population an increase of energy efficiency can be stated for all sectors. On average energy efficiency in Denmark increased by 1.1%/year since 1990.

The UK: In 2009, total primary energy supply (TPES) was 197 Mtoe and natural gas had the highest share with 39.7%, oil 32.5%, coal/peat 15.2% nuclear 9.2% and renewable 3.3% (IEA 2011). In 1970, fuel consumption was dominated by solid fuels use (47 per cent of all energy consumption in the UK) and petroleum (44 per cent), with gas contributing a further 5 per cent and electricity 4 per cent. By 1980 the fuel mix had evolved with natural gas making up 20 per cent of all energy consumption in the UK, solid fuels (36 per cent) and petroleum (37 per cent). In 1990, the split between fuels was similar to that in 1980, however by 2000 with changes in electricity generation, natural gas consumption had become the dominant fuel responsible for 41 per cent of all energy consumption in the UK, whilst solid fuels had fallen from 31 per cent in 1990 to 17 per cent in 2000. By 2011 more renewable fuels had entered the energy mix for both electricity generation and bioenergy consumption.

Between 1970 and 1990 industrial consumption had fallen from 40 to 24 per cent of total final energy consumption in the UK, whilst transport consumption had risen from 18 to 31 per cent. Domestic use had increased slightly from 24 to 26 per cent whilst other final users (mainly agriculture, public administration and commerce) and non-energy use remained at 12 per cent and 7 per cent respectively. The decreasing trend in industrial consumption continued and in 2011 was 18 per cent of total final energy consumption in the UK, with transport consumption responsible for 38 per cent and domestic 26 per cent.

2.4 Drivers of Energy Policy

The main drivers of the energy policy in the countries bordering the North Sea are drawn up in several common EU documents, such as the Energy 2020 strategy and the energy Roadmap 2050 (see above). This implies a policy which aims to achieve a low-carbon economy more based on renewable energy, increased energy efficiency and improved security of supply. Although there are many similarities between the North Sea countries, there are also some differences with regard to drivers of energy policy.

Belgium: Belgium is committed to goals as they are set out by the European Union and the Kyoto protocol. Targets for CO_2 reductions differ in regions. The national benchmark for the share of energy from renewable resources in energy consumption is set at 13% in 2020. Belgium has in 1999 announced to phase out the utilisation of nuclear power. As in other European countries, this development is expected to lead to a more important role of renewable energies in energy market structures. The high dependency of Belgium on the import of energy makes this development specifically urgent. The Belgium federal government promotes the European Emissions Trade System (ETS). The effect of applications is monitored at the regional level. Specifically in the highly industrialized Flemish region effects are (as the environmental balance in general) strongly influenced by ups and downs of economic development.

Germany: The Federal Government of Germany set out its binding Energy Concept in September 2010 with an objective to achieve the transition to an era of renewable energy latest at 2050. The Energy Concept's guidelines opt for an environmentally sound, reliable and affordable energy supply within that time frame. The long-term objectives are of particular importance to the future direction of energy research policy (BMWI, 2011b). The key targets for 2050 are as follows: (i) Reduce emissions of greenhouse gases by between 80% and 95% compared with 1990 (by 40% by 2020), (ii) Cut primary energy consumption by 50% compared with 2008 and (iii) Curb overall electricity consumption by approximately 25% compared with 2008 (by 18% by 2020), (iv) Ensure that energy from renewable sources accounts for 60% of gross final energy consumption (18% by 2020) or 80% of gross electricity consumption (at least 35% by 2020). The energy agendas set at all the levels of the German political and administrative system (from Federal via -State to -regions and municipalities) consider this framework. However, the energy strategies and schemes reflect the different natural and societal conditions and the geographical and political context.

The national framework (BMWI 2011b, BMU 2012) defines some priority goals thus providing a catalyst for action in political and economic sectors and society as a whole. The basic statements of the framework are (i) the restructuring of the energy system must be as cost effective as possible, (ii) grid expansion is the foundation for the continued development of renewable energy, (iii) new gas- and coal-fired power stations necessary to safeguard future supply security, (iv) closer market integration of renewable energy is important, (v) energy research drives growth and investments in new energy technology, (vi) better energy efficiency is a central requirement for restructuring the energy system, (vii) partnership with European countries as partner to restructure the energy system in Germany plus (viii) a good foreign energy policy guarantees a secure energy supply.

The Netherlands: Policies to achieve benchmarks are largely taken by the Dutch Ministry of Economic Affairs. Many measures seek to realize CO_2 reductions while sustaining the important role that the Dutch grey energy sector takes in the production, refinement and trading of energy carriers in North West Europe. The most important building block in Dutch energy policies is the European Emission Trade System (ETS). The Dutch government intends to broaden the application of this system by including other than the up until now defined economic sectors in the trading of rights. Gas plays a significant role in Dutch energy market structures and in the Dutch economy and it causes relatively low CO_2 emissions. The Dutch government supports a transition of the gas sector from focusing on production to trading and refinement of gas by facilitation of carbon capture and storage (CCS), transport capacities and diplomatic and trade missions (Ministerie van Economische Zaken, Landbouw & Innovatie, 2011). Increased use of renewables has also been encouraged by subsidies and obligation of the transport sector to replace fossil fuels with bio-fuels. All Dutch provinces that are part of the North Sea region as well as a range of governance arrangements in the area have drawn up structural visions to guide spatial development that leads to more sustainable production and consumption of energy. Regional energy self-sufficiency is a re-occurring theme of these visions under construction. There are, however, currently neither regional energy authorities nor policies to address specific trends in regional energy production and consumption.

Norway: Norwegian energy policies are closely interrelated with the other Nordic countries and there are several common features in their energy policies. Norway has, as the other Nordic countries very long-term ambitious goals towards decarbonising their energy systems. Decarbonisation is vital in the areas of electricity generation and energy use in industry, transport and buildings; it also requires deployment of carbon capture and storage (CCS) for cost-effective reduction of greenhouse-gas (GHG) emissions (IEA, 2012). The use of energy in Norway in a long-term perspective will be influenced by factors such as economic growth, industrial structure, demographic development, technological development and policies. The population is estimated to grow from 5 million in 2013 to 6 – 8 million in 2050 (Statistics Norway). This in itself will lead to increased consumption but since the economy probably will be less energy-intensive than today and, since the

strongest population growth will be in the largest cities, increased urbanisation together with more energy-efficient economic production and living may contribute to reducing the total energy consumption. However, this requires increased energy efficient use and more production based on renewable energy sources. Norway has high ambitions and has also implemented several measures which will contribute to reduce total use of energy and increase renewable energy production and use.

Sweden: Sweden's energy policy – integrated with climate policy – is guided by two government Bills 2008/09:162 and 163) which were approved by the Swedish Parliament in 2009. The bill on *En integrerad energi- och klimatpolitik* ("integrated climate and energy policy") sets out ambitious targets in support of and beyond the 20/20/20 objectives of the EU, in pursuit of a sustainable policy for the environment, competitiveness and long-term stability (Energy Policies of IEA Countries: Sweden 2013 IEA/OECD Paris, 2013. 34) . Short- to medium-term targets for 2020 are 40% reduction in greenhouse gases (GHGs) or about 20 million tonnes of carbon dioxide equivalent (Mt CO_2-eq), compared to 1990, to be achieved outside the European Union Emissions Trading Scheme (EU-ETS) with two-thirds in Sweden and one-third by investments in other EU countries or the use of flexible mechanisms; at least 50% share of renewable energy in the gross final energy consumption; at least 10% share of renewable energy in the transport sector; and 20% more efficient use of energy compared to 2008. The long-term priorities are that by 2020, Sweden aims to phase out fossil fuels in heating; by 2030, Sweden should have a vehicle stock that is independent of fossil fuels. Sweden is committed to develop a third pillar in electricity supply, next to hydro and nuclear power, with increased co-generation, wind and other renewable power production to reduce vulnerability and increase security of electricity supply; and by 2050, the vision is that Sweden will have a sustainable and resource-efficient energy supply with zero net emissions of GHGs. Sweden sees a role for natural gas as a transition fuel in industry and co-generation. The Swedish Environmental Agency, supported by the Swedish Energy Agency and other national authorities, presented a proposal for a Climate Roadmap in December 2012. The roadmap identifies scenarios for achieving the long-term 2050 priority and is to be adopted in the course of 2013.

Denmark: In November 2011 the Danish government passed an energy strategy (Danish Government, 2011) aiming for an ambitious goal: the entire energy supply – electricity, heating, industry and transport – is to be covered by renewable energy by 2050. This goal of 100% renewables has been renewed by the Energy Agreement passed in March 2012 (KEMIN, 2012). With this strategy the Danish Government plans to over-fulfil Europe's 20-20-20 goals. The national energy strategy includes a few milestones which illustrate how the implementation of this goal shall be achieved. Energy savings play a major role to achieve this strategy. By the year 2020 the share of renewables in final energy consumption shall be more than 35% and approximately 50% of the electricity consumption shall be supplied by wind power. To achieve this both offshore and onshore wind farms shall be expanded and new planning tools shall encourage an increase in net capacity of onshore wind power (repowering). Even more important than wind farms

shall be the role of biomass, e.g. as a substitute for coal and natural gas in combined heat and power plants. Denmark's economic policy encompasses intensive green growth ambitions including intensified development of various kinds of renewable energy products. However, competitiveness has deteriorated in the past decade and productivity growth has been weak, eroding potential growth (OECD, 2013). The OECD (2013) currently states a potential of these green growth ambitions to translate into new sources of growth, but recommends also to review energy and climate change policies to achieve better results at low cost. Further challenges are the development of storage techniques and facilities as well as the reorganisation of electricity and pipeline networks. Another yet unsolved question is how the increasing consumption of oil products by the transport sector, especially road traffic, can be decreased and substituted by an alternative energy carrier.

The UK: Central Government sets the broad approach to energy policy and whilst most of its activities are designed to shape domestic production and consumption patterns it is interesting to at least note some of the production challenges are in part being met by international collaborations. For example, recently (January 2013) the UK and Irish governments have signed a Memorandum of Understanding focusing on the potential of importing substantial gigawatts (GW) of green energy (predominantly produced by wind) from Ireland to the UK. The broad policy framework is set out in the Renewable Energy Roadmap which was updated in December 2012. Given the broad range of producers and consumers the incentive packages to encourage production and reduce consumption are very wide ranging. The following paragraphs deal with both consumption and production issues to provide a flavour of the incentives on offer. It is not intended to be a comprehensive summary.

Furthermore as noted earlier, whilst the direction of travel is the same the devolved administrations (most notably in this case Scotland) are able to set their own policy objectives and within their own devolved competencies provide the framework for this to happen. For example, the aspiration that 100% of Scotland's electricity demand will be generated by renewables is driving the development of both onshore and offshore wind farms and with it local planning controversies.

2.5 Conclusions

Energy has been at the centre of EU policy since the European Coal and Steel Community (1951) and the Treaty of Rome (1957), which established the European Atomic Energy Community (Euratom) alongside the European Economic Community (EEC). A major step was taken by the Treaty on European Union (the Maastricht Treaty) in 1992 by giving the Community the task of creating 'trans-European networks' in energy, telecommunications and transport. In 1994 eight priority energy projects of European significance were identified. More recently, the Treaty of Lisbon has enhanced the EU's objectives for energy policy. The current policy debate centres on Energy 2020 and the Energy Roadmap 2050. The EU strategy focuses on *energy*

efficiency, achieving a 20% saving by 2020; an *integrated energy market* and supporting the 20% target for renewable energy supply by 2020; *empowering consumers* and ensure energy security; extending Europe's leadership in *energy technology and innovation* related to renewable energy; and strengthening the *external dimension of the EU energy market* by reaching agreements with neighbours who adopt the EU market model.

The policy debate in Europe has changed somewhat in recent years. The economic crisis has redirected more of the political attention from climate change issues to economic recovery. The Emission Trading Scheme (ETS) is in turmoil and global investments in renewable energy fell in 2012, carbon Capture and Storage (CCS) has not taken of and there was a shortfall in delivering the EU's 2020 energy efficiency target. However, the 20-20-20 targets seem to be over-delivered by 2020 but mainly due to economic recession and the goal of 80-95 % decarbonisation by 2050 is still in force (Hanrahan2013). The key challenges for European energy policy are related to target setting for 2030, balancing national and European dimensions, competiveness, energy security, the EU position for a 2015 global deal, policy coherence and getting the policy right.

Innovation is a key driver in the transition to a green, sustainable economy and the *sustainability transitions perspective* is a highly relevant research approach to this fundamental challenge. This perspective indicates that realising a new energy system based on renewables and a green economy in general will require fundamental socio-technical changes which imply a radical transition towards a more sustainable society. Innovation is a key driver in the transition to a green economy and the energy sector will be critical to achieving greener growth.

There are large differences in production and consumptions between the countries that border the North Sea. Norway is a large net exporter of energy based on oil and gas and Denmark is also a net exporter. The other countries are net importers with Belgium and Germany on the top with the UK in the other end of the range. The national/regional variations in energy consumptions are mainly due to use of different energy carriers, hydro power dominates in Norway, renewables are relatively big in Germany and in Denmark, bio-fuel and waste is significant in Sweden, gas in The Netherlands and oil and natural gas in the UK.

The main drivers of the energy policy in the countries bordering the North Sea are drawn up in several common EU documents, such as the Energy 2020 and the energy Roadmap 2050. This implies a policy which aims to achieve a low-carbon economy more based on renewable energy, increased energy efficiency and improved security of supply. Although there are many similarities between the North Sea countries, there are also some important differences with regard to drivers of energy policy often based around current patterns of production and consumption.

3. Scenario Building Proposals

This section provides further details of the scenario building work undertaken so far. It discusses the reasoning behind our scenario building, the analytical framework that has been developed for scenario evaluation and assessment together with the initial outputs in the form of three scenarios for the North Sea Region.

3.1 Reasoning of Scenario Building

The European North Sea Region is a major player in producing and consuming energy. The major challenge is to manage the shift from fossil to renewable energy resources while simultaneously improving the economic power and the well-being of the societies in the region.

In building the scenarios, we consider two aspects as key factors shaping the transition process. The first relates to the time spans that processes in energy transition from fossil to renewable energy sources combined with energy efficiency will cover. This depends on technological and societal innovations, but also on the availability of renewable resources. The second key factor is related to obstacles and barriers and/or stimulating or triggering events which can significantly influence the pace of change shaping the future energy landscape of the North Sea region.

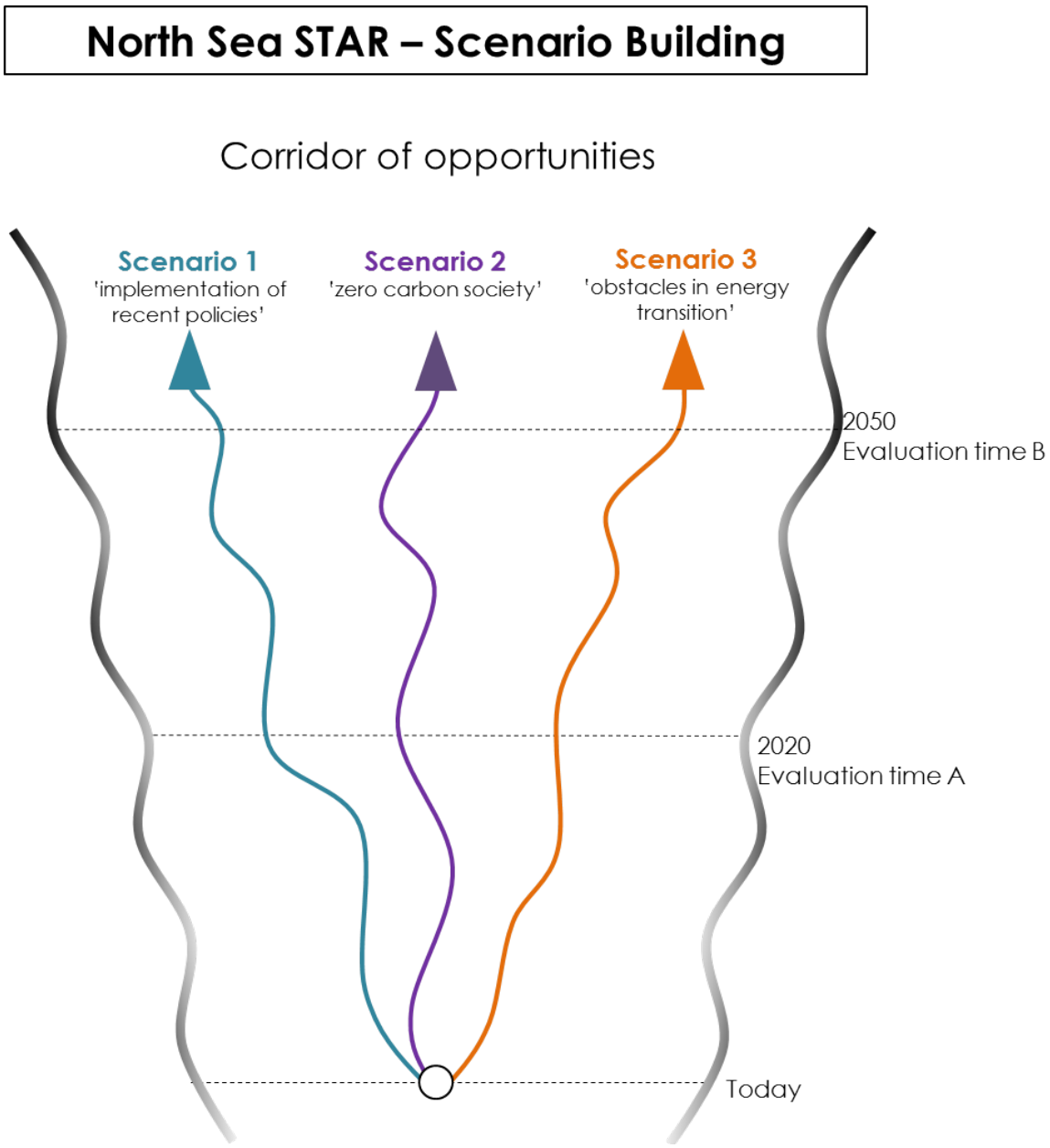
Considering the ways that these two key factors interact, three possible scenarios are compiled. They are useful in exploring transition pathways and development stages with respect to two crucial times for planning and decision-taking, i.e. 2020 and 2050 (Figure 4).

Scenario 1 - Implementation of recent policies - This scenario reflects the successful implementation of recent energy policies from the EU to the local level. Current ambitious energy and climate goals will be achieved and any amendments to recent policies will continue to follow existing visions and goals. Current trajectories will be maintained.

Scenario 2 - Zero Carbon society - For various reasons, the shift from fossil to renewable energy sources is proceeds even faster and with more socio-ecological benefits than expected. This self-energising development emerges as a pioneering function of the North Sea Region.

Scenario 3 - Obstacles in energy transition - Difficulties in realising reliable infrastructures for renewable energies, fading societal acceptance, economic market failures and other factors hamper the implementation of intended energy measures and the region's transition to a low carbon economy.

Figure 4: Foci of scenario building: Three energy scenarios of North Sea STAR and two evaluation times.



3.2 Analytical Framework for Scenario Evaluation and Assessment

In order to evaluate the performance in implementing energy policies and monitor the progress of the crucial processes, a set of enablers needs to be considered. These indicators can be examined using qualitative, semi-quantitative and quantitative approaches. Information and data will be gathered from various documents and by contacting relevant institutions and experts. The resulting matrix highlights the differences of the three scenarios (Table 4).

Table 4: Assessment Matrix - Criteria and indicators of the three scenarios

Criterion	*Description, indicators*	*Evaluation time*	*Scenario 1*	*Scenario 2*	*Scenario 3*
Energy production	Potential and realised energy production	*By 2020 (vs. 2010)*	+ 10%	+ 5%	+ 5%
		By 2050 (vs. 2010)	+ 20%	+ 10%	+ 5%
Energy consumption	Energy consumption	*By 2020 (vs. 2010)*	*stable*	*- 5%*	*stable*
		By 2050 (vs. 2010)	- 8%	-15%	+ 5%
Energy efficiency	Potential and realised energy efficiency	By 2020 (vs. 2010)	+ 9%	+ 25%	+ 4%
		By 2050 (vs. 2010)	+ 27%	+ 40%	+ 15%
Energy costs	Costs for different types of energy per energy source and for consumers	*By 2020 (vs. 2010)*	+ 5%	+ 5 %	+ 10%
		By 2050 (vs. 2010)	+10 %	- 10 %	+ 20 %
Technological innovation	Availability of reliable and efficient technologies for (renewable) energies production, use and energy savings	*By 2020 (vs. 2010)*	Several technological innovations are implemented	Significant technological innovations in all fields of energy transition are successfully implemented	Economic crisis and societal ruptures inhibit technological innovation
		By 2050 (vs. 2010)	Several technological innovations are implemented	Significant technological innovations in all fields of energy transition are successfully implemented	Economic crisis and societal ruptures inhibit technological innovation

Table 4 *continued*

Criterion	***Description, indicators***	***Evaluation time***	***Scenario 1***	***Scenario 2***	***Scenario 3***
Decisive societal partners	Level of collaboration of the societal partners in energy policies	*By 2020 (vs. 2010)*	Balanced partnerships	Emerging frameworks for collaboration of all relevant partners	Sectoral interests and powerful social partners are dominating
		By 2050 (vs. 2010)	Balanced partnerships	Emerging frameworks for collaboration of all relevant partners	Sectoral interests and powerful social partners are dominating
Social changes	Changes of the societies interacting with energy behaviours and policies (demographic changes, economic preferences, shifting societal baselines)	*By 2020 (vs. 2010)*	Energy transition is competing with other societal grand challenges	Energy transition boosts resilient social structures	Unsolved challenges to the social systems inhibit energy transition
		By 2050 (vs. 2010)	Energy transition is competing with other societal grand challenges	Energy transition boosts resilient social structures	Unsolved challenges to the social systems inhibit energy transition
Policy making	Level of interaction of the policy levels and sectors (EU, national, regional local; energy related plus/versus actions in other domains). Role and responsibility of the different policy levels	By 2020	Regions and municipalities	All administrative levels and stakeholder groupings	National governments with a focus on safe energy supply
		By 2050	Regions and municipalities	All administrative levels and stakeholder groupings	National governments with a focus on safe energy supply

Table 4 *continued*

Criterion	*Description, indicators*	*Evaluation time*	*Scenario 1*	*Scenario 2*	*Scenario 3*
Economic development and markets	Developments and events on the global and EU market	By 2020 (vs. 2010)	+ 13 %	+ 9 %	+ 7 %
		By 2050 (vs. 2010)	+ 64 %	+ 121 %	+ 38 %
Impacts of climate change or environmental hazards	Developments and impacts of environmental processes incl. catastrophic events	NSR level by 2020 (vs. 2010)	- 7 %	- 15 %	+ 3 %
		Global by 2020 (vs. 2010)	+ 60 %	+ 67 %	+ 98 %
		NSR level by 2050 (vs. 2010)	- 38 %	- 100 %	+ 42 %
		Global by 2050 (vs. 2010)	+ 298 %	+ 327 %	+ 395 %
Social learning	Status of public awareness and knowledge, availability of skilled and trained people	By 2020 (vs. 2010)	Partial social interaction focusing research and training	Generation and transfer of knowledge and societal competence	Fragmentation of social structures, mis-communication
		By 2050 (vs. 2010)	Partial social interaction focusing research and training	Generation and transfer of knowledge and societal competence	Fragmentation of social structures, mis-communication

3.3 NSS-Energy Scenarios for the North Sea Region

The North Sea Star-Energy scenarios are designed to discuss and analyse pathways of energy transition in the North Sea Region. The focus is on developments in the socio-economic and the socio-technological spheres. Plausible changes in the environment are considered as well, in particular impacts of changing climate conditions. These are compiled into one single baseline scenario for all the three energy scenarios.

Impacts of climate change - The impacts of climate change on the North Sea Region are mainly driven by global greenhouse gas emissions. Therefore energy savings, increased production of renewable energies and less CO_2 emissions on the level of the North Sea Region might not lead to a direct reduction of climate change impacts. However, the occurrence of climate change impacts does influence awareness of climate change and promotes sustainable energy consumption and production.

By about 2020 the impacts of climate change do not differ very much from scenario to scenario because of the climate lag of about 40 years, the time between the cause (increased greenhouse gas emissions) and the effect (increased temperatures, changes in precipitation etc.). By this time the UK is not noticeably impacted by climate change, eastern and southern parts of the North Sea Region have an increased air temperature of about 1°C (yearly average) and a slight average increase in precipitation (5-10%).

Furthermore by 2050 climate change impacts still differ little from scenario to scenario, again due to the climate lag. With strong energy growth and delayed attention to carbon capture and storage, greenhouse gas emissions are likely to follow a pathway much higher than the 2°C goal by 2100. Within the North Sea Region an air temperature increase of 2°C during winter is recognisable already by 2050 in eastern parts (Norway, Sweden, Denmark, and Germany). Sea level has increased about 30-40 cm (regionally variable, not considering isostatic land movements). Additional flooding, either caused by storm surges or heavy precipitation are not critical yet, but costs for improved water management are constantly increasing. Locally problems with salt water intrusion occur, which as one of many consequences, has an impact on agriculture. Peat soils start to degrade and species start to migrate northwards. At the same time fish stocks become more vulnerable.

The sections below describe the likely implications of each energy scenario for the North Sea Region. More detailed explanations of each scenario can be found in Annex E to the Interim Report.

3.4 Scenario 1 - Implementation of Recent Policies

This scenario envisions that current ambitious energy and climate goals will be achieved. For each of the ten criteria the following impacts can be anticipated.

Energy Production – The North Sea Region is a core region of the EU's energy transition where the total power capacity installed in Europe will reach more than 1,200GW by 2050. Renewables will represent more than half of newly installed capacity, requiring an investment of around €2 trillion (at 2005 prices) for the period up to 2050. In the North Sea region, power generation will rise by more than 20% until 2050, with renewables representing 55% of total generation by 2050. The share of solid fuels in the electricity mix will be cut by half by 2050. In some regions, remaining coal fire plants are converted to cofire generation[2] and fitted with carbon capture and storage (CCS). Since the mode and localities of power generation will change considerably in the next decades, investments are needed to adjust the grid infrastructure onshore and offshore and to improve the reliability of aging energy infrastructure.

Energy consumption - In accordance with existing national and European energy strategies the regions around the North Sea invest in insulation and energy savings measures. Financial incentives, regulations but also slightly increasing market prices for energy are drivers for this process. Progress in savings is mainly made in housing, industry and agriculture. In contrast road traffic and aviation lead to increasing energy consumption which is partly compensated by savings in other sectors. Natural gas plays an increasingly important role on the way towards more renewable energies, but also energy consumption by oil products continues to play a dominant role, especially in the transport sector.

Energy efficiency - Progress in achieving better insulation and efficient building equipment and appliances is slow but continuous. Energy production, industry and transport become more efficient due to technological progress, market benefits and incentives. But strong progress in achieving better energy efficiency is hampered by disintegration. Monitoring, enforcement and evaluation of cross-sectoral energy efficiency strategies is not fully implemented.

Energy costs – Excluding hydro, the costs of all renewables will decrease. By 2050, wind will be the lowest cost renewable and solar costs will drop nearly 80% but still remain high relative to wind and hydro. Non-renewable energy is expected to cost twice as much as wind energy. Electricity trade via international grids favours the integration of renewables. The main effects of this trade are decreases in the need for back-up installed capacities and for large-scale storage technologies.

Technological Innovation – Development and rapid implementation of innovations in the field of energy delivery and efficiency are key to

[2] Cofiring means that power stations are able to burn two fuels simultaneously.

transitioning to an affordable, predominantly renewable energy landscape. As reliability of currently available renewable resources increases and technology improves, costs of infrastructure decrease. Energy storage and low-loss transmission capacities will be expanded in concert with renewable electricity generation capacities. The implementation of super-smart grid infrastructure challenges information and communications technologies (ICT) in the North Sea offshore grid. Renewable energy technologies which are currently in the early stages of development (hydrogen and wave-todal-currents) will mature.

Societal Partners – Reform of existing carbon and electricity markets will be crucial in achieving the emissions reduction goal, and the cost internalization of greenhouse gases. This need challenges all societal parties to develop and establish well-functioning markets as the energy transition progresses. A diverse set of alliances will subsequently emerge. The alliances will focus the regional energy production and consumption chains. Stakeholders entering the energy market as new partners due to developments in renewables become easily accepted. Formal and informal approaches to planning and management of energy strategies will be accompanied by shifts of national budget priorities and acknowledge the importance of investing in an intelligent energy economy. Entrepreneurial activities are promoted by an intense public-private dialogue and the formation of multi-sectoral clusters on a sub-regional scale.

Social changes - With respect to the North Sea Region, energy technology and society evolve and improve simultaneously and in balance. The energy transition will promote the human well-being in both urban and rural areas. New approaches to energy production and consumption will, in a stepwise manner, help to improve the socio-cultural conditions in marginal areas of the North Sea Region. It still seems inevitable that better coordination of energy policy, spatial planning and land-use regulation issues are needed. This requires the establishment and/or improvement of integrated planning structures at the national and regional levels and the re-design of subsidy schemes.

Policy making – Ambitious energy policies have existed since the turn of the millennium. Climate change and secure energy supplies in times of rising energy prices have been intensively discussed. General messages from this time are still valid but not an important part of national policies anymore. For regions and municipalities, however, the topic is still a central part of the-regional development strategies. With this change in policy level from the European and national sphere to lower levels possibilities of steering energy efficiency and of renewables actions becomes weaker.

Economic development - With the global economic crisis from 2008 and a subsequent recovery the price of crude oil has been stable for several years. With the return of world growth, to slightly below pre-crisis rates, the price of Brent crude increases to far above early-2012 levels by 2020. From 2020 onwards, greater independence from global energy markets and imports turns into a benefit for economy in the North Sea Region. Some firms heavily benefit from the trend towards more renewables and more efficient

technology. Major companies in the energy sector gain about half of their revenues from energy-saving and green technologies.

Social learning - Creating a radical energy transition requires an awareness of complex learning processes. Such processes involve a multitude of actors and levels such as energy providers, policy actors consumers, social networks, and broader societal contexts. The energy transition shapes up as a catalyst for system innovations. The profound change requires the re-configuration of technologies and modified institutions. Social practices (e.g. use patterns, lifestyles), as well as cultural norms and values will shift to more collaborative approaches.

3.5 Scenario 2 - Zero Carbon society

In scenario 2, the shift from fossil to renewable energy sources is proceeding even faster and with more socio-ecological benefits than expected. Impacts on and for the criteria can be envisaged as follows.

Energy Production - The North Sea region is successful pioneer in the energy transition. In 2020, 35% of the energy production will be related to renewable sources which will become the sole source of energy production by 2050. The decommissioning and, wherever possible, adaptation of the fossil energy infrastructure will be harmonised with the build-up of a modern renewable energy based infrastructure. This decarbonisation of the power sector will require investments in renewables and their large-scale uptake in the electricity system. Investments in smart grids are also needed, with a particular focus on transmission and distribution structures.

Energy consumption - The building stock is renovated towards modern standards in all parts of the North Sea Region. The North Sea Region specialises on the export of their fossils and spends part of the profit of these exports for a quick and innovative change towards a carbon free society. A smart grid is established and major consumers become even more flexible in using and storing energy when it is cheap whilst reducing consumption during more expensive periods. The use of natural gas and gasified methane becomes an important transitory technology. The carbon emissions resulting from these are compensated by carbon capture and storage techniques where carbon is stored e.g. in former gas fields. This scenario requires energy savings of 15%.

Energy efficiency -Transport is organised in the most energy efficient way. Long distance travels, for example, are as far as possible done by train instead of flights or individual traveling by car. Deteriorated energy infrastructure is without exception replaced by modern and efficient technique supporting a mix of renewable energies together with selected fossils (mainly natural gas). Gasification of electric energy (Power-to-Gas), e.g. from wind farms, is established not only in pilot projects but also on larger scale. This technique is yet not too efficient by itself but allows a quick transformation into a zero carbon society by using existing infrastructure, e.g. pipelines, storage facilities and heat systems for natural gas. Energy efficiency has become a

core interest of regional and national governments as the mid-term economic benefit has been clearly understood and is publicly accepted.

Energy costs - Renewable energies will become the major source of energy in a short period of time. By 2050, renewables deliver energy in an affordable and reliable way. Existing infrastructure from the fossil and nuclear phase of the energy production, distribution and consumption will be re-used and adapted wherever possible and economically feasible. While the potentials for further cost reduction or the integration of additional resources of hydro or bioenergy are limited, wind and solar will benefit from significant technological innovations in conversion efficiency and robustness both being main drivers of cost reduction. In 2050, energy trade via international grids favours the massive integration of renewables. Related infrastructure in the North Sea Region and neighbouring regions will also buffer marked fluctuations in energy prices.

Technological Innovation - The next decades breed successful implementation of significant innovations in the fields of energy delivery and energy efficiency. Technological barriers in all the sectors of renewable energies will be unlocked. The up-scaling of wave and tidal and hydrogen from pilots to large scale installations including the embedding in the energy infrastructure is a success factor for regional sustainable developments. New mobility technologies lead to increasing efficiency and reduction of carbon dioxide emissions. Feed-in of biogas instead of natural gas will promote increasing application of electric and biofuel powered engines in the expanding transport sector. Innovations to low-cost and low-loss grids help to further optimise the distribution of electric energy, heat and gas for various purposes.

Societal Partners - New social and organisational structures are recognized as being of high importance in re-shaping the socio-economic energy landscape in the North Sea Region. In order to get these systems to work in practice, social actors from research, technological development, planning as well as architectural and political fields manage to organize themselves soon and successfully. Close cooperation with investors and on-site users prove to be essential in that respect. The transfer of good practice and appropriate local participation models enable societal partners to establish sound policies and frameworks. The new societal partnerships are capable of compensating for barriers due inconsistent government policy.

Social changes – The harmonious evolution of the socio-ecological and socio-technological spheres is a key feature of the significant progress in decarbonisation as a priority field of the North Sea Region. Of importance here is the positive impact of energy transition measures in coping with the challenges of demographic changes, disparities of urban and rural areas and economic crisis. Many individuals and most of the societal groups can benefit from resilient social structures which are strengthened or emerge from a more renewable, multi-modal and decentralised approach to the energy sector.

Policy making - Public awareness of climate protection and sustainable energy policy is high. Governments therefore develop strong frameworks for

energy efficiency and accelerate implementation by stimulating investment, monitoring, evaluation and enforcement. The expansion and conversion of energy grids is prioritised by legal frameworks. Research and development are heavily involved in developing a holistic energy concept and the necessary technologies. Regions around the North Sea cooperate intensively and contribute to a stable and climate friendly energy mix.

Economic development - On a global level the world order is held together by nationally disembodied, economic relationships. Economic growth helps developing countries to close the gap with developed countries, which also achieve further growth. This new world order leads to a significant increase in prices for fossil energies. Because global natural gas production growth is more modest than anticipated, prices, which remain regionalised, are strong in regions of relative scarcity. For those regions which have no or nearly no access to fossils it becomes financially attractive to save energy and to produce renewable energy within a stabilising North Sea Region wide network. For other regions around the North Sea, which have access to oil or natural gas, it becomes more attractive to sell them.

Social learning - The energy transition of the North Sea Region is a worldwide recognised blueprint. In addition to local to national structures, strong transnational settings have been established in the North Sea Region. The energy sector is a major driver for societal inclusion and making the North Sea Region a frontrunner in all respects of sustainable development. Improvement of integrated planning structures at the national and regional levels, the re-design of subsidy schemes, the closer adjustment of land development plans, and an improved urban/rural cooperation are prominent outcomes of social learning at all relevant levels.

3.6 Scenario 3 - Obstacles in energy transition

Scenario 3 focuses on factors which inhibit the implementation of intended energy measures and the region´s development in general. The consequences for the criteria are:-

Energy production - The North Sea region is confronted with an un-easy process in shifting the energy production to renewable sources. This is documented by a slight increase in overall energy production in the whole region. In 2020, 25% of the energy production will be related to renewable sources, slightly increasing to 35% in 2050. Onshore wind will be the main source of electric energy from renewables, while the contribution from offshore wind will increase only slightly due to difficulties in the acquisition of investments. The share of solid fossil fuels in the electricity mix will cut by half until 2050 and be replaced by fossil gas. In some regions, remaining coal fire plants are converted to co-fire generation and fitted with carbon capture and storage. Overall, the energy landscape in terms of infrastructures and producer-consumer relationships will not change fundamentally.

Energy consumption - The recent re-urbanisation trend continues. Within urban areas an increasing share of public transport leads to decreasing energy consumption in inner-urban transport. But at the same time, people tend to have more than one home. Long distance commuting as well as a significant increase in flights leads an overall increase in consumption by transport. Individual and goods transport are further based on fossil fuels. Heating systems are mainly based on oil and gas. Increasing living standards lead to an overall increase of energy consumption of 5% by 2050.

Energy efficiency - Energy efficiency is not a major part of public discussion or governmental action. Progress is solely achieved by technological innovations and the replacement of obsolete appliances and equipment. The North Sea Region has failed to achieve earlier goals as property owners hesitate to invest into insulation and more energy efficient appliances. High initial costs, unsolved problems with inaccurate installation of insulation and limited functionality of energy efficient cars or equipment slow down efficiency improvements. Fossil fuels and the related technologies are still recognised as the most reliable and most convenient technique.

Energy costs - Non-renewable energy will be the main factor for energy prices to be paid by the consumers. The energy costs tend to increase sharply as it is projected for the market prices for fossil and nuclear fuels. The energy costs will also be high. By 2050, wind will provide the lowest-cost renewable energy. Offshore will be less competitive than onshore due to continued technological difficulties. Within the North Sea Region, energy tariffs continue to differ on a sub-regional scale.

Technological Innovation – due to market and policy failures, low public interest as well as a consequence of decreasing efforts in research and technology, the further improvement of renewables technology is proceeding slowly. Marine renewables including off-shore remain a hardly exploited potential. Development of bioenergy and further wind generation, both on and off shore, stalls after 2030 while small scale wave and tidal projects help to maintain the contribution of energy generation from renewables. Despite a coal revival by 2020 with the commercialization of affordable and efficient carbon capture and storage technology, an increase of the efficiency of fossil energy plants remain an unresolved technological problem.

Societal Partners - The next decades will bring long term economic and energy crises. This results in significant quality of life losses and an increase in distributional inequalities. Less pressure on the energy system is related to a reduced economic growth. Increase in renewable energy resources is driven exclusively by economic interests of powerful investors. Sub-regions of the North Sea region with already strong economies and access to traditional energy resources and related infrastructure can benefit from this in economic terms, but some regions will face social problems as economically marginalized sub-regions as well.

Social changes - Changes of the societies interacting with energy behaviours and policies are constricted by market crisis and socio-ecological impacts over the decades to come. An aging population tends to continue economic

preferences. This also sustains traditional approaches to the energy sector both in terms of the fossil sources and market partners.

Policy making - Renewable energies are important for electricity production. However, the region has not been able to make further progress yet. After a euphoric phase the energy transition concept lost its attractiveness for policy makers. Single politicians stoke uncertainties about retroactive cuts in subsidies for renewables. This makes investors feel insecure and slows down the transition process. Network expansion is also slowed down as no interregional agreement on detailed routes was achieved yet and affected population opposes to new infrastructure facilities. Furthermore, the different parts of the North Sea Region follow their own agenda and a region wide energy concept is not actively pursued.

Economic development - Europe emerges from the crisis of the early 21st century weaker than before. Economies in other regions of the world are doing better than Europe. Some regions across the globe benefit from shale gas, cheap coal and the availability of natural gas while Europe suffers from policy disintegration and high energy prices. Around the North Sea Region this leads to a slowdown not only of the economy but also the take up of green energy. Areas with access to hydrocarbons still do relatively well while others suffer from the economic depression without having alternatives at hand, such as production and maintenance of renewable energies.

Social learning - The energy transition of the North Sea Region turns out to be a troublesome process. The fundamental disaggregation of social structures into separately acting sectors and individuals hampers the flow of ideas, information about promising experiments and the pooling of intellectual and physical resources. Severe consequences are (i) a low success rate of research and development projects, (ii) less qualified and trained people and (iii) no profound institutional improvement.

4. Stakeholder Sparring

Work package 2.7 Stakeholder Sparring runs alongside other work packages. The objective here is to engage in inter-active dialogue with key stakeholders drawn from the steering group and interested regional partners to feedback the results of the work as they emerge and shape future activities and policy recommendations. Three stakeholder sparring sessions have been scheduled:

- 7th May 2013 – Programme Evaluation Steering Group, Edinburgh
- 11th June 2013 –North Sea Region Programme's Annual Conference, Halmstad, Sweden
- 16th September 2013 – North Sea Star Stakeholder Workshop, TU Delft, Netherlands

The first two, within scheduled meetings of the North Sea Region Operational Programme, have been completed and the key results of these are outlined below. The objectives for the final session to be held in Delft in September are included as part of the section looking to the draft final report.

4.1 Session 1 - Programme Evaluation Steering Group, Edinburgh

The meeting of the Programme Evaluation Steering Group in May 2013 provided a timely opportunity for the first stakeholder sparring session. This was attended by members of the North Sea Programme secretariat and national contact point representatives for the UK, Netherlands and Denmark, as well as representatives of the project team. Key points of discussion included the initial results of the energy policy and data collection work packages and it was agreed that the general direction and outputs of these elements provided useful context setting material for developing the energy dimensions of the next North Sea Operational Programme. The meeting also considered the proposed methodologies for the Case Study and Scenario work packages and some useful advice was received on ways in which these could be refined and developed.

The main item for consideration was however the focus of the second stakeholder sparring session which would form part of the North Sea Programme annual conference. Initially the project team had proposed that this would focus on the scenario work package, but it was felt that the 3 x 20 minute workshop format wouldn't allow sufficient time to deal with this material. It was agreed that stakeholders would be more likely to participate in the workshops if they could see an obvious benefit, such as helping to shape future policy or project development and that the focus of the workshop sessions should be devised with this in mind. It was agreed instead that the scenarios should be included as a key element of the final project focussed stakeholder sparring event in Delft where more time would be available and a more targeted audience would be invited to attend.

4.2 Session 2 - Stakeholder Workshops at the North Sea Programme Annual Conference

Following the inputs from the Edinburgh meeting, the team recast the three 20 minute workshop sessions that had been allocated as part of the annual conference programme to obtain stakeholder views on matters related to the future design of the Operational Programme.

Workshop 1: Added Value of Cluster Projects was designed to inform the review of cluster projects and asked delegates what added value joining a cluster could bring as well as their views on how clusters might be organised in future programmes with added value in mind.

Workshop 2: Ensuring On-going Impact of Projects asked delegates to identify aspects of good practice in project and programme design that could help ensure continuing impact of findings and outputs beyond the period of project funding.

Workshop 3 Future Energy Related Projects asked delegates to suggest where the priorities for future energy related projects within the next North Sea Operational Programme should be. This workshop in particular was informed by previous discussions at the conference related to the potential focus of the future programme around the EU's Innovation, Environment and Transport thematic priorities.

The focus of the workshops proved to be popular and between 10 and 20 delegates attended each of the sessions. Each included a mix of stakeholders including project partners involved in previous energy related projects and national contact points. After a short introduction the issues were open to the floor for discussion and stakeholder responses were recorded on a flip chart. As time was short, delegates were also provided with post-it notes so that they could record any observations that they were unable to express within the sessions themselves. These were collected at the end of the sessions and the combined results are presented Tables 5, 6 and 7 below in as faithful a format as possible for each workshop. There is no doubt that the workshops produced some very useful stakeholder inputs that can help to inform the development of the next operational programme and have provided a significant reference point for the team's initial options for policy development set out later in this Interim Report.

Table 5: Workshop - Added Value of Cluster Projects

Why Join a Cluster Project? • An opportunity to make contact with areas that you wouldn't have been able to without it • Can help encourage projects when they have got going • Joining forces can create added value • Clusters can help projects talk to each other and develop synergies • It helps to develop a more holistic perspective • It can enable broader refection on project results • It can provide new perspectives on the same issues • It provides greater collective weight and influence for project results • 'Size matters' – helps to gain more attention by doing things together • It can help feed new projects
How should clusters be organised in future programmes? • The approach should be included in the next programme and the programme secretariat could come up with 2 – 3 different structures /ideas for clustering/cooperation • Clusters can be both subject and region based – in the current programme some regions have brought local projects together to help focus regional attention on what is going on and achieve programme goals • Development of the approach in the next programme could draw upon some of the thinking related to industrial clustering • There is value in a bottom up approach where projects take responsibility for clustering and including a variety of stakeholders • Even if they are not attached to clusters, all projects could benefit from being required to attend and present at wider INTERREG meetings to promote wider learning. • Involvement in clusters is not necessarily helpful at the very start of projects – better 1 – 2 years in when projects have become established. • However, relatively early establishment of clusters can help provide peer feedback and assist the iterative development of projects • Clusters need a common challenge to convene around • Clusters should be encouraged to think about the legacy of the cluster

Table 6: Workshop - Ensuring On-going Impact of Projects

How can the impacts of projects be sustained after their completion?
• During the project it is important to engage and involve different stakeholders from the public (including politicians), private and voluntary sectors to encourage a sense of ownership • The process of engagement is more important than content – the aim should be to establish an active network of stakeholders in a user friendly way and to develop a sense of share experience • Communication with different groups may need different approaches. Imaginative means of regularly updated communication including social media and interactive methods should be considered. • Stakeholders should be specifically encouraged to engage with the results of projects • Clustering and the added strength of a wider group can help to sustain impact. • A stakeholder forum may be a means of engaging a wider community and ensuring resilience in the longer term. • European Networks of Territorial Cooperation can provide a mechanism for parties to join together and collaborate beyond the end of projects. • On-going impact should be included as one of the criteria in the application process but at the same time it should be recognised that a proliferation of networks may not necessarily to a good long term goal. • The value of organisation level learning and on-going commitment at the project partner level should also be recognised and this can be encouraged by focussing projects around the key interests of partner organisations. • Consideration should be given to the receivers of the project results and whether they feel a responsibility to carry forward the ideas – discussion of the ownership of results should be included in project proposals. • Formal publications of the project findings – perhaps in the form of a book can help keep project ideas alive after staff have left. • Create an infrastructure for dissemination like an E - library of project results – project websites can disappear quite quickly after the end of a project. • It is important to recognise that the results of an INTERREG project are not just about networks and reports. • In addition to reports it could be more effective if projects could explain their results verbally perhaps in an interview session with JTS staff.

Table 7: Workshop - the Future of Energy Related Projects

Where should the priorities for future energy related projects be?

In a period of reducing fears about energy security and shifting political perspectives on action on climate change is there a need for a new driver for energy matters?

The programme should focus on areas that are deliverable within the scope of the resources available.

This might suggest a focus on:

- Energy efficiency and 'price - cost cutting' could be a consumer driver and within this energy efficiency in transport is a key issue for the North Sea Region.
- The North Sea is the premier maritime land/sea gateway of Europe – this could potentially be a key unique feature of the region to focus energy projects around – this could be extended to include integrated approaches with neighbouring regions such as the Baltic aimed at achieving wider benefit. (A good idea – there is some magic in this!)
- Liquefied Natural Gas Infrastructure for shipping will be available in North Sea hub ports by 2015 and there is a need to develop unified quality standards and maybe use this system for other transport modes e.g. trucks
- Business Innovation – energy related business development is facing difficult market conditions at the moment but there may be project opportunities related to energy regime constraints to help businesses with green energy aspirations and uptake
- North Sea waves, wind, tide and sea provide base for future renewable energy production and innovation in this area. Harvesting this natural resource could also be seen as a unique thing for the North Sea region.
- Energy supply and EU energy grid matters are more topics for national governments and core EU activities, but issues of local energy storage might be a useful topic for INTERREG – building flexibility into energy systems and encouraging integration could be a theme for the next programme.
- Social ownership and engagement with energy issues

Energy generally was seen as a cross cutting theme with related possibilities across the dimensions of innovation, environment and transport, rather than a theme in its own right. There seems to be much scope for community building using energy as a driver.

4. 3 Initial Options for Policy Development

The following initial thoughts on options for policy development have been based on the interim findings of the North Sea STAR project. In particular they have drawn upon the outputs of the three stakeholder sparring workshops that were held at the North Sea Operational Programme annual conference held in Halmstad in June 2013 as well as insights gained from a range of other stakeholder meetings associated with the case study work package. The ideas are provisional and will be subject to further discussion and development not least at the final stakeholder sparring event that will be held in Delft on 16th September 2013.

Energy within the next North Sea Operational Programme

1. **If the take up of renewable energy is to be accelerated then energy must be explicitly included as a cross-cutting theme in the next North Sea Operational Programme. Serious consideration will need to be given to how energy projects are facilitated in the next programme, possibly in terms of explicitly highlighting where energy projects fit within the thematic priorities of the operational programme.**

   Within the current programme there have been seventeen energy related projects within the 71 projects funded. However we have noted how the political imperatives and drivers of the energy transition are potentially slipping down the political agenda as jobs, growth and economic recovery predominate. Furthermore in the next Programme a balance will need to be struck between safe projects that might deliver clear and measurable outputs compared to more risky experimental ideas that might promote transformational change, this for example might relate to the move towards a more bio-based economy.

   It is noted that energy has not emerged as a thematic priority in its own right in the current discussions about the shape of the future North Sea Operational Programme, though each of the selected themes – Innovation, Environment and Transport do have significant energy considerations embedded within them and it is envisaged that energy will continue to be important within the EU policy context. Although for some North Sea countries the recent detection of new fossil fuel reserves may mean that concerns about energy security could decline as a motivation for energy project development, concerns about competiveness and climate change are likely to remain to the fore. However evidence from the United States is suggesting that renewable energy or energy efficiency businesses are increasingly struggling as more traditional energy costs are reducing, meaning that market conditions are not so conducive to energy related innovation. Its potential inclusion as a cross-cutting theme would therefore be an imperative to help ensure that appropriate and continuing prominence is given to energy matters in the next programme.

2. **Under the Innovation thematic priority the following types of energy related projects could be promoted: local energy storage; building local flexibility into energy systems; encouraging integration across different sources of energy; technology transfer between research institutions and the market; and institutional innovation related to supply and demand.**

   While the North Sea Region offers significant scope for continuing technical innovation particularly in relation to wave and tidal power and in other aspects of energy production, developments here are highly capital intensive and matters to be addressed by national governments and the EU in tandem with the private sector. Instead it is suggested that it is more appropriate to focus the resources of the future North Sea programme on encouraging innovative decentralised energy projects related to increasing green energy supply and demand at the local level. In this context there is much potential for institutional innovation with new roles for public and community-led initiatives in the energy field.

3. **Under the Environment thematic priority the following types of energy related projects could be promoted: projects that facilitate a shift away from a fossil fuel based economy to a bio-based economy; climate change mitigation such as projects encouraging resource efficiency; and climate change adaptation including projects developing green infrastructure.**

   Key challenges under the Environment thematic priority relate to industrial transition towards resource efficiency and promoting green growth. Again energy issues lie at the heart of this agenda not least in terms of the fundamental shift that is likely to take place over the next century as we try to move from a fossil fuel based economy to a more sustainable and environmentally benign bio-based economy. Support for small scale bio-based energy projects like BIOCHAR and ENERCOAST developed under the current programme will continue to be important in this context. In addition climate change mitigation and adaption will remain core concerns and energy related projects connected to both spheres could be closely connected to the promotion of green growth in the North Sea region.

4. **Under the Transport thematic priority the following types of energy related projects could be promoted: projects related that encourage energy efficiency and green energy use within different transport modes (shipping, rail, road, etc.); transport logistics projects that promote intra and intermodal integration and efficiency; and projects that encourage businesses and individuals to the shift to greener transport modes.**

   The North Sea region is the premier maritime land/sea gateway of Europe and this could be a key unique feature of the region to focus energy projects around. Transport and logistics projects related to green shipping such as OPS systems, multimodal use of the emerging LNG infrastructure available at ports, and innovative approaches to city logistics illustrate the potential of the programme to play an important part in stimulating improvements in the energy performance of one of the key areas of energy consumption in the

North Sea Region. As the bridge head to most other parts of Europe, this could be extended to include integrated approaches with neighbouring regions such as the Baltic aimed at achieving wider benefit.

Design, governance and administration of projects within the next North Sea Operational Programme

5. The concept of project clustering and cooperation should be maintained and enhanced as part of the next North Sea Operational Programme

The outputs of the Halmstad workshop on clustering, together with the early interviews that have been undertaken as part of the Case Study work package indicate broad support for the idea of clustering projects and other forms of project cooperation. Project partners feel that clustering can add value by helping projects talk to each other, learn from others' experience, develop wider synergies and a more holistic perspective; and provide greater collective weight and influence for project results. As a consequence it is suggested that the approach should be retained as a feature in the new programme.

6. Consideration could be given to developing different models of clustering/cooperation in the new programme reflecting different roles that such arrangements might play.

The outputs of the Halmstad cluster workshop indicate that there is scope however to develop the idea of clustering further. For example different models of clustering/cooperation could be included involving clustering on a thematic and geographic basis and /or at a range of different scales - national, transnational, and cross transnational regions. Equally, a spectrum of formal and informal arrangements could be envisaged perhaps reflecting different purposes and offering all projects the opportunity of some level of wider engagement /cooperation. It is also felt that there could be benefit in combining top-down cluster formation with bottom up approaches where project partners can extend or build cluster themselves. In addition thought could be given to the organisation of clusters in terms of the timing of formation, nature of added value and legacy.

7. In order to promote on-going impact and a sustained legacy of projects, it is suggested that closer attention to these matters in project design and evaluation could be included in the new programme.

The output of the Halmstad workshop on the on-going impact of projects suggested that in many instances this was an important issue and could be promoted through project design and selection processes. For example, project activities can help to embed project ideas within partner organisations and in the wider community (at a range of different scales) and encourage subsequent uptake in policy and practice by building thoughtful stakeholder engagement and dissemination strategies into the project design. Effective stakeholder engagement and ownership of project ideas beyond the life of a

project could be built into assessment criteria for projects as a mechanism for encouraging greater attention to these issues in the next programme.

8. **In order to promote on-going impact and a sustained legacy of projects, consideration could be given to more consistent approaches to project dissemination of project results in the new programme.**

   Delegates at the Halmstad workshop on on-going impact noted that another way to support the on-going impact of projects when projects have finished would be to encourage a more systematic approach to dissemination of project results. At present project websites can disappear soon after projects close and collation of information on the North Sea Operational Programme website is variable. This means that wider and on-going learning from project results can be compromised. To improve this situation consideration could be given to requiring all projects to produce a synthesis report which can be made available on the programme web portal.

9. **In order to help accelerate the uptake of renewable energy technologies and supporting green economic activities better sub-national information is required across the North Sea region in order to monitor performance and provide an base for targeting projects.**

   The research has confirmed that at a European scale much of the available energy related data is only available at NUTS 0, the scale of the nation state. Within countries there is a growing availability of energy related data at different spatial scales, however because it is collected in slightly different ways in different national jurisdictions it is impossible to consolidate into a picture of what is happening across the region as a whole. Developing scenarios that are more quantitatively informed will require more consistent data inputs.

5. Proceeding Towards the Final Report

The Draft Final Report is due on 31st December 2013. There are a number of activities to be completed before this can be produced, including the completion and synthesis of the case study reports, reflecting on feedback on the scenarios workshop and other feedback from stakeholders. The case study methodology and scenarios approach has been detailed elsewhere within this report and is not repeated here, we do however outline the objectives, purpose and structure of the Stakeholder sparring session to be held in Delft on the 16th September 2013.

5.1 Final Stakeholder Sparring Event – TU Delft, September 2013

The purpose of this final stakeholder workshop is to discuss the potential for energy related projects in the North Sea Region Operational Programme for 2014-2020. In addition the role of the energy scenarios as a tool to help monitor and guide the Programme in contributing to the 20-20-20 goals will be considered. More specifically the objectives of the workshop are:

- To engage stakeholders (current project beneficiaries, future project partners and policy makers) with the North Sea STAR project and the draft Operational Programme for the North Sea Region.
- To provide an overview of current global/European/national energy policies shaping the transition to a low carbon, resource efficient economy.
- To outline different scenarios for progress towards Europe's 2020 energy targets and beyond and examine their likely implications for energy planning.
- To find ways that the North Sea Region Programme Secretariat can contribute to more positive outcomes for energy planning through project development.

Anticipated outcomes include:

For the project team:

- To road test and agree on likely impacts of each policy scenario,
- To supplement information on existing energy projects/case study evaluations,
- To gather ideas for the type of energy projects or ways of organising projects (clusters?) that should be supported in the next Operational Programme.

For participants:

- To gain a better understanding of current energy policies and programmes shaping development in the North Sea Region,

- Opportunities for networking with other NSR projects and potential project partners,
- The chance to influence the development of energy-related projects in the next OP.

5.2 Draft Final Report

In terms of producing a draft final report and drawing upon the ESPON generic template and our Annex III of the contract, the following draft and indicative table of contents for comment are proposed:

A. Executive summary

1. Analytical part including key messages and findings
2. Options for policy development which will be substantive, procedural,
3. process and technical in nature and can be applied at a variety of different scales (e.g. local/regional national, North Sea/Transnational Programme and European level)
4. Suggestions for further analysis/research

B. Main Report

1. Main Results

- Evaluation of the effectiveness of European, national and regional energy policies;
- Elaboration of the most likely future energy scenarios for the North Sea Region;
- An assessment of the role of transnational cooperation projects in contributing to the Europe 20-20-20 goals, ascertaining the added value of a project clustering approach; and
- Providing recommendations on accelerating the take-up of renewable energy technologies and supporting relevant green economic activities in the North Sea Region

2. Summary/synthesis reports based around

- Energy policy
- Data availability and limitations
- Case study overview
- Scenarios development

3. Options for policy development (basis for interventions related to development opportunities relating to energy and the North Sea Region Programme.

- As an applied research project the results are primarily orientated towards the needs of the client, in this case the programme secretariat for the

North Sea OP, in relation to the key aims of the project outlined above. However many of the key findings, whilst having a focus on the North Sea Transnational area, will have relevance to other policy makers and the ESPON community, for example, there could be generic lessons on the role of energy projects and the management of clusters that enable added value to be gained from other transnational projects.

4. Key analysis / diagnosis / findings and the most relevant indicators and maps.

5. Issues for further analytical work and research, data gaps to overcome.

C. Scientific report

1. Introduction
- Project Aims and Objectives
- Methodology

2. Research Findings

3. Data Availability for Energy Policy in the North Sea

4. Energy Policy Reviews
- European
- National
- Synthesis Report

5. Case Study Reports
- Eight project reports, two cluster reports and a synthesis report

6. Synthesis Report from Stakeholder Sparring

7. Scenarios Overview Paper

8. Annexes to the Scientific Report
- List of Abbreviation and glossary
- List of References including the use of results from projects outside the ESPON 2013 Programme
- List of Publications and Presentations of the TPG members resulting from the targeted project
- Bibliography

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