North Sea STAR
Spreading Transnational Results

Targeted Analysis 2013/2/23

MAIN REPORT

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This report presents the final results of a Targeted Analysis 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.

This report does not necessarily reflect the opinion of the members of the Monitoring Committee.

Information on the ESPON Programme and projects can be found on www.espon.eu

The web site provides the possibility to download and examine the most recent documents produced by finalised and ongoing ESPON projects.

This basic report exists only in an electronic version.

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Taken from the *EU Energy in Figures Statistical Pocketbook, 2013*

Renewable Energy
For the purposes of this research and ease of measurement across the countries of the North Sea Region, the definition of renewable energy is taken from DG Energy and includes hydro, wind, solar (photovoltaic and thermal), geothermal, tidal and biomass.

Available for Final Consumption (Energy)
Energy available for final consumption covers the energy made available to final users. This is calculated as follows:
gross inland consumption + transformation output – transformation input + exchanges, transfers, returns – consumption of the energy sector – distribution losses

Energy Import Dependency
Energy dependency shows the extent to which a country relies upon imports in order to meet its energy needs. It is calculated using the following formula:
net imports / (gross inland consumption + bunkers)

Final Energy Consumption (FEC)
Final energy consumption covers energy supplied to the final consumer's door for all energy uses. It excludes deliveries to the energy transformation sector and to the energy industries themselves. It is the sum of final energy consumption by industry, transport, household, services, agriculture/forestry, fishing and other unspecified.

Gross Final Consumption of Energy
Gross final consumption of energy means the energy commodities delivered for energy purposes, including the consumption of electricity and heat, by the energy branch for electricity and heat production including losses of electricity and heat in distribution. It excludes the final non energy use (FNEC).

The gross (overall) final consumption of energy from renewable sources is calculated as the sum of: (a) gross final consumption of electricity from renewable energy sources; (b) gross final consumption of energy from renewable sources for heating and cooling; and (c) final consumption of energy from renewable sources in transport.

Primary Energy Production
Any kind of extraction of energy products from natural sources to a usable form is called primary production. Primary production takes place when the natural sources are exploited, for example in coal mines, crude oil fields, hydro power plants or fabrication of biofuels. Transformation of energy from one form to another, such as electricity or heat generation in thermal power plants, or coke production in coke ovens, is not included in primary production.

Total Primary Energy Supply (TPES)
Total primary energy supply, an IEA definition, represents the quantity of energy necessary to satisfy inland consumption of the geographical entity under consideration. It corresponds to Eurostat gross inland consumption. It is equal to the indigenous production + imports – exports - international marine bunkers +/- stock changes.

1. Introduction and Outline of Methodology

As Europe emerges from the economic crisis a renewed period of structural fund programmes are about to be launched, promoting what is known as 'smart, sustainable and inclusive growth'. Within this new funding period (2014-2020) 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 aiding recovery and promoting growth. Hence Operational Programmes are being asked to frame their actions and priorities drawn from a list of eleven thematic priorities identified in the Common Strategic Framework.

The North Sea STAR project is an ESPON Targeted Analysis based on user demands. It is focused on the experience of energy related projects within the current North Sea 2007-2013 Operational Programme with a view to providing advice and guidance as to how energy (and related) issues should be addressed in the next Operational Programme.

Thus the 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 energy project clusters; and
- Provide recommendations on accelerating the take-up of renewable energy technologies and supporting relevant green economic activities in the North Sea Region.

For the purposes of this research, the definition of renewable energy is that used by DG Energy and Eurostat for the purposes of measuring progress towards renewable energy targets and includes natural sources such as wind, hydro, solar photovoltaic, solar thermal and geothermal power, and manufactured/processed sources such as biomass and organic waste materials.

In order to achieve these objectives the research team has focused on the following tasks:

- 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 energy project clustering approach.
- To provide policy recommendations related to how both the governance arrangements for transnational co-operation and the delivery of regional energy

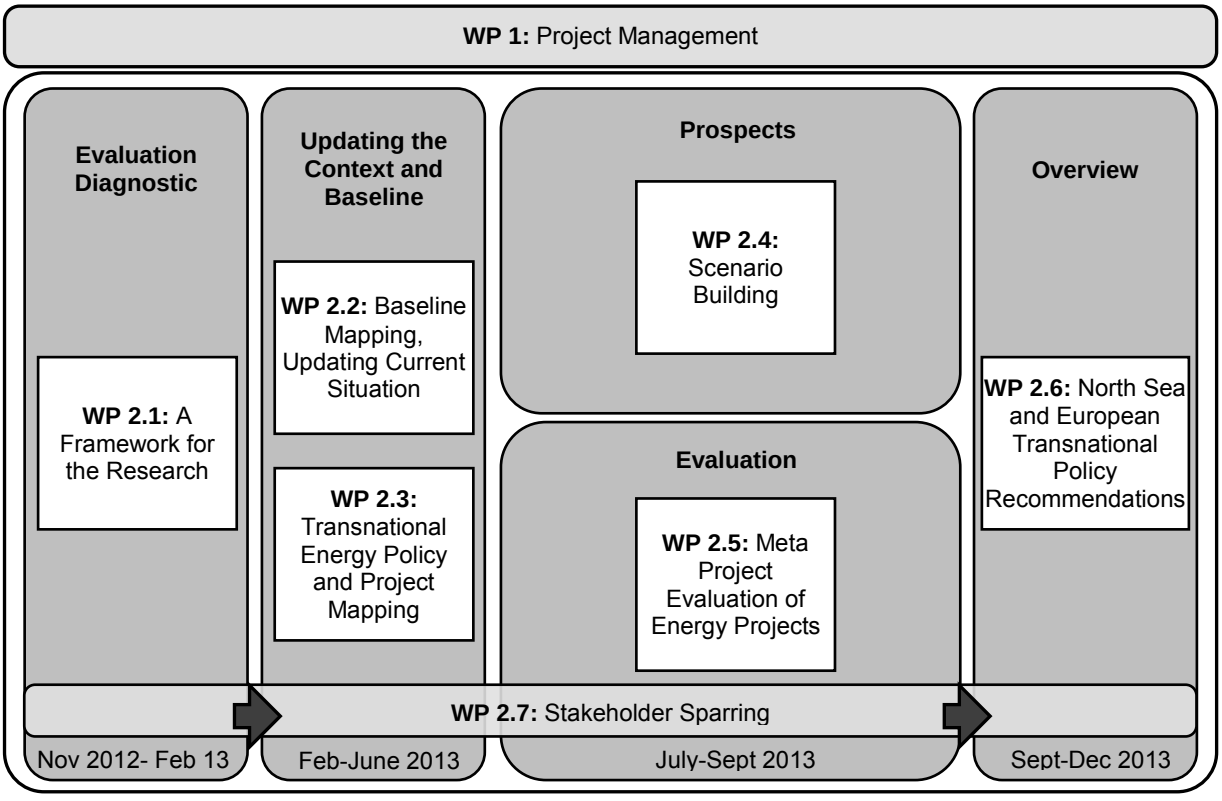
self-sufficiency can be improved in relation to the prospective post 2013 funding period.

It is recognized from the outset that the North Sea Region is not self-contained and behaves as a 'prosumer' in that it produces energy, it consumes energy for regional development and it imports/exports its energy to and from other regions. To this extent the concept of regional self-sufficiency is likely to be contested because energy production and consumption largely operates within national and international markets. Furthermore it is important to emphasise from the outset that although the opportunities for projects within any transnational Operational Programme to make major impacts in wider energy debates are limited, the scope for significant transnational learning should be not under-estimated.

1.1 Research Approach

In order to answer the aims and objectives outlined above, the research approach follows five key stages, shown in Figure 1 below. Following on from developing the initial research framework we engage in a context setting and baseline mapping exercise in order to understand the European, national and regional policy context in relation to the Europe 20-20-20 energy debate, and also to identify and map the existing regional energy situation.

Figure 1: Overview of Research Approach



Then, in the prospect stage, this baseline mapping is used to develop future energy scenarios for the region. In parallel with this, the evaluation stage provides an analysis of the efficiency and effectiveness of energy related projects under the current North Sea Region Operational Programme, in particular considering whether the clustering approach to energy projects adds significant benefits. Running

alongside these stages the research team has engaged stakeholders through what is known as stakeholder sparring. These elements contribute to the final stage, a synthesis of the findings and policy recommendations. This approach is elaborated further in the following sections (and in the Scientific Report).

1.2 Mapping Activities

Following on from an initial search for energy data sources at international, European and national scales, (which was included in Annex 2 of the North Sea STAR Inception Report), an evaluation of data comprehensiveness and compatibility was undertaken. This evaluation assessed which data sets could 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 of this work is provided in Chapter 2 the Scientific Report, alongside a discussion of the use of other ESPON results and tools to provide further contextual information and new data that might be relevant to the North Sea Region Secretariat.

1.3 Policy Review

A review of energy related policy activities was undertaken at a number of different spatial scales: European, national and sub-national (regional and local) were explored to provide the context for the research.

At the European scale the focus of the review was to better understand the different policy drivers and targeted aspirations which could be used to frame national and regional policy agendas.

For each of the countries within the North Sea Region a report on their energy production and consumption trends was produced, paying particular attention to whether there were any sub-national variations in the approaches. The country reports were expected to be provided in a common format so that a synthesis report could be produced, and provided baseline data should on energy production, consumption and main trends, a discussion of energy policy drivers, particularly on supply and demand issues, and identification of any specific trends in regional energy production/consumption or policies (within regions) that may be different from national level.

1.4. Scenario Building

The scenario building is essentially a gap analysis designed to explore the differences between the existing situation and the 2020 and reasonable 2050 aspirations for carbon reduction and the use of renewable energy.

In order to arrive at comparable scenarios for further discussion and consideration the following steps were undertaken:

1. The characteristics of three reasonable development pathways were described and comprehensive narratives compiled.
2. An analytical framework for the evaluation of crucial aspects and drivers for change was developed.

3. Critical aspects of the development of the Scenarios were road tested through workshops.
4. The key elements for future spatial energy development plans were identified.

1.5 Case Studies

Case studies provided the opportunity to:

- Reflect on the impact of energy related projects in the North Sea Region
- Explore the effectiveness of project partnerships and
- Assess the role of added value of transnational cooperation projects, and
- Ascertain the added value of a clustering approach within the two clusters of energy projects.

Eight case studies of individual North Sea Region energy projects were selected for further analysis alongside two clusters of energy projects. Clusters are thematically linked groups of projects that have been developed to pool existing results and develop a package of activities that will increase the long-term impact of these results – through identifying new ideas within the cluster, gaining a stronger voice in policy discussions and drawing in new stakeholders. Within the North Sea Region Programme five clusters of projects have been funded – Digital Agenda for the North Sea (DANS), the Maritime Transport Cluster, Water Management in a Changing Climate (WaterCAP), and the two that are the focus of this project – Energy Vision North Sea Region (EVNSR) and Low Carbon Regions in the North Sea (LOWCAP).

The two clusters and eight case study projects that have been selected are listed in Table 1 below.

Table 1: List of Selected North Sea Region Case Study Projects

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

The case studies were undertaken by means of documentary analysis and interviews with key stakeholders.

1.6 Stakeholder Sparring

Stakeholder sparring ran in parallel to all the other work packages. The objective here was to engage in an inter-active dialogue with key stakeholders drawn from the steering group and interested regional partners to feedback the results of the work as they emerged and shape future activities and policy recommendations.
Three stakeholder sparring sessions were held:

- 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

1.7 North Sea and European Transnational Policy Recommendations

This concluding section seeks to draw all the components of the research together in in order to make evidence based policy recommendations where appropriate. More detailed analysis of the research approach and findings are provided in the Scientific Report and supporting Annexes. A summary of the findings and recommendations are included in the following sections of this Main Report.

2. Data Availability

As part of the North Sea STAR project, a comprehensive analysis of energy data at international, European and national levels has been undertaken in order to underpin two main aspects of the research. First, to provide a characterisation of the North Sea Region and consider the main trends related to energy production and use. This in part also helps to increase understanding of the notions of "energy self-sufficiency" in the region. Secondly, this data was intended to form the basis for developing North Sea Region energy scenarios.

An initial overview of potential data sources was presented in Annex 2 of the North Sea STAR Inception Report. In this overview data sources at international and European level were analysed, including mainly databases generated and updated by international organizations and boards, research centres or enterprises and outputs from international collaborative projects. The availability of energy data from national and regional sources were also examined as part of the national energy reports. A final source of information was the data provided by ongoing or completed ESPON projects, which was presented in Annex D of the Interim Report.

In order to assess the quality and relevance of the data provided, the following criteria were applied:

- Geographical coverage: data should provide complete geographical coverage of the North Sea Region.
- Scale: Where appropriate, data should be available at lower geographical units, e.g. NUTS2, NUTS3. This is particularly important where only part of a nation's territory is part of the North Sea Region Programme Area, for example the west of Sweden or the east of England and Scotland.
- Time series: availability of data over longer, fixed intervals of time.

This extensive data search produced mixed results. At the international/European scale, data availability is generally good in terms of geographical coverage and comparability over longer periods of time; however this data is frequently reported at national (NUTS0) level (for example by Eurostat). In some cases, data provided by research centres or international projects (such as the ESPON Programme) is good in terms of geographical coverage and scale, but is frequently old and there are few or no resources to update what is already available.

At national levels, data availability are dependent upon the country and on the thematic field, but in most cases the availability of energy data for the most important indicators (data on production, consumption, electricity generation and energy intensity) at a sub-national level is poor and not always coherent and compatible. Some specific datasets are provided by different countries at regional level, such as potential of wind energy or capacity of inland wind turbines (Belgium), but much of this is determined by national interests in particular energy topics. Furthermore, national statistical offices do not provide the same indicators in different countries, and statistical definitions of the indicators can have small variations (e.g. *final energy consumption* is not the same as *energy available for final consumption*), creating further difficulties in providing a clear picture of the current energy situation for the North Sea Region.

Within the suite of ESPON projects, maps providing mostly contextual information on the North Sea Region (for example resilience to climate change impacts and location of oil and gas fields) were provided on a Europe-wide basis. In this respect, the CLIMATE and European Seas (ESaTDOR) projects were most useful. In addition, the Transnational Support Method for European Cooperation (TransMEC) project suggested a number of mapping tools that could be used to assess the performance of the North Sea Region Operational Programme and steer new investments in energy projects. These have been evaluated (in Chapter 2 of the Scientific Report) and where possible variations on these tools have been used to capture and analyse information relating to the case study projects.

For the purposes of this project, the following new energy maps have been created using Eurostat data:

- 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

A separate set of maps, showing the distribution of partners in energy projects has also been created using data from the North Sea Region Programme and project applications.

Due to the lack of detailed energy data for the North Sea Region, a more pragmatic approach has been taken to the development of energy scenarios. These have been based on a more qualitative approach, using policy documents and targets to inform future trajectories for the achievement of the 20-20-20 goals and further ambitions up to 2050. The scenarios are discussed in Chapter 6 of the Scientific Report. Suggestions for improving the availability and comparability of energy data are also provided in Chapter 2 of the Scientific Report.

3. Putting the North Sea Region in Context

Introduction

The purpose of this chapter is to provide a very brief contextual overview of the situation in relation to energy supply and demand within the North Sea Region as defined by the Interreg IVB North Sea Region Programme Area (see Map 1 below). The North Sea Region extends beyond the North Sea basin and includes parts of the neighbouring countries of United Kingdom, Belgium, Netherlands, Denmark, Sweden and the whole of Norway. Hence its maritime reach extends into the Arctic.

The section is divided into four parts. The first describes, in broad and general terms some of the characteristics of the region, particularly focusing on the supply and demand for energy. The second part identifies the critical European policy contexts, within which national and regional policy sits. Next, national policy contexts and energy trends for the countries surrounding the North Sea are given in brief. The final section of the chapter explains the rapidly changing and evolving policy context of the North Sea Region which is the focus of this research. It explains the policy context within which the case studies were framed and the evolution of thinking for future action.

3.1 The North Sea as an Energy Region

This section seeks to briefly describe the dominant characteristics of the region, its current role and potential with regards to energy production and consumption. Our analysis here draws largely on other ESPON related projects, particularly within the recent past *Specific Types of Territories* (GEOSPECS), CLIMATE and *European Seas and Territorial Development – Opportunities and Risks* (ESaTDOR). Some of the earlier projects provide a context, although some of their data is a little old, nevertheless the key messages remain pertinent and can be reinforced with reference to more recent data.

Map 1: The North Sea Region

Structural Funds 2007 - 2013: Transnational Cooperation North Sea

EU27 Cooperation areas

Other cooperation areas

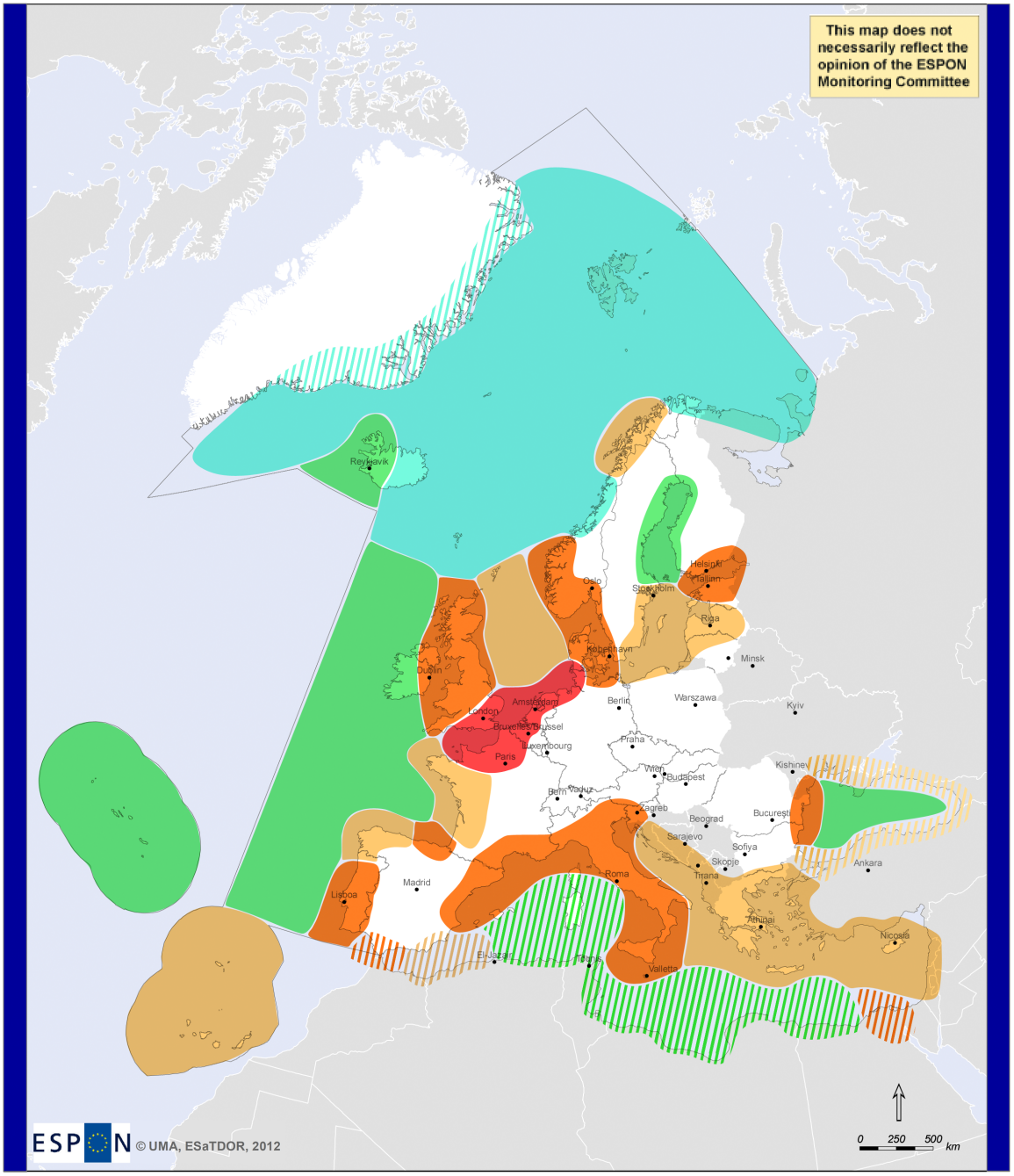
0 500 Km

Source: DG Regio

In European terms the North Sea Region can be described as an area of intense activities, with access to large, although arguably declining oil and gas reserves, but with significant potentials for marine renewable energy. However this broad characterisation hides variations in the intensity of activities across the region. Based on land and sea interactions, the ESPON ESaTDOR project has created an initial typology which differentiates parts of the North Sea Region, based on an analysis of the relative intensity of relevant activities (for which information was available) to visualise hot and cold spots where this activity is most or least intense respectively. Three broad categories of information were used in constructing this typology: economic activity (which is largely land based), flows of goods, services and people (through the seas but originating or finishing on the land) and environmental pressure (within the sea). The results reveal the diversity of opportunities and risks that are evident across the North Sea Region (Map 2). The European Core exhibits an intensity of land sea interaction focused on the southern end of the North Sea Region. This European core is coincidental with what has been recognised for many years, as the “Pentagon” at the centre of Europe.

The importance of land sea interactions here is based on the area acting as the predominant gateway between Europe and the rest of the world. From this hub a significant proportion of Europe’s goods and services are transhipped throughout Europe, either via short sea shipping activities or through inland transport networks. Beyond the core two regional hubs can be identified, although the lack of available data particularly within the marine environment probably leads to underplaying of the links between the two regional hubs, one which focuses on the west coast of the United Kingdom, and from Denmark through to southern part of Norway, focused around Oslo. Between these two regional hubs, the marine part of the North Sea has been characterised as a transitional zone, indicating an area that is being used for a variety of different activities, including oil and gas extraction. To the far north, the wilderness represents a remote and environmentally fragile region; however this area is increasingly becoming the focus of attention for further oil and gas exploration.

European Maritime Regions



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Thematic data: Typology Map, Economic Significance and Environmental Pressures Composite Maps
Land boundaries: © EuroGeographics Association and ESRI. Regional level: NUTS2.
Sea boundaries: OSPAR Convention, EU Integrated Maritime Policy and EEZ.

Regions derived from typology map

- European Core
- Regional Hub
- Transition
- Rural
- Wilderness
- Typology influenced by lack of data

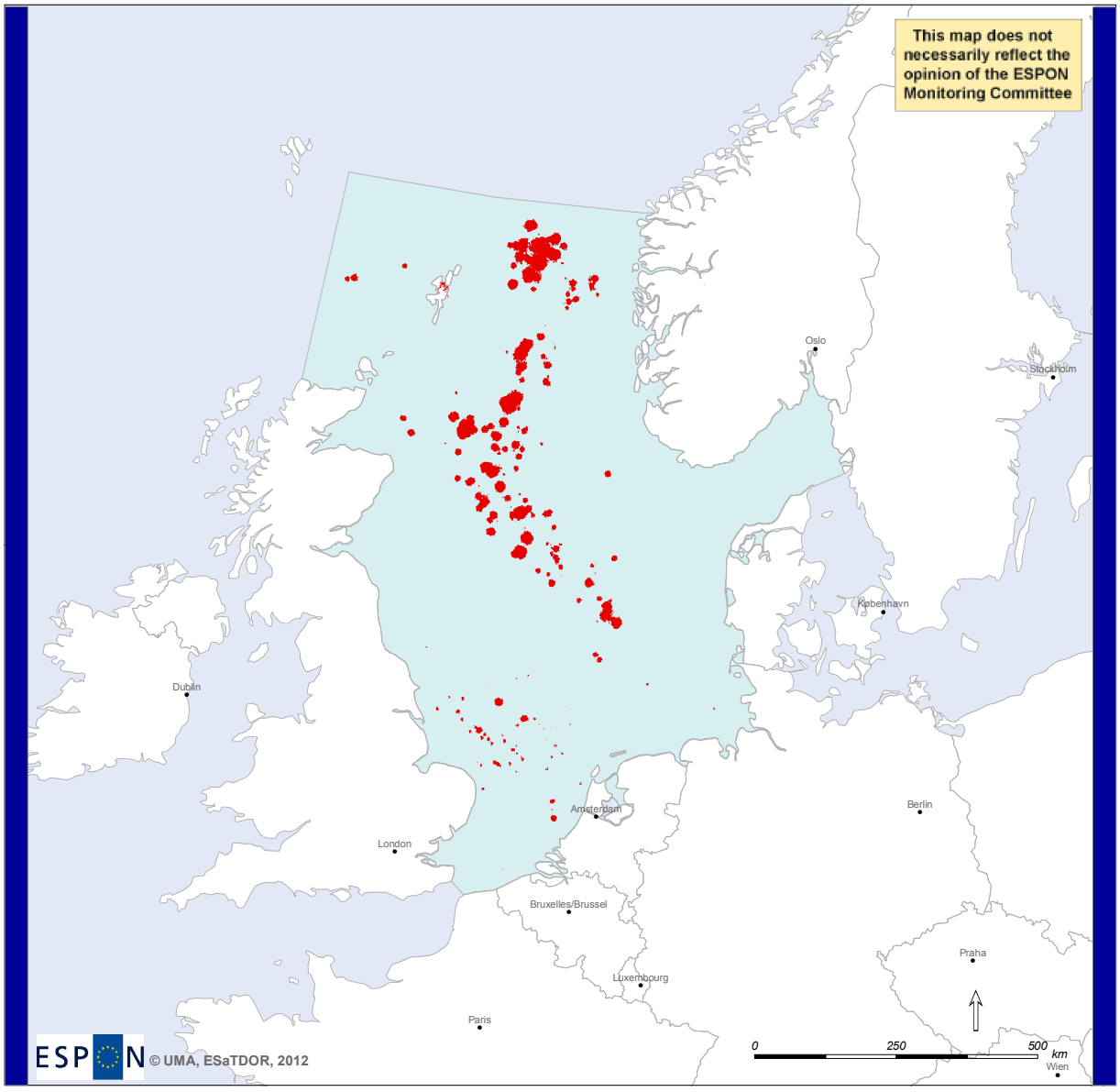
This schematic typology map shows Europe's coastal and maritime regions classified based on the intensity of land-sea interactions (economic activities, flows of goods, people and information, environmental pressures). These interactions are greatest in the Core and at their lowest in the Wilderness.

Source: ESPON and the University of Liverpool (2013)

Map 2: Typology of European Maritime Regions

The North Sea's importance as an energy producing region is also demonstrated by the ESaTDOR project, which highlights the location of offshore oil and gas installations (Map 3) and ports handling large volumes of liquid bulk cargo (Map 4), notably in Antwerp, Rotterdam, Amsterdam and Bergen.

Location of Oil and Gas Rigs



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Thematic data: National Center for Ecological Analysis and Synthesis based on data from NOAA's National Geophysical Data Center, 2008; HELCOM and LOTOS Petrobaltic S.A., 2011.
Land boundaries: © EuroGeographics Association and ESRI. Regional level: NUTS0.
Sea boundaries: OSPAR Convention, EU Integrated Maritime Policy and EEZ.

Location of Oil and Gas rigs

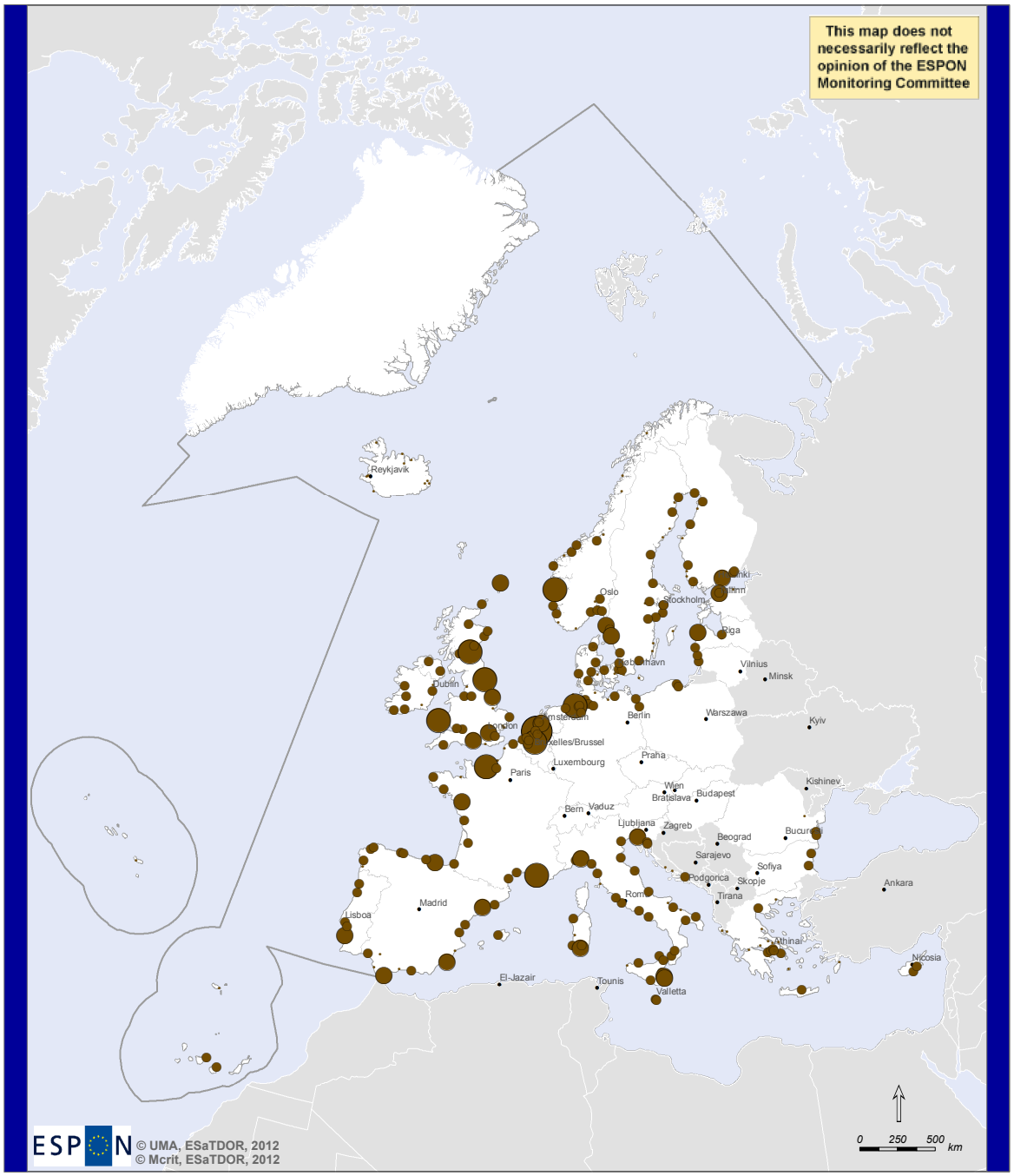
Oil and gas rigs

This Map is produced using data on the location of stable lights at night (the Stable Lights of the World dataset) of a NOAA program with ephemeral sources of lights (e.g. fires, mobile structures) removed. data represents presence/absence of light in a resolution of 30 arc-second for 2003. This has been integrated into a 10x10km grid based on the presence or absence of light in every cell, which does not mean that the whole cell is occupied by oil or gas rigs.

Source: ESPON and the University of Liverpool (2013) Annex 7, p42

Map 3: Location of Oil and Gas Installations in the North Sea

Liquid Bulk Shipping, 2008



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Thematic data: EUROSTAT, 2008.
Port locations: Eurostat - GISCO (European Commission), 2009.
Land boundaries: © EuroGeographics Association and ESRI. Regional level: NUTS0.
Sea boundaries: OSPAR Convention, EU Integrated Maritime Policy and EEZ.

Liquid bulks goods by port, 2008 (thousand tonnes).

- < 1000
- 1001 - 40000
- 40001 - 80000
- 80001 - 160000
- > 160000

Source: ESPON and the University of Liverpool (2013) Scientific Report, p85

Map 4: Liquid Bulk Goods Shipping by Port (2008, million tonnes)

Due to this abundance of energy resources it is often assumed that the North Sea Region is relatively energy self-sufficient, however there are significant variations across the region. At a European scale declining self-sufficiency is evident (energy dependency has increased from 46.7% in 2000 to 52.7% in 2010, as shown in Table 2). For North Sea Region countries the picture is more mixed, as some have increased self-sufficiency very slightly in the same period (Belgium, Sweden and the Netherlands) whilst Germany, although to a large extent dependent on energy imports, has maintained a relatively stable rate of energy dependency during the same period.

Table 2: Energy Dependency Ratios, 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

Note: negative figures denote the country is a net exporter of energy.
(Source: DG Energy, 2012)

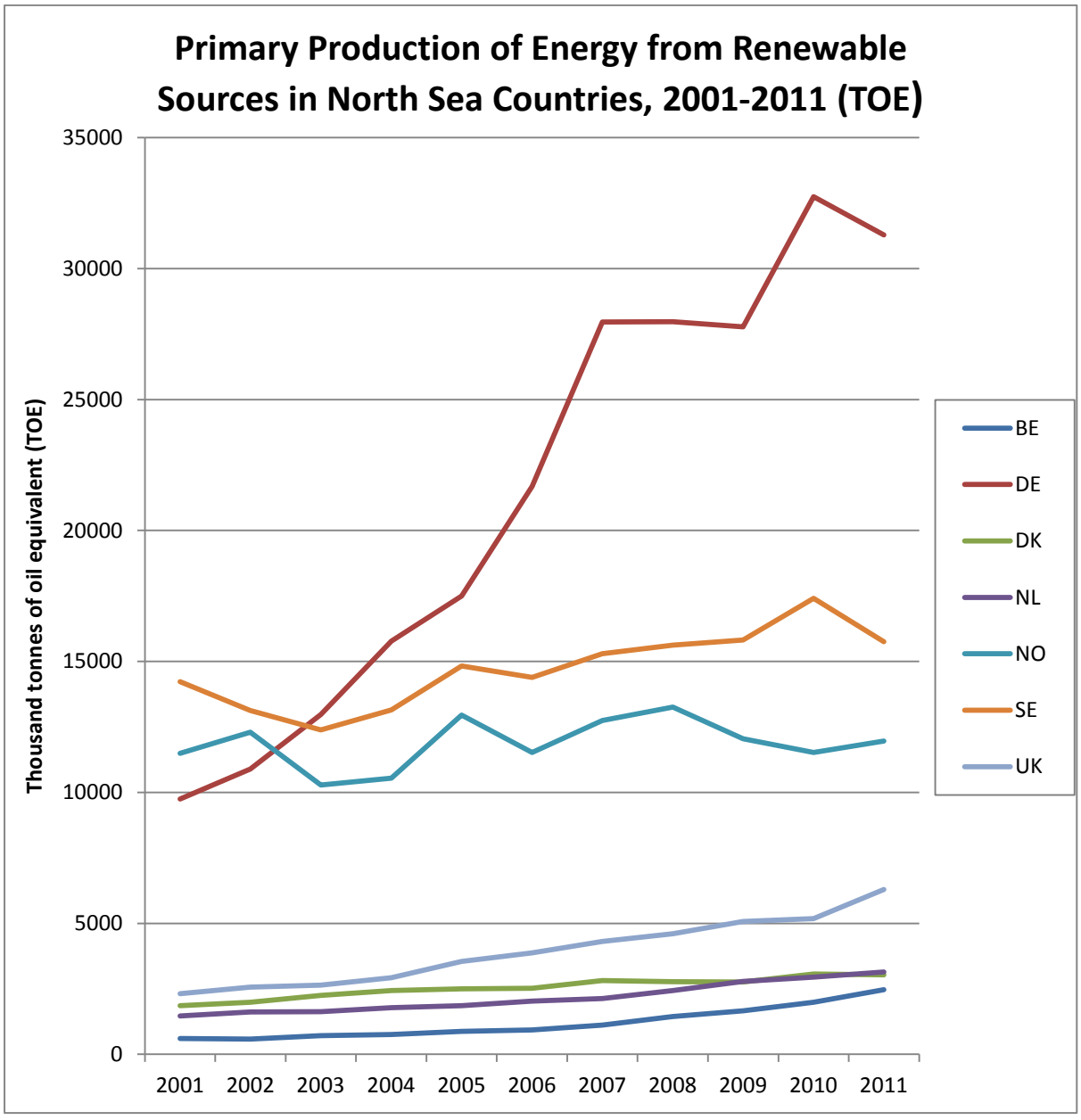
Nevertheless the region also currently generates and has the potential to generate considerable energy resources from renewables. The regions propensity to meet its energy needs from renewable resources in part depends on its natural resource asset base. Renewable energy can divided into two broad categories, renewables utilizing natural assets (wind, hydro, solar and ocean energy) and renewables that have been produced or manufactured, such as bioenergy and biofuels. Figure 2 and Maps 5 and 6 provide an overview of renewable energy production for the countries bordering the North Sea.

Offshore wind (Map 5) is a rapidly growing source of energy and more wind farms have been built in the North Sea since this map was produced. 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 (Map 6). 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.

Overall, a large part of the energy demand is currently supplied within the region, although this has extensively been based on the exploitation of fossil fuels. Nuclear power is still a significant source of energy in the UK, Belgium and Sweden (as shown in Map 6), however Belgium plans to phase out nuclear power by 2025 and

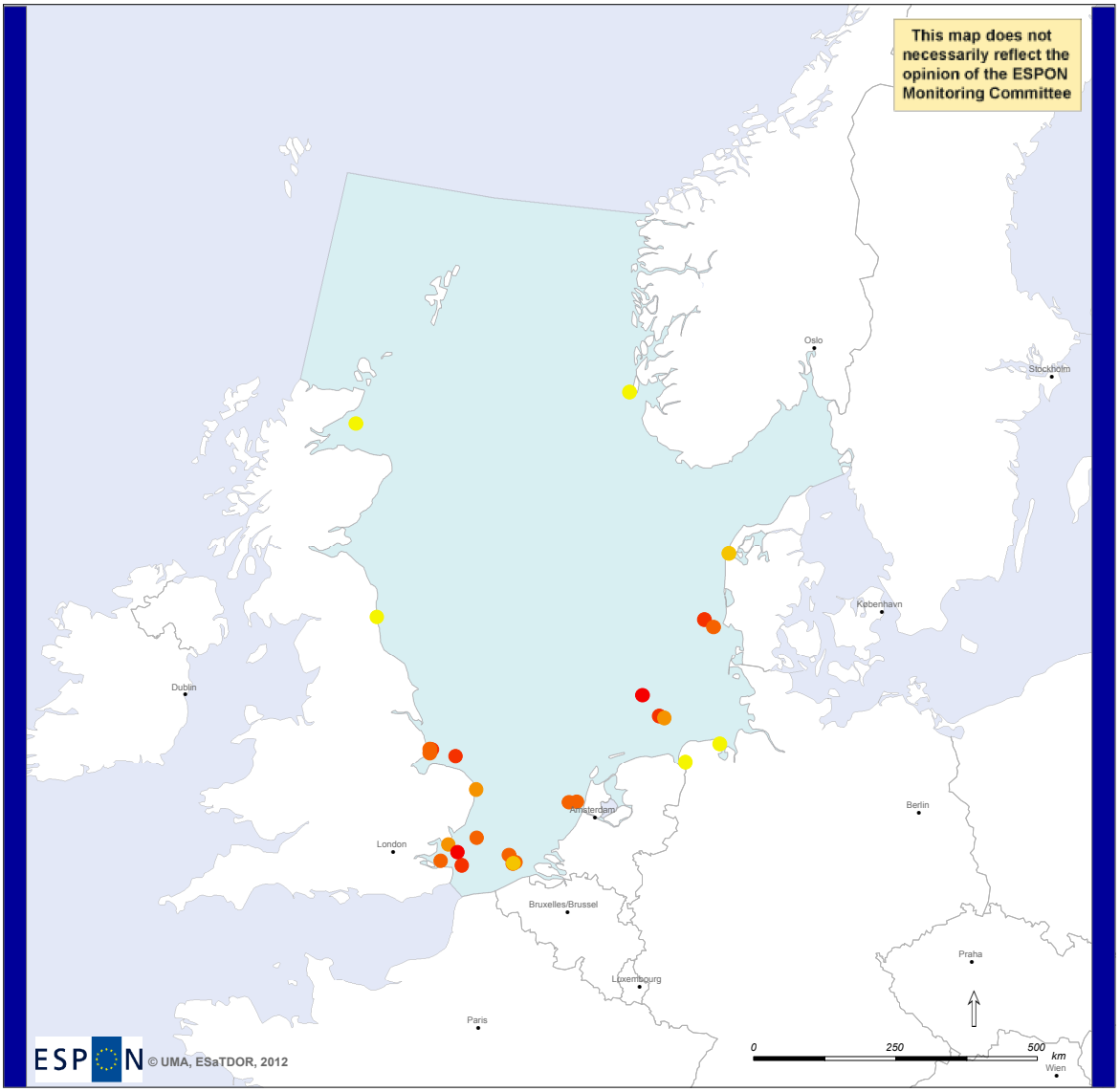
following the Fukushima Daiichi nuclear disaster in March 2011, Germany has announced plans to close all of its nuclear power plants by 2022.

Figure 2: Production of Energy from Renewable Sources, North Sea Countries



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

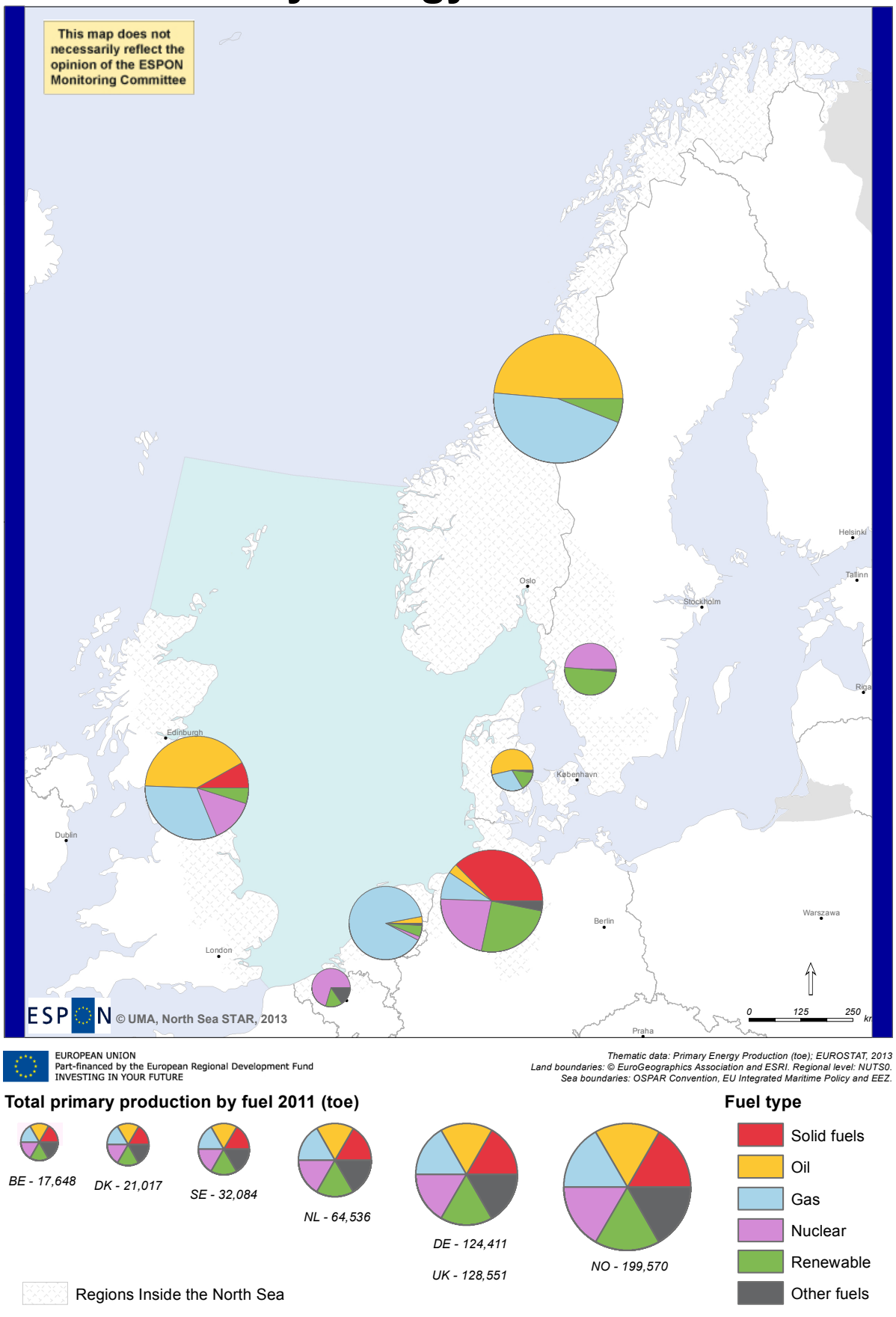
Offshore Wind Energy



Source: ESPON and the University of Liverpool (2013)

Map 5: Existing Wind Farm Generation Capacity in the North Sea

Primary Energy Production



Map 6: Total Primary Energy Production by Fuel, 2011

3.2 European Policy Context

In recent years the European aspiration in energy policy has been to achieve the targets set out in *Energy 2020: a strategy for competitive, sustainable and secure energy* (COM(2010) 639 final). Known as the 20-20-20 targets, these are:

1. A reduction in greenhouse gases by 20% compared to 1990 levels,
2. An increase in the share of energy consumption to come from renewable energy sources by 20%, and
3. A 20% improvement in energy efficiency.

It appears that these targets are likely to be surpassed, although this may be in part due to the economic crisis and the downturn in production impacting upon carbon emissions. However the policy debate in Europe has changed somewhat in recent years. The economic crisis has redirected political attention away from climate change issues to economic recovery. Reducing patterns of consumption and the goal of 80-95% decarbonisation by 2050 is still in force (Hanrahan, 2013). A new Green paper ((COM (2013) 169 Final)) was launched in March 2013 in order to ensure that EU is on track to meet longer term climate and energy objectives. The key challenges for European energy policy are set out in the new 2030 framework:

What kind of target regime is appropriate to 2030 is perhaps the most contested issue or the biggest challenge in the current policy debate. How many targets should Europe have and how should they be achieved?

The second issue (after targets) relates to the tension between a re-nationalisation of energy and protecting the integrity of the Internal Energy Market. Barriers to cross-border operation may be created by several unilateral decarbonisation strategies which generate risks 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, particularly since the energy competitiveness gap between Europe and the US is widening (Hanrahan, 2013) and that increasing the energy self-sufficiency of a country or region will require significant and costly investment. Thus different energy dependency policies can be applied that would help to achieve greater resource efficiency and thereby increase resilience to increasing energy costs.

Enhancing energy security is a fourth challenge. Europe is the world's biggest energy importer and its dependency could increase from 54% to 70% by 2030. Furthermore, Russia, Norway and Algeria together account for 85% of Europe's natural gas imports and 50% of the crude oil imports (Hanrahan, 2013). The EU Commission recently presented a report focusing on external dimension of the EU energy policy. Here it is stated that secure, sustainable and competitive energy is of fundamental importance to the EU economy, industry and citizens and, that achieving these policy objectives requires EU action internally and the appropriate instruments to promote EU interests abroad ((COM(2013) 638 final)).

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. 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 final challenge in the 2030 debate is to "getting the politics right". 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.

As the European policy map changes it is nevertheless important to remember that many of the national energy policy responses are framed in the European rhetoric and adapted to meet national specificities. Some of the key energy policy issues for the countries bordering the North Sea are set out below.

3.3 National Policy Contexts for the North Sea Region Countries

In this section we very briefly review national energy policy. More detailed reports of energy trends and national policies for each country bordering the North Sea are included in Annex B of the Scientific Report.

Belgium:
Belgium is highly dependent upon imported energy, with nearly three quarters of its energy needs coming from imports. In terms of its domestic production, nuclear power provided 70% of Belgium's energy production in 2011, with around 14% coming from renewable and energy from waste sources. Energy consumption is dominated by the industrial and transport sectors.

The Belgian government's announcement in 1999 that it would phase out nuclear power by 2025. Alongside its existing energy import dependency this meant that it became an urgent priority to develop its market for renewable energy. Currently different measures for promoting the use of renewable energy between regions means that co-ordination and integration of effort are difficult. For example there are five different green energy certificate schemes that operate across Belgium and the province of Flanders, planning and environmental legislation (for example the development of structure plans such as the Windplan Vlaanderen), grant funding and information campaigns are used to stimulate renewable energy production, but Wallonia and Brussels offer different schemes and approaches.

Denmark:
Overall, the greatest share of Denmark's energy production comes from oil (39% in 2011), and it is in net terms and exporter of oil and gas. Renewables contribute 22% production. Energy production processes and transportation account for the greatest,

and an increasing share of energy consumption in Denmark. Energy consumption in the agricultural and industrial sectors has decreased.

Denmark has an ambitious energy strategy for its entire energy supply (for electricity, heating, transport and industry) to be provided by renewable energy by 2050. Commitment to this goal of 100% renewables was confirmed by the Energy Agreement passed in March 2012 (KEMIN, 2012) with several energy milestones being put in place to facilitate this transition in a stepwise basis. These include increasing energy efficiency (particularly in buildings and the industrial sectors) and increased utilisation of wind energy, biomass and combined heat and power facilities. Public Service Obligations (additional charges on energy bills paid by consumers) will provide the finance for many of these measures.

Germany:
Germany is also highly dependent on imported energy (59% in 2010). In terms of gross power production, the largest energy sources are lignite and hard coal accounting for 44% of production in 2011. Renewable energy represents 20% of gross power production, predominantly from wind (BMWI, 2011a).

Germany set out its Energy Concept in 2010, however these policies have been challenged by more recent plans to shut down nuclear power stations. Subsequently updated, but retaining the same headline targets, the Energy Concept sets out medium and long term ambitions for reducing greenhouse gases (by 80 to 95% by 2050 compared with 1990 levels), cutting primary energy consumption, reducing electricity consumption and increasing the share of renewables in final energy consumption (to 18% by 2020 and 60% by 2050). The national framework, the Second National Energy Efficiency Action Plan (BMWI 2011b), recognises that new coal and gas fired power stations are required to meet energy needs in the short to medium term, however grid expansion, better market integration of renewable energy, further research driving technology and investment and cooperation with neighbouring countries to assist in restructuring of energy networks are the main priorities for action.

Netherlands:
Due to large reserves of gas, the Netherlands has enjoyed a relatively lower energy dependency than other North Sea countries, with only 30% of its energy being imported in 2010. Gas is also the primary fuel used in energy production accounting for 90% of indigenous production. Only 5% comes from renewable sources with energy from biomass a significant contributor to renewables production.

Gas continues to play an important role in the Netherland's energy mix and economic development, measures to move activities from gas production to refining and trading have been put in place. Measures to promote the use of renewable energy, include a requirement for biofuels use in transport (and an ultimate ambition that all new cars sold by 2035 to be CO_2 emission free), subsidies for renewables production (although subsidies may be replaced by feed-in tariffs), housing should be energy neutral by 2050 and measures to address high energy use in agriculture are being put into place.

Norway:
Norway's rich natural assets mean it is a net exporter of energy, mainly fossil fuels such as crude oil and natural gas, which account for over 90% of Norway's energy production. It is also the sixth largest producer of hydroelectricity in the world. Behind hydro energy, other renewables such as wind only represent a tiny fraction of Norway's energy production.

Continuing population growth and economic development in Norway will lead to higher energy consumption, however decarbonisation of energy systems is an important goal. Norway has set a target of 30% reduction in greenhouse gases by 2020 compared to 1990 levels, and a 67.5% share of renewable energy by 2020 (this was at 62% in 2008). Whilst Norway is largely ahead of other countries in its use of renewable energy, reducing the use of fossil fuels in transport remains a major concern.

Sweden:
Sweden's energy production relies on energy coming from three main sources – fossil fuels (oil, coal and natural gas) representing 31.8% of total primary energy supply in 2011, in addition to 35.5% from renewables and 32.5% from nuclear sources. Hydropower and biofuels/energy from waste represent the largest share in renewable energy production. Industry and transport are the two biggest consumers of energy in Sweden, accounting for 39.3% and 24.1% of energy consumption respectively in 2011.

Sweden's energy policy, set out by two government acts in 2009, calls for a 40% reduction in greenhouse gases by 2020 compared to 1990 levels, a 50% share of renewables in gross final energy consumption and a 10% use of renewables in the transport sector. Although nuclear energy still has a role to play in Sweden's energy mix, action plans for renewables, energy efficiency and transport are driving the energy transition. The expansion of wind power, green energy certificate schemes, increasing energy efficiency in industry and moving to a fossil-free car fleet (including all privately owned vehicles) by 2030 are all expected to contribute to longer term targets for Sweden to have zero greenhouse gas emissions by 2050.

UK:
Whilst the UK has reserves of oil and natural gas in the North Sea, it is still a net importer of energy, importing 28.3% of its energy needs in 2010. In the UK, gas is the largest contributor to energy production, representing a 39.7% share of production, followed by oil with 32.5% and nuclear 9.2% in 2009. Renewables at the same time accounted for 3.3% of gross energy production. In recent decades the UK has seen a large fall in energy consumption by industry; however consumption in the transport sector has increased from 31% in 1990 to 38% in 2011. In other sectors (agriculture, commerce and domestic), energy consumption has remained relatively stable.

The UK's Renewable Energy Roadmap (DECC, 2012) sets out the broad energy policy framework for the UK, however there are different ambitions within the devolved administrations. For the UK as a whole, the ambition is 15% renewable energy by 2020, whilst in Scotland a more ambitious target exists of 100% of

electricity demand to be met from renewables. Nuclear energy will continue to play an important role in energy production in England, which is due to build new nuclear facilities, whilst in Scotland nuclear power will be phased out. Energy efficiency and renewable targets are being met in the UK through Renewable Energy Obligations, which require energy producers to generate a certain proportion of energy from renewable sources. Increasingly, efficiency measures such as renovating houses are financed through additional charges on consumer energy bills.

3.4 The Changing Policy Context for the North Sea Region

This research project has taken place at the same time that considerable effort has been made to prepare the next North Sea Region Operational Programme, scheduled to start in 2014 and last until 2020. Therefore the policy context within which this project has been situated is changing. The current programme (2007-2013) has a set of strategic priorities which were framed in the middle of the last decade.

Within the current programme (2007-13) four key strategic priorities have been identified and all potentially have an energy related component:

- Building on the regions capacity for innovation;
- Promoting the Sustainable management of the environment;
- Improving the accessibility of places within the North Sea Region; and
- Promoting Sustainable and Competitive communities

In 2013 North Sea Region Programme Secretariat began to develop, in consultation with key stakeholders the strategic priorities for the next programme framed within the EU's Common Strategic Framework which called for 'smart sustainable and inclusive growth' where there was a strong focus on the specific characteristics of places and an emphasis on a relatively small number of priorities that would make a significant difference. This was called 'smart specialisation'.

Initially the North Sea Region Programme Secretariat identified three strategic priorities:

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

Following various stakeholder consultation events, including online consultations, public meetings (e.g. at the annual conference in Halmstad in June 2013, these initial priorities have been revised as three thematic objectives, six investment priorities and nine specific objectives (see Table 3). These were submitted to the Commission for approval in November 2013, and the details of the future Programme will be developed within this framework.

Table 3: Priority Axes for the North Sea Region Programme, 2014-2020

Thematic Objective	Investment Priority	Specific Objective
I) Thinking Growth - Revitalising economies in the North Sea Region		
1) Strengthening research, technological development and innovation	b) Promoting business investment in R&I, developing links and synergies between enterprises, research and development centres and the higher education sector, in particular promoting investment in product and service development, technology transfer, social innovation, eco-innovation, public service applications, demand stimulation, networking, clusters and open innovation through smart specialisation, and supporting technological and applied research, pilot lines, early product validation actions, advanced manufacturing capabilities and first production, in particular in key enabling technologies and diffusion of general purpose technologies.	Develop new or improved knowledge partnerships between businesses, knowledge institutions, public administrations and end users with a view to long-term cooperation (post project) on developing specific products and services
		Enhance regional innovation support capacity so that it will allow regions to effectively increase innovation levels after the end of the funding period and particularly in line with smart specialization strategies
		Stimulate the public sector in generating innovation demand and innovative solutions for improving public service delivery
II) Renewable North Sea Region – Continuing to lead on sustainable growth		
4) Supporting the shift towards a low-carbon economy in all sectors	f) Promoting research and innovation in, and adoption of low-carbon technologies	Develop new products, services and processes that reduce carbon emissions
5) Promoting climate change adaptation, risk prevention and management	a) Supporting investment for adaptation to climate change, including ecosystem-based approaches	Demonstrate new and/or improved methods for improving the climate resilience of target sites
6) Preserving and protecting the environment and promoting resource efficiency	d) Protecting and restoring biodiversity and soil and promoting ecosystem services, including through Natura 2000, and green infrastructure	Develop new methods for the long-term sustainable management of North Sea ecosystems
	g) Supporting industrial transition towards a resource- efficient economy, promoting green growth, eco-innovation and environmental performance management in the public and private sectors	Develop new products, services and processes to accelerate greening of the North Sea economy
III) Green Mobility – Leading the way in sustainable transport and logistics		
7) Promoting sustainable transport and removing bottlenecks in key network infrastructures	c) Developing and improving environmentally-friendly (including low-noise) and low-carbon transport systems, including inland waterways and maritime transport, ports, multimodal links and airport infrastructure, in order to promote sustainable regional and local mobility	Develop demonstrations of innovative and/or improved transport and logistics solutions with potential to move large volumes of freight away from long-distance road transportation
		Stimulate the take-up and application of green transport solutions for goods and personal transport

Source: North Sea Region Programme (2013), www.northsearegion.eu

3.5 Summary

Energy policy is a multi-dimensional, multi-faceted and extremely complex area of policy. Current European policy which frames national action is still shaped by the more immediate goals of Energy 2020 combined with a longer term strategy of decarbonising the economy by between 80-95% by 2050. National policy, whilst framed within the Energy 2020 targets remains primarily focused on responding to domestic challenges and opportunities. Whilst recession may have reduced energy demand and consumption, the need to replace old infrastructure (whether based on coal or increasing unacceptable nuclear (for example Germany and Belgium) or responding to declining oil and gas reserves, sustaining relative energy self-sufficiency will involve substantial investment in the energy infrastructure. National policy responses to a large extent depend on local production potential and the extent to which energy supply is within the control of the public or the private sector, and governments' ability to incentivise investment.

Innovation is a key driver in the transition to a green, sustainable economy. However, existing energy systems tend to be very difficult to 'dislodge' because they are stabilized by various lock-in processes that lead to path dependent developments and 'entrapment'. Highly institutionalised processes perpetuate existing systems and make it difficult for innovative sustainability alternatives to find space to develop and influence radical structural transformations and this is ceratinly the case for many of the countries bordering the North Sea Region.

The challenge is to develop concepts, theories and policies that help us understand how to unlock processes and stimulate path-breaking changes towards a more sustainable, green economy and society. The new North Sea Region Operational Programme at least offers the potential for small scale transnational experimentation in realising a new energy system based on renewables and a green economy (broadly defined). If successful such could gain purchase to help deliver the fundamental socio-technical changes which are implied by a radical transition towards a more sustainable society.

4. Energy Scenarios for the North Sea Region

The European North Sea Region is a major player in producing and consuming energy, however it faces a major challenge in managing the shift from fossil to renewable energy resources while simultaneously improving the economic power and the well-being of the societies in the region, thereby supporting the EU objective of smart, sustainable and inclusive growth.

In order to understand how the North Sea Region might achieve this objective, moving towards the more immediate 20-20-20 goals for energy and, in the long term, towards the transition to a decarbonised Europe by 2050, different energy scenarios have been developed by the North Sea STAR project and tested as part of the stakeholder sparring workshop which took place in Delft, Netherlands in September 2013.

4.1 The Scenarios in Outline

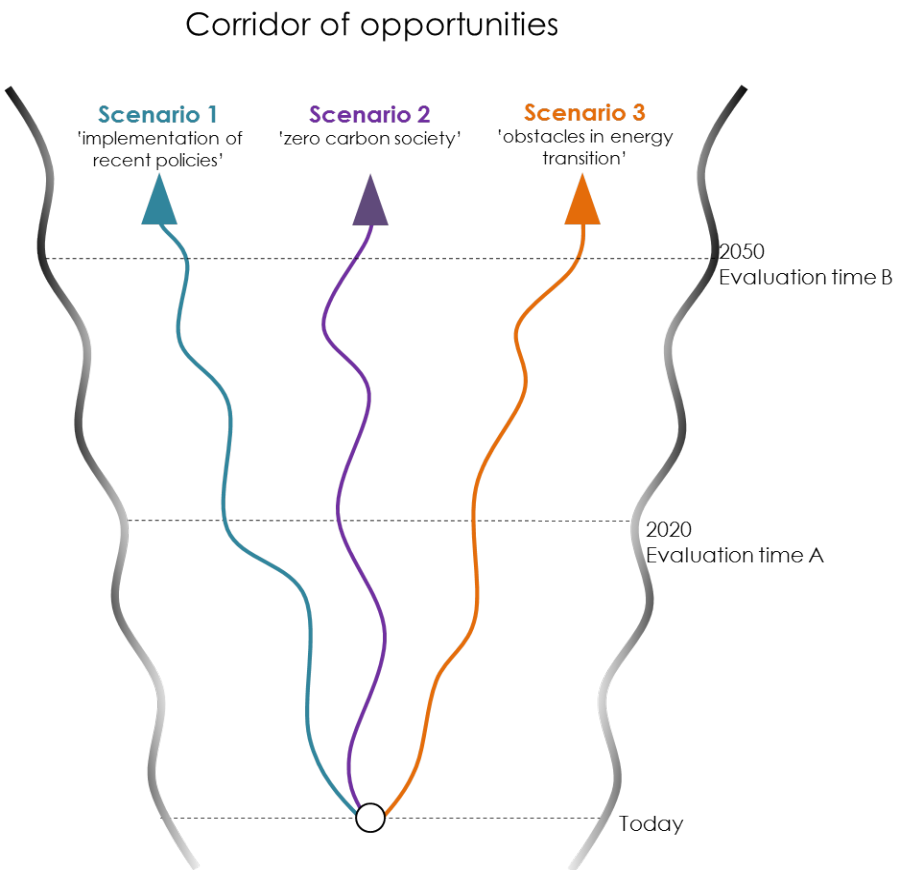
In building the scenarios, two aspects were considered as key factors shaping the energy transition process.

1. *Time spans* – the time needed for the energy transition from fossil fuels to renewable energy combined with increasing energy efficiency. This depends on technological and societal innovations, but also on the availability of renewable resources.

2. *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 have been devised. 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 (see Figure 3 below).

Figure 3: Three Energy Scenarios of North Sea STAR and Two Evaluation Times



Scenario 1 - Implementation of recent policies - This scenario reflects the successful translation and 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 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 is slowed down.

4.2 Analytical Framework for Scenario Evaluation and Assessment

To evaluate the performance in implementing energy policies and monitor the progress of crucial processes, a set of enablers has been considered. These include the following which interact with each other in various complex ways:

- Energy Production
- Energy Consumption
- Energy Efficiency
- Energy Costs
- Technological Innovation
- Decisive Societal Partners
- Social Change
- Policy Making
- Economic Developement and Markets
- Impact of Climate Change or Environmental Hazards
- Social Learning

These enablers were examined using qualitative, semi-quantitative and quantitative approaches. Information and data has been gathered from various policy documents and by contacting relevant institutions and experts. Table 14 in Chapter 6 of the Scientific Report highlights the differences between the three scenarios in relation to each of the enablers listed above.

In addition to the enablers which focus is on developments in the socio-economic and the socio-technological spheres, plausible changes in the environment were also considered, in particular the impacts of changing climate conditions. These have been 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 further 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 change 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.

A full account of possible developments under each scenario can be found in Sections 6.4 to 6.6 of the Scientific Report.

4.3 A Stakeholder Perspective: Strengths, Weaknesses and Recommendations

The three energy scenarios as described above were discussed with stakeholders during the ESPON North Sea STAR Stakeholder Workshop “Energy and the North Sea Region” in Delft, Netherlands, on 16th September 2013. The discussion was structured along the following four main questions:

- Is the structure of the scenarios logic and are the criteria and descriptors in each of the scenarios complete and relevant?
- Are the pathways for the scenarios chosen well enough to describe the probable range of developments in the North Sea Region energy sector?
- Which other aspects play a role for the evolution of the energy sector and what is the role of a) nations and b) regions around the North Sea in the formulation of a common energy policy?
- And what are the recommendations of stakeholders to achieve more collaboration on the future energy landscape around the North Sea Region?

During the interactive workshop with 18 participants, the scenario building methodology used was appreciated by the stakeholders. Both the pathways for the three scenarios and the criteria elements within each of the scenarios were approved. All of the criteria and their descriptors were considered as important and were ranked as shown in Figure 4 below.

Figure 4: Scenario Criteria Affecting the Energy Transition, Ranked by Importance

Additionally to the scenario criteria further elements have been named by stakeholders as relevant aspects influencing the energy landscape. Stakeholders stated that most of the Member States are not in favour of a macro-regional energy approach, but instead they emphasised the function of local and regional initiatives and actors as facilitators of macro-regional collaboration on energy issues. Although regional and local agendas differ, many regions have strong interests in transnational cooperation as they see economic benefit to their own region in collaborations bringing the energy sectors forward. Those alliances do not have to be limited to either renewable or fossil energies. Joint approaches utilising both energy types may be attractive for SMEs, e.g. using same techniques, markets or infrastructure.

Stakeholders identified elements which could slow progress or impair the development towards a sustainable, innovative and cooperative energy landscape. These included:

- Inconsistency of national policy priorities makes stakeholders and investors insecure.
- An uncoordinated private sector.
- Uncertainty especially for larger projects is additionally caused by a lack of long-term goals on European level for 2030/2050. The “Energy Roadmap 2050” (COM/2011/0885 final) was not seen as being concrete enough.
- Technological innovation is hampered by a large number of small and medium enterprises (SME) which require external venture capital to shoulder larger investments.

A full documentation of stakeholder’s assessment can be found in Annex C.

A zero carbon society (scenario 2) is the goal which was unanimously recommended by the stakeholders. It was clearly stated that the most ambitious scenario should be what the North Sea Region is aiming for. The existing energy assets of the North Sea Region, including extensive energy infrastructure and potential from a variety of energy carriers (fossil fuels, wind, biomass, hydro and marine energy) and expertise and experience in different energy technologies were recognised as being able to support the transition from fossil-based to renewables, supporting the zero carbon

society. However, reorganisation of the energy infrastructure and overcoming the obstacles outlined above will also be crucial to supporting this goal.

Based on these strengths and weaknesses of the North Sea Region stakeholders gave a number of recommendations necessary for the achievement of a zero carbon society. Not all of these recommendations can be delivered through programmes such as the North Sea Operational Programme; however they can continue to make a contribution.

- Transnational energy cooperation should be further intensified, preferably under the lead of the EU.
- Technological innovation needs to be fostered, e.g. by intensified dialogues, transfer of good practices and facilitated access to public or private innovation funds for SMEs.
- As the public acceptance for more renewables is highest in generations younger than 35, awareness campaigns need to address older generations. This is especially important for ageing societies.
- Education, training and awareness rising play a major role for the achievement of a zero carbon society. Additionally to focused campaigns relevant education programmes in engineering, economics, natural and social sciences, international affairs, policy and law studies should be further strengthened.
- The level of collaboration of the societal partners in energy policies needs to be further increased, especially on the local level. One way could be the support of local action frameworks to assist in large infrastructure or international collaboration projects.
- Despite on-going efforts there is still a huge potential for better energy efficiency and more retrofitting efforts should be undertaken.
- The transport sector shows a significant potential for increasing energy efficiency. One way to realise this potential are changes in the composition of transport carriers. These will go along with changes in the structure and capacity of the different transport systems.
- Challenges, political expectancy and political statements should be consistent. There is no doubt that policy makers will need to readjust measures over time but statements should be made with greater consideration.
- Transparency needs to be assured in various fields, e.g. in decision making, formation of energy prices, or payment of subsidies.

Considering the ranking of scenario criteria as given in Figure 4 it becomes apparent that stakeholders are less concerned with energy production techniques. Instead energy costs and energy efficiency but also social learning are weighted as being very important aspects for the achievement of the zero carbon goal. This is reflected also in the recommendations (above) which mainly deal with the efficient use of both energy and energy infrastructure, with technological innovation and the marketability of innovations as well as with social and policy dimensions of the transition process.

5. Case Studies

Within the North Sea STAR project, the effectiveness of energy projects in delivering the aspirations of the 20-20-20 energy targets and the added value of transnational cooperation both within individual projects and clusters of energy projects has been investigated.

5.1 Case Study Method

In the North Sea STAR Inception Report, 17 projects out of a total of 71 from the North Sea Region Programme were identified as having an energy dimension, alongside two energy project clusters, Low Carbon Regions in the North Sea (LOWCAP) and Energy Vision North Sea Region (EVNSR). The distribution of all 17 projects and individual project partners (by NUTS2 region) are shown in Map 7.

Eight projects and the two energy clusters were selected for further analysis. Of the eight projects, five were part of clusters (belonging to either the LOWCAP or EVNSR clusters, or both) and three were "standalone" projects (see Table 1). In selecting projects the following criteria (in order of priority) were used:

- Thematic scope (similar to clustered projects)
- End date (before 1st January 2014, to see tangible project outputs)
- Geographic scope (location of lead beneficiary)
- Project objectives

The case studies were investigated using first, documentary analysis to determine the basic facts about the project partnership, aims and objectives. Secondly, a mixture of documentary analysis and interviews with project partners were used to determine and assess the achievements (impacts) of projects. Project results were analysed in three main dimensions:

Territorial impact: expectations about the use of geographic renewable energy potential within the participating areas as well as expectations about the perceived benefits stemming from spatial integration.

Technological impact: this is about the perceived (i.e. expected) potential for technological innovation as well as expectations about the perceived benefits stemming from sharing technical knowledge.

Policy/Organisational impact: this is about perceptions of the benefits stemming from organisational/policy innovation. It concerns expectations about improved enabling conditions for the implementation of policies as well as the improvement of implementation practices.

Full reports of each case study are included in Annex D.

5.2 Energy Project Clusters - Scope

In addition to the individual projects, the Energy Vision North Sea Region (EVNSR) and Low Carbon Regions in the North Sea (LOWCAP) clusters were examined to determine what added value this approach might bring to energy project results. A cluster is a collection of partners from at least 3 existing projects. Through a cluster

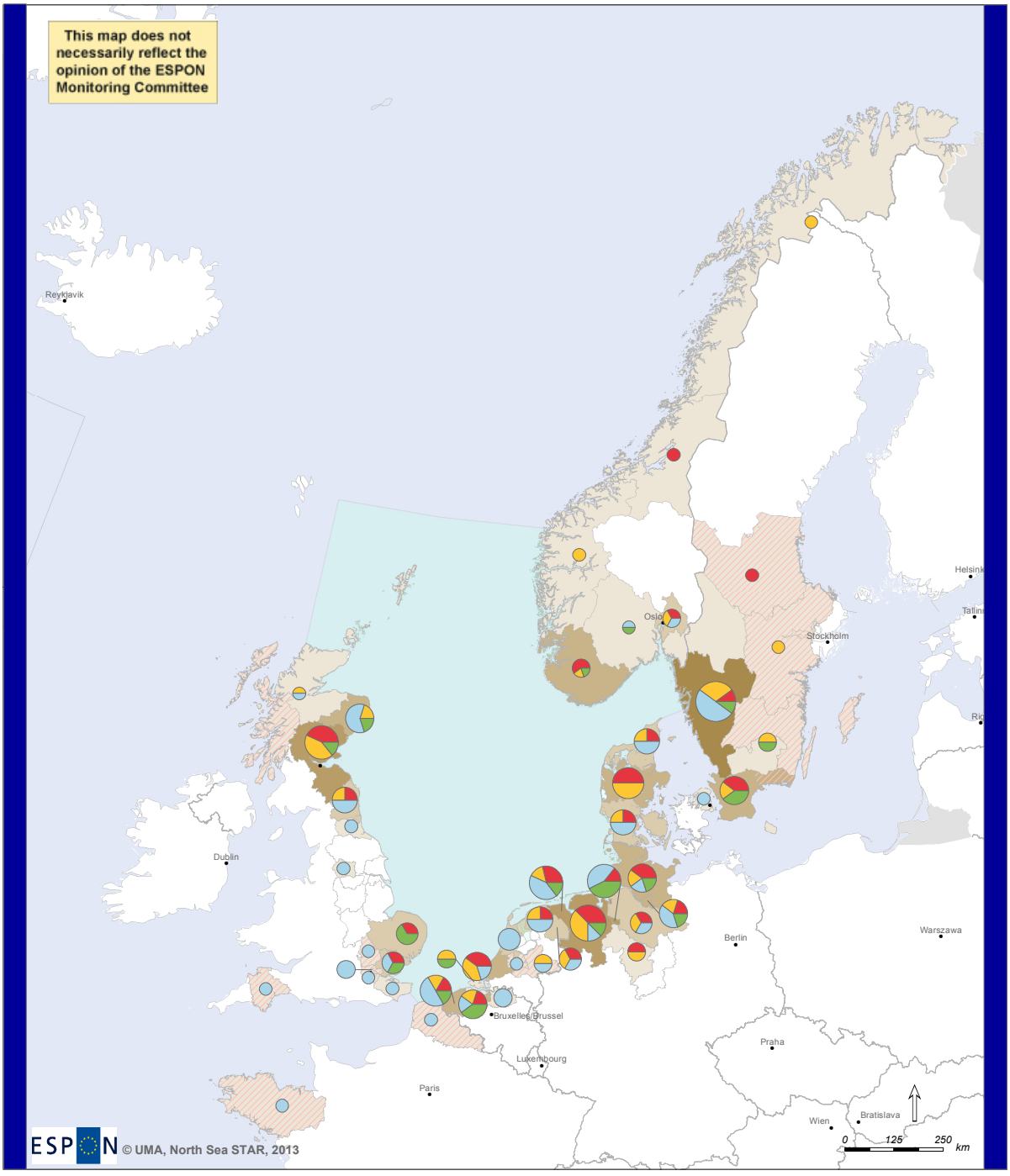
these partners are expected to come together to pool existing results and develop a package of activities that will increase the long-term impact of these results – through identifying new ideas within the cluster, gaining a stronger voice in policy discussions, drawing in new stakeholders, or whatever else cluster members believe will have the greatest effect.

Increasing the impact of (individual) projects is the prime reason behind the cluster concept where 'impact' is especially meant as policy impact. Communication is therefore a crucial part of the cluster approach which should go hand in hand with visibility. There ought to be a direct line between project results, communication and finally – visibility: visibility of the cluster and clustered projects but also visibility of the North Sea Region INTERREG Programme in general.

Therefore as part of the case studies, projects which had also participated in energy clusters were asked about their reasons for engaging in the cluster, anticipated and realised benefits, and what (if any) added value the clustering approach achieved. For those standalone projects that were not part of an energy cluster, reasons for non-participation were also examined.

The full list of interview questions asked to case study project partners can be found in Annex E.

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 7: Distribution of Partners in North Sea Region Energy Projects

5.3 Activities of North Sea Region Programme Energy Projects

This Section provides a brief overview of the main activities of the eight case study projects and their impacts.

Build with Care

The **Build with Care** (BwC) project focused on integrating low carbon building technologies into the construction supply chain, increasing attention to low carbon building strategies in regional and local planning and developing innovative carbon reduction techniques to improve the Region's competitiveness. As part of the project a number of building projects (e.g. in Aberdeen and Wilhemsburg) have adopted low carbon technologies as standard in new housing, reducing their carbon footprint and increasing quality of life for residents. Low carbon and energy efficiency standards have been incorporated into building agreements and local planning policies (e.g. within the "Smart Energi" initiative in Västra Götaland, Sweden, municipalities worked together to find common regulations on energy efficiency in the planning process).

BwC has also had technological impacts, through demonstration projects including the Puyenbroeck visitors centre, East Flanders, built to passive house standards. Campaigns, education (e.g. online tools) and training have increased technical knowledge. Whilst the partnership itself has benefited from transnational learning, the full benefits of the project have yet to materialise. The economic downturn has had a major impact on the number of houses built as part of the project, and the high costs of some technologies and differing standards in building regulations across North Sea Region countries remain critical barriers to further progress.

Care-North

The **Carbon Responsible Transport Strategies for the North Sea Area (Care-North)** project had several ambitions in relation to reducing transport-related carbon emissions whilst improving low-carbon accessibility, including increasing commitment to national, European and international policy goals for carbon reduction, the promotion of e-mobility and alternative fuels, changing traveller behaviour, carbon accounting and developing financial instruments to incentivise greener transport.

A number of "lighthouse" activities have supported these aims, for example, the establishment of a car sharing scheme in Aberdeen and dedicated school bus services in West Yorkshire, helping to take private cars off the road. In the innovation dimension, work has been undertaken to model the carbon reduction impacts of Low Emissions Zones for transport, a smartphone application to assist more sustainable commuting has been developed, and electric vehicles have been tested. Policy impacts have included the development of biofuels procurement guidelines, incorporation of Care-North ideas into local transport plans, and setting of new standards for carbon reduction in participating regions. The Care-North partnership has been particularly successful in promoting its ideas to a high level political audience, including at the world EXPO in Shanghai, China (2010) and the ICLEI (Local Governments for Sustainability) World Congress. In this respect Care-North has been an exemplar for the North Sea Region and beyond.

North Sea-SEP

The **North Sea-Sustainable Energy Planning** (North Sea-SEP) partnership was focused on the exchange of experiences in order to create new tools for regional planning, thereby increasing the use of sustainable energy in the North Sea Region and supporting the long term goal of creating energy self-sufficient regions. This was to be achieved through developing new models for regional development centred on renewable energy and efficiency activities, related governance and the trial of new organisational models, stimulating cooperation between a broad range of stakeholders.

The development of renewable energy strategies and master plans providing guidance on how to harness renewable energy potentials were significant for the participating regions, providing transnational learning experiences about differences in renewable energy potential in different local contexts. Tools for analysing renewable potentials have been adopted by other regions and municipalities to support their own planning processes. A range of online tools and a compendium of project outputs, summarising best practices, energy policies, planning systems and actions for the business and education sectors have been developed to help overcome barriers to cooperation and innovation. Gaining political support has been a key achievement of North Sea-SEP. By engaging with local and regional authorities and providing inputs into regional plans, the outputs of North Sea-SEP have had broad political endorsement.

Innovative Foresight Planning

The **Innovative Foresight Planning for Business Development (IFP)** project aimed to support business development by developing and applying innovative foresight planning as a tool both for the private sector and public bodies. Foresight planning techniques for specific industrial sectors were to be used to improve competitiveness, stimulate knowledge and technology transfer, improve strategic technological and capital management and market expansion.

Foresight methods were used to map the value chain in the offshore wind industry in the North Sea Region. This has assisted in supporting the supply chain in offshore wind energy and the development of new offshore wind clusters in participating regions, e.g. North Netherlands Offshore Wind Cluster. Potential barriers to expanding this sector were identified, such as the need to test new technologies or build capacity for wind farm maintenance; however these issues can also be recognised as opportunities for further business development and new markets.

Overall, whilst project reports and case study interviews indicate that the foresight planning tool itself was not utilized to the extent first envisaged by the project, it has developed transnational business networks, inspired more future-oriented thinking about regional energy policy in both the private and public sectors, and it also increased the awareness about new business possibilities within important industries in the regions.

Supply Connect

The **North Sea Supply Connect (NSSC)** project aim was to increase the involvement of SMEs in transnational business networks through assisting their applications to tenders set out by large procuring companies. This was to be

achieved through the production of guidelines for SMEs, an online company register, training and innovation programmes, business exchange and partnership networks focusing on clusters in the maritime and energy sectors (amongst others).

A number of online tools were developed, including a business support network, the company register, self-assessment for SMEs to evaluate their business against customer requirements. A set of policy recommendations was developed in order to promote innovative initiatives for improving SME market access. Whilst the self-assessment tool has been taken up by some companies the company register appears to have been an under-used part of the project's outputs, with a lack of companies registering themselves on the site.

Direct impacts on energy per se in this project have been marginal, however there have been a number of indirect impacts based on improving SME access to (international) markets, and facilitating transnational business networks. At a broader level the approach taken by NSSC (and its sister project in the Baltic Sea Region) have been viewed positively as a means to improve opportunities for SMEs.

BioChar

Climate Changing Soils (BioChar) aimed to increase knowledge of biochar as a means of carbon capture and storage with benefits for improving soil quality, develop biochar applications and promote them to end users. A final goal of the project was to make biochar applications tradable on European carbon markets. During the project field trials of biochar were undertaken to ascertain its effects on crop yields, mitigating water contamination from pesticides and modifying soil properties. Barriers to trading biochar applications on carbon markets were also investigated, revealing uncertainties among end-users as an obstacle.

Activities to promote the production and utilization of biochar have been relatively successful in targeting (primarily) academic audiences. National Biochar Competence Centres were established (taking different forms in each country), and the BioChar project itself has become an important source of information for other initiatives in Europe.

However, the broader impacts of biochar have been low. Concerns about the toxicity of biochar and decreasing carbon values in emission trading systems have negatively impacted on the attractiveness of biochar technologies. More efforts in biochar research are needed to test applications before they are fully introduced to the market, but the potential for biochar applications to be more widely rolled out remains an important message of the project.

EnerCOAST

The **BlueGreen Coastal Energy Communities (EnerCOAST)** project aimed to apply proven supply chain management tools to the underdeveloped bioenergy market in the North Sea Region. As part of this, "sustainable supply chain management" was to be used to increase production from renewable energy sources including marine and terrestrial biomass, supporting regional economic development and energy self-sufficiency.

As part of the EnerCOAST project, new sources of renewable (biomass) energy have been developed in a number of participating regions, including Ryfylke (Norway) and Dornum (Germany). High levels of technological innovation including the EnerCOAST model itself - to first assess biomass in a sub-regional context and then combine this with tools to calculate business development potential - have been realised. This model was applied to e.g. municipal energy planning in Denmark (Municipal Biomass Action Plan) and piloted by the German partners.

The establishment of multi-stakeholder networks in the participating regions has been crucial for success. By integrating stakeholders from industry, public administration, science and society across various local, sub-regional, regional and transnational levels this has facilitated the implementation of bioenergy solutions. In addition, supportive policies in local and regional contexts have facilitated business development and innovation.

e-harbours

The **e-Logistics in North Sea Region Harbour Cities (e-harbours)** project aimed to innovate logistics systems in harbour cities to help maintain economic growth whilst trying to minimise energy demands and the impacts of CO_2 emissions through the use of smart metering, electric mobility and energy flexibility. A further objective was to promote the production and use of renewable energy. This has been achieved through a number of showcases, for example, a "Virtual power plant" to simulate how revenues can be optimised using energy flexibility, i.e. switching energy use to times when there is lower demand or cheaper rates. Eco-houses were built in Malmö, fitted with smart grid controls allowing residents to monitor energy use and generate their own power, and in Zaanstad the REloadIT Smart Grid scheme used renewable energy to charge car batteries for use and energy storage based on smart grids and optimisation of electricity costs.

Whilst operating on a small scale or providing "simulations" rather than physical changes, the showcases have been used to develop business cases for energy flexibility, the integration of small scale renewable energy production and promoted the benefits of smart grid technologies. In addition, the project has influenced several local level plans, including an energy plan for the Port of Hamburg and a clean canal boating guide for Amsterdam.

Summary: Territorial Impacts

With respect to territorial impacts, projects that have delivered concrete actions on the ground such as North Sea-SEP, BWC and e-harbours, are not only meant to see whether the advocated approach works, but if successful serve as demonstration projects: projects which are worth replicating. Whilst this has generally been the case, the BioChar project demonstrated an opposing outcome. Because BioChar techniques are in a state of infancy this demonstration project has found limited scope for wider usage at this point. Although not foreseen when the BioChar project was initiated this in itself should not be interpreted negatively: learning can be based on a variety of experiences, including negative ones. BioChar also suffered from contextual developments: a decrease of CO_2 values in emission trading schemes. This will make it less likely that BioChar techniques will be taken up. Projects like IFP

and NSSC did not have explicit territorial ambitions, but their effects in the long run could have (probably beneficial) territorial effects, such as supporting the growth of new energy related industries and economic clusters.

Technological Impacts

As already emphasized, INTERREG is primarily not meant for technological innovation, but experimenting through pilot and demonstration projects can have a technological impact. So again North Sea-SEP, BWC and e-harbours can be mentioned and again BioChar, but in this instance for revealing significant limitations to new applications. IFP and NSSC could have indirect technological effects due to networking and clustering of enterprises. Bringing entrepreneurs together could lead to a variety of innovation activities ranging from marketing to technological impacts, although the former are the main object of these projects.

Policy/Organisational Impacts

Projects having an organisational impact mean that these projects bring actors and stakeholders into new relationships with each other. The IFP and NSSC projects focusing on networking and cluster formation shared this ambition. e-earbours should also be mentioned as the Virtual Power Plant concept is about connecting energy suppliers and consumers together (organizational impact) via smart networks and grids (physical/territorial networks).

There is no single project which did not have policy impact ambitions. A project like IFP had ambitions to influence policy in its life span by providing input for concrete strategies and policies. Other projects have had a basic ambition to communicate their results to the wider community of policy makers and decision-makers. This could be called valorisation. Classic tools like open access websites, reports and hand-outs have been used widely. Sometimes project participants have written recommendations for policy change. The impact of all these project outputs is somewhat insecure. Much depends on the level of direct relationships with policy and decision-makers. Because some impacts can appear in the long run – after the lifetime of projects – it could be worthwhile to revisit projects again, in a few years' time.

Overall, the case studies display varying degrees of success in achieving their stated ambitions. In part, external factors such as the economic crisis have reduced possibilities, for example in house building (in the Build with Care project) or carbon trading (BioChar). However, a number of other factors have determined the achievements of projects. These are discussed in Section 5.5 below.

5.4 Experiences of the Energy Clusters

Energy Vision North Sea Region (EVNSR)

The Energy Vision North Sea Region cluster was developed with the primary aim of drawing together results from projects with a renewable energy theme to help accelerate the energy transition. Three of our case studies – Innovative Foresight

Planning for Business Development (IFP), Sustainable Energy Planning (North Sea-SEP) and North Sea Supply Connect (NSSC) were represented in the cluster (as financial beneficiaries), whilst lessons from other North Sea Region projects were integrated into EVNSR's activities. These activities took a twin approach: analysis and communication. The analysis was based on project results, identifying regional strengths in renewable energy and possibilities to technically integrate renewable energy systems and infrastructures. The communication strategy was eventually connected to the making of an energy vision for an integrated energy system.

Within the case study analysis, two issues in the EVNSR cluster were highlighted. First, in terms of participation, EVNSR was dominated by the participating organisations from the northern part of the Netherlands. Whilst this has not been criticised, it appears that some partners may have had a more marginal role in cluster activities. A second issue has been trying to find the right balance between developing the energy vision and communication, as the double focus of the project was difficult to deal with given the timeframe and the budget of the project.

EVNSR's final outputs identified a series of policy recommendations and enablers to facilitate achievement of the energy transition, including social awareness, policy consensus, education and training, engagement of SMEs, triple-helix collaborations between the research, public and private sectors, and increased cooperation between industrial sectors. In addition a number of "building blocks" for system integration were elaborated. These building blocks represent future opportunities that should be exploited as part of future energy cooperation to ensure an energy transition, whilst maximizing economic and social benefits to the North Sea Region.

Low Carbon Regions in the North Sea (LOWCAP)

The LOWCAP project aimed to develop a common approach to carbon reduction and energy efficiency within the North Sea Region. In this cluster four projects were represented – Build with Care, Care-North, North Sea SEP and the INTERREG IVa (Skagerrak-Kattegat) Carbon Capture and Storage (CCS) project. This cluster drew upon North Sea Region project results in order to identify best practices and high impact initiatives that would help to meet the European 20-20-20 carbon reduction and energy efficiency targets.

As with the EVNSR cluster, LOWCAP used results from its constituent projects to identify opportunities and develop a set of recommendations for delivering a low carbon, energy efficient North Sea Region. In doing this a major challenge for the cluster partnership was to integrate projects with a distinct emphasis on reducing carbon from the outset of any activity (Care-North, SEP and Build with Care) with the "end of pipe" solutions offered by the Carbon Capture and Storage project, particularly as this is a new and relatively untested technology that has not yet found political acceptance in some countries. Additional efforts were required to reach a consensus on this issue amongst project partners in the cluster and to ensure that recommendations made about CCS would be appropriate to the audience the cluster hoped to address.

The final outputs of the LOWCAP cluster included a series of factsheets based around the expertise of its partner projects (mobility, buildings, planning, CCS and a cross-cutting factsheet on "human actions" that may influence carbon reduction strategies) and a brochure of final policy recommendations aimed at European and North Sea Region level decision makers. The results of both the LOWCAP and EVNSR clusters were presented at a joint final event during the EU's Sustainable Energy Week in June 2013.

5.5 Lessons from the Case Studies

In analyzing the factors which determine the effectiveness (or otherwise) of energy projects, a number of key factors have to be considered. This section draws together the factors that have made projects successful and also identifies those which have impacted negatively on project results. In addition to territorial, technological and policy/organizational impacts, this section considers elements that have contributed to transnational learning and improved transnational cooperation, a major objective of all INTERREG programmes. These have helped to develop the set of recommendations presented in Chapter 7.

Characteristics of Partnerships

The composition of project partnerships, in terms of balancing diverse interests, was shown to be an influential factor in the initial establishment of partnerships with clear project aims. When considering the distribution of interests across different domains (increasing knowledge/research functions, economic development or territorial interests including spatial planning) in project partnerships, some distinct characteristics can be observed:

- The diversity of interests of partners in projects was seen as an important asset of cooperation, and such diversity was a motivation to participate in project partnerships. In retrospect, actual assets emerged. Several partners reported that their understanding of issues under investigation has increased through being confronted with 'new' knowledge, alternative positions and perspectives. In some cases this lack of aligned interests has caused disagreement, but in other cases this has not affected partnership working.

- Where additional efforts were made to integrate different perspectives early on in projects, for example building consensus around common frameworks or methodologies (as in the North Sea SEP or EnerCOAST projects), this has proved to be a good investment, not only in the sustainability of the transnational partnership but also in the project itself. The framework made custom-fit knowledge transfer and standardised assessment of project results possible.

Over the course of projects, partnership characteristics also had a range of effects:

- In projects with a high level of involvement from public authorities with planning competences (IFP, EnerCOAST, e-harbours) barriers to cooperation (and achieving project results) were associated with differences among planning systems and administrations in countries. In interviews it was stated that

individual partners were aware of issues that are important in their own country, but that there was a lacking transnational perspective that could facilitate insights into the realisation of energy potentials in different countries. Political instability was also recognised as a threat to project partnerships where local/regional authorities were involved. However, it was also noted that public authorities can reach a broad audience and thus accelerate local implementation processes.

- In a number of cases partnerships often 'discovered' the value of analytical knowledge in the course of projects. Such knowledge was frequently highly appreciated only in retrospect. Underrepresentation of partners with specific knowledge interests (research institutes, universities) was mentioned several times, however their role in disseminating project results was downplayed in the case study evidence, suggesting that greater integration and clearer roles for partners with research/knowledge interests may be required to maximise their inputs into projects.

Project Focus

In some cases where there was disagreement between project partners, this was seen to originate in the broad focus of projects rather than diverging interests.

- All projects from which a (serious) lack of agreement or moderation was reported had relatively few partners with a distinct, well-defined expertise. In projects in which relatively many partners with specific interests or expertise were involved, notions of disagreement were fewer and, in case they occurred, were articulated more precisely. Most frequently they related to struggles with specific frameworks to integrate interests (such as frameworks to integrate planning systems) or with a lack of insights from distinct fields.

- In projects with a high degree of economic interests, difficulties were found in establishing focus due to the ways in which economic clusters were defined, the level of institutionalisation that clusters had obtained in different regions and the broad range of economic sectors covered by partners. Organisational complexity (for example, business networks or Chambers of Commerce representing several different organisations) also proved to be challenging for determining project ambitions.

Other Factors Determining Success

- Existence of a strong lead partner, in terms of experience and success in other European projects can be an asset, increasing the attractiveness of project ideas and inspiring confidence in the overall partnership.

- Existing social ties, for example, where partners have worked together in European projects before, can strengthen partnerships by creating trust, easing communication and speeding up decision making processes. However, attempting to integrate new partners into these partnerships can bring difficulties

in finding the appropriate partners and ensuring their commitment to the partnership.

- In some cases partners that are network organisations were expected to be able to act with ease across regional and national boundaries, however they are often faced with an obligation to focus on distinct economic activities within (often softly) defined territories. This can limit the extent of transnational cooperation and engaging new stakeholders in their activities.

Overall, the learning dimension of transnational cooperation in energy projects has been a crucial factor in determining their effectiveness. This has been driven by involvement in new networks, exposure to new technologies and solutions for reducing carbon, increasing efficiency and promoting renewable energy. A key challenge moving forward is to ensure that the knowledge gained from participation in North Sea Region projects and new ways of working become embedded in organisations and spill out into wider communities of stakeholders, whether this is through the creation of new low carbon products and business opportunities, creating new planning policies that enable increased renewable energy production and use, or improving energy efficiency in businesses and homes to mitigate for rising energy costs to name a few examples. Some recommendations for supporting the legacy of projects are given in Chapter 7.

5.6 Added Value of Energy Project Clusters

This final section considers the key findings from the analysis of the two energy clusters. In particular, the additional impacts (added value) that can be obtained from the clustering of projects are considered, with a view to providing recommendations as to how the cluster approach may be utilized in future Operational Programmes.

Participation and Non-participation

Respondents from projects who participated in energy clusters gave reasons for participation which are in most cases well in line with the general objectives of the North Sea Region cluster approach. Learning from other, similar projects was a prime reason. Also the anticipation of a greater political and societal impact of project results formed the second dominant reason. A less frequently mentioned reason to participate was the expectation to increase the lifetime of a project.

Reasons for non-participation in the energy clusters are interesting. These can be quite diverse but are in any case relevant for the cluster approach as such. Most seem to have to do with *expectations* and *perceptions* of being part of a cluster. An example of this is the fear that when the achievements of a project are ‘uploaded’ in a cluster the original ownership of these achievements can become less visible: a cluster ‘would claim some of the achievements of the project’. ‘Not being relevant for the project’ is mentioned by respondents from two projects as a reason for non-participation. More practical reasons have been mentioned like ‘the project has just started while the cluster was well under way’ and beneficiaries were too busy fulfilling their own project obligations. Mentioned several times by respondents from

standalone projects was that contacts with other projects were a (good) alternative to cluster participation. In addition, some project partners have stated that they were not aware of the energy clusters until after they had been formed, and this might be regarded as a missed opportunity for involvement.

Two Energy Clusters or One?

Evidence suggests that it was not easy arrive at a joint approach within the two energy clusters. Quite a number of respondents nevertheless expressed the opinion that – with hindsight – probably one energy cluster would have been enough. For the political visibility of energy issues this could have been a better option. A degree of overlap was noted between the clusters; in this respect more differentiated foci for both clusters would have been much better.

Summary

The EVNSR and LOWCAP clusters both display a reasonable level of success in combining the key messages and results of individual projects to have impacts on higher levels of policy making. Another (partial) intention of clusters has been to provide building blocks or inspiration for the new 2014 North Sea Region Operational Programme, but given their ambitions the clusters seemed to have become projects in their own right. Finding a non-contentious joint approach in clusters proved to be rather difficult. EVNSR gives the impression of a project somewhat biased towards partners from one single country. Participants in LOWCAP were facing the challenging task of combining approaches which although not fully opposing each other, do not seem to easily combine in their logic. Looking at participation we see – formulated in straight terms – leaders, followers and a considerable amount of (limited) participation. However, on the whole the cluster approach has been seen as a positive approach that should be used again the next Operational Programme.

6. Stakeholder Sparring

Stakeholder Sparring ran alongside all the other work packages. The objective here was to engage in inter-active dialogue with key stakeholders drawn from the steering group and interested regional partners to feedback the results of the research as they emerged and shape future activities and policy recommendations.

Three stakeholder sparring sessions were held:

- 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

At each of the sessions the purpose of stakeholder sparring was described as being about:

- Independent critical reflection,
- Challenging dialogue with key partners,
- Knowledge exchange between the research team and partners,
- Providing an evidence base for future regional priorities, and
- Being innovative and creative with regards future transnational programmes.

Throughout these workshops a number of key themes kept re-emerging, the added value of project clusters in Programme design and the role and potential of energy related projects in the future Operational Programme.

6.1 Energy as a Cross-Cutting Theme in Programme Development

At the North Sea Region Programme Annual Conference in Halmstad (Sweden, 11th-13th June 2013) delegates concluded that energy should be seen as a cross cutting theme with related possibilities across the dimensions of innovation, environment and transport (the preliminary priorities for action for the next Operational Programme identified at the time), rather than a theme in its own right. There also seemed to be much scope for community building using energy as a driver and emphasising a focus on small scale, bottom up innovative initiatives that can contribute to the broader agendas outlined earlier.

At the Delft Stakeholder Workshop (Netherlands, 16th September 2013) the context had moved on and the Programme priorities were being further refined and clarified.

Under the **Thinking Growth** thematic objective it was agreed that major energy infrastructure projects and innovation in energy generation were both likely to require resources beyond the scope of the programme. Instead it was felt that technology transfer and innovation support capacity related to the range of ideas identified should be a key focus for action.

Under the **Renewable North Sea Region** thematic objective the team suggested that 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/energy efficiency; and climate change adaptation including projects developing green infrastructure. It was felt that the commentary on the Thinking for Growth thematic objective also applied here. It was also noted that the World Bank definition of green economy extended to include ecosystem services thinking and this could also be an area meriting support.

Under the **Green Mobility** thematic objective, the team suggested that 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 shift to greener transport modes. It was felt that these provided appropriate examples of the focus of action under this theme.

In the discussions a number of overarching messages emerged. These included the following:

- A view that reflection on the energy scenarios could assist project development. It was felt that projects should be aiming either at Scenario 2, 'zero carbon society' or Scenario 3, addressing 'obstacles in energy transition'. Projects focussing on Scenario 1, 'implementation of recent policies', were thought to be insufficiently innovative to merit support under the new Programme.
- Social innovation and social learning were potential key areas to be addressed in projects under all of the thematic priorities.
- Inclusion of SMEs in energy projects was also considered as a cross-cutting theme.
- The desirability of supporting projects which respond to the distinctive energy issues of the region, for example marine/maritime energy issues reflecting the particular significance of the maritime economy.

6.2 Ensuring the Ongoing Impacts of Projects

The discussion about future Programme development focussed in particular on sustaining the legacy of projects after their completion. Key issues for consideration by the Programme Secretariat were identified as:

- Encouraging projects to set out ideas about wider dissemination of findings and legacy in funding applications;
- Developing the future orientation of energy clusters, encouraging them to consider legacy issues and initiatives that encourage ongoing impact where relevant.
- Possible development of a North Sea Region Operational Programme seminar series targeted at disseminating a collection of projects outputs to policy makers. However it was recognised that there may be difficulties in assembling projects into sensible themes with enough relevant projects to make this worthwhile and that a dedicated action plan and funding would be required to facilitate such activities.

6.3 Project Clusters in the Next Programme

The discussion about energy project clusters was wide-ranging but centred around two key themes – 1) the purpose of project clusters; 2) the process of project clustering. This was set within a context where the stakeholders were generally supportive of the cluster concept and felt it should be an integral part of any future Programme.

In terms of the first theme it was felt that greater clarity in establishing the purpose of energy clusters from the outset or at an early stage in cluster formation would be beneficial. Although it was recognised that there should be flexibility to tailor purposes to particular clusters, the following were put forward as examples of questions to be asked when thinking about the purpose of clustering:

- Can clustering help to create a balance of perspectives on energy issues?

- Can clustering help to draw out the economic value of energy projects which have a lesser economic focus?
- Can clustering involve a mentoring function?
- Can clustering help individual projects better appreciate their individual contribution and wider value/relevance?
- Can clusters strengthen/extend transnational learning between energy projects?
- Can clustering create critical mass and efficiencies in a time of austerity within different areas of energy policy, which gives weight to local efforts and facilitates contact and impact with policy makers at different levels?

It was also felt that the process of establishing and operating energy project clusters could be refined and developed and key points of discussion included:

- Identifying the different points in project lifecycles at which clusters could be formed and the appropriateness of early or late clustering;
- Enabling bottom up cluster formation as experience suggests that this produces good results;
- Measures to facilitate broad partner not just project participation in clusters to reduce situations where only a few partners benefit;
- Provision for clustering across programme areas;
- Possible inclusion of projects from other EU funding regimes e.g. Horizon 2020.
- The possible value of having an independent cluster facilitator such as used in some 7th Framework Programme project clusters.
- The desirability of linking early clarity in the purpose of project clusters to greater clarity in the specification of their outputs in order to achieve a clear focus and direction to cluster activities.

7. Recommendations

The North Sea STAR project has run alongside the development of the new North Sea Region Operational Programme for 2014 – 2020. The project has dovetailed with the work undertaken by the Programme Secretariat to define priority axes for the new Operational Programme and energy perspectives are strongly represented in the Thematic Objectives and Investment Priorities that have been put forward. Now that the broad priorities of the Operational Programme have been outlined, the North Sea STAR project's final recommendations have been focused on matters related to three main areas: A) future project development and evaluation, B) programme management, and C) the development of tools to support territorial cooperation on energy related issues. The recommendations are targeted at the North Sea Programme Secretariat, other Programme Secretariats, potential programme beneficiaries and in relation to the final area, to the European Union and national governments.

A. Project Development and Evaluation

1. Energy projects in the new programme should be directed towards delivering a 'Zero Carbon Society'.

Target audience: North Sea Programme Secretariat, Programme Beneficiaries

The Scenario Building aspect of the North Sea STAR project defined three possible energy scenarios for the North Sea region - Scenario 1 *Implementation of recent policies*; Scenario 2 *Zero carbon society;* and Scenario 3 *Obstacles in energy transition*. Each scenario set out alternative futures for the region in relation to energy production, energy consumption, energy costs and technical innovation. The validity of the scenarios and their value in informing future energy project development and evaluation was a key focus of discussion at the Stakeholder Sparring Workshop held at the University of Delft. This workshop unanimously recommended that Scenario 2, "Zero Carbon Society" should be the target for the North Sea Region in line with the EU's Energy Roadmap of 2050. By adopting this as the goal for the Operational Programme it was felt that the North Sea Region could become an exemplar in the transition to this ambitious energy future.

With this scenario in mind, and drawing in particular upon the outputs of the Halmstad and Delft Stakeholder Sparring sessions, possible areas for energy project development in relation to the three priority axes of the new North Sea Region Operational Programme, as follows:

Thinking Growth: 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.

Renewable North Sea Region: facilitation of a shift away from a fossil fuel based economy; climate change mitigation including measures related to resource/energy efficiency; and climate change adaptation including the development of green infrastructure and ecosystem services.

Green Mobility: Energy efficiency and green energy use within different transport modes (shipping, rail, road, etc.); transport logistics promoting intra and intermodal integration and efficiency; encouraging businesses and individuals to the shift to greener transport modes.

It should be noted that energy efficiency is identified as a key area for attention here as this together with the linked concern of energy costs were ranked by stakeholders as very important issues for the North Sea Region. Direct interventions in energy pricing mechanisms are not envisaged as these are national matters beyond the scope of Programme intervention. However, in line with the 'zero carbon society' ambition it is suggested that the Operational Programme should look beyond conventional solutions and direct its resources to developing innovative new approaches to achieving energy efficiency.

2. **The new North Sea Region Operational Programme should give particular encouragement to energy projects which focus on technology transfer, innovation support capacity and social innovation.**
   Target audience: North Sea Programme Secretariat, Programme Beneficiaries

   It is important to note that in the stakeholder sparring sessions it was generally agreed that major energy infrastructure interventions and research and development associated with innovative modes of energy generation were both likely to require resources beyond the scope of the Operational Programme and therefore were NOT suitable for programme support. Instead it was felt that technology transfer and innovation support capacity related to the range of ideas identified in Recommendation 1 above should be focal points for action. In addition the need for social innovation came up repeatedly as being very important and also as an area suitable for Programme intervention in terms of the nature of activities and scale of resourcing available. Stakeholders felt that education, training and awareness raising have major roles to play in the achievement of a zero carbon society and that there was great scope to increase social ownership and engagement with energy issues in the region.

3. **The new North Sea Region Operational Programme should encourage a strong business and growth perspective on energy transitions.**
   Target audience: North Sea Region Programme Secretariat, Programme Beneficiaries.

   Reflections from the case studies indicate that attempting to incorporate an economic perspective on energy transition has been at the core of some past and current projects. The analysis of these projects has identified barriers in bringing such interests to the forefront as well as particular organisational challenges to their involvement. It is apparent that institutions with economic interests in energy transitions are diverse, with frequently complex motivations and concerns that are often still in a state of formation. In several projects this has led to misunderstanding, disagreement among partners and long lasting searches for a project focus. In approaching future projects such institutions should be encouraged to communicate their interests, capabilities and possible barriers to engagement early in partnership formation to inform a better understanding of their potential role in projects and help to avoid conflict and delay later. Such considerations are anticipated to be particularly important in the new Operational Programme given the focus on the growth agenda. It is also needed if the programme is to respond to the view to emerge from the Stakeholder Sparring sessions that SME engagement in energy issues should be a particular concern in the new programme.

4. **The North Sea Region Energy Scenarios should be promoted as a useful project development and evaluation tool.**
   Target audience: North Sea Programme Secretariat, Programme Beneficiaries.

   Although there was a clear endorsement of the “Zero Carbon Society” scenario as the target energy trajectory of the new programme, stakeholders at the Delft workshop felt that the wider scenario building work was potentially helpful as an

aid in developing and evaluating projects under the new programme. For example, it could help to highlight where projects were insufficiently innovative or simply focussing on 'business as usual' activities. Similarly it could draw attention to obstacles in achieving energy transitions and encourage thinking about activities that help to break out of the national policy 'lock-in' to less ambitious energy trajectories discussed in the energy policy review. In this way it could help to stimulate imaginative new local level solutions that support the transition to a decarbonised Europe, as proposed in the EU's Energy Roadmap 2050.

5. **Projects should be encouraged to develop a sound methodological approach as part of the application process to ensure effective partner engagement and project delivery.**
Target audience: North Sea Region Programme Secretariat, Programme Beneficiaries, Other Programme Secretariats

In the case study analysis the comparison of expected and realized project results revealed that projects with a clear methodological approach integrating diverse partner interests were generally more successful, particularly where such an approach was developed at a very early stage. It appeared that barriers to the construction of common frameworks and methodologies were often rooted in territorial conceptions that had not been made explicit at early stages in the project cooperation.

Another factor affecting success of some projects is the extent of existing social ties within a project partnership. It is apparent from the case study analysis that in many instances project cooperation has been built up on earlier cooperation among partners. Pre-existing social ties have frequently been cited as an asset as they have made communication faster and easier and action more effective. However sometimes existing social ties appear to have formed barriers especially in cases where partners have been added to already familiar partnerships to increase the required involvement from different regions and countries. Such new partners have turned out to be vulnerable. Their commitment was lower and several have dropped out in the course of projects.

It is therefore recommended that increased attention toward project methodology should be given in project development and evaluation to ensure that partners are clear about their roles and that the profile of partners matches the overall ambitions of the project. In addition project methodologies should recognise and respond to the additional partnership building support that may be required for new partners.

6. 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 should be included in the new Operational Programme.
Target audience: North Sea Programme Secretariat, Programme Beneficiaries, other Programme Secretariats.

The outputs from the Stakeholder Sparring sessions on the on-going impact of projects suggested that this was an issue of concern for many with some frustration expressed that project ideas were quickly forgotten when key staff left. It was felt that much could be done to sustain the legacy of projects through careful project design and selection processes. Project activities should help embed project ideas and thinking within partner organisations and in the wider community (at a range of different scales) and encourage subsequent uptake in policy and practice. Building thoughtful stakeholder engagement and dissemination strategies into the project design could help to achieve this. Similarly, it was noted that dissemination strategies that were based on project websites can disappear quickly and that formal publications in terms of books and reports could be useful in sustaining the legacy of projects. A key message though was that projects vary greatly and that approaches need to be tailored appropriately, recognising for example that a proliferation on ongoing networks was not necessarily desirable.

B. Programme Management

7. The concept of project clustering and cooperation should be maintained and enhanced as part of the next North Sea Region Operational Programme.
Target audience: North Sea Programme Secretariat, other Programme Secretariats.

The outputs of the Stakeholder Sparring sessions and the case study reveal 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 Operational Programme.

8. Consideration should be given to developing different models of clustering/ cooperation in the new Operational Programme, reflecting different roles that such arrangements might play.
Target audience: North Sea Programme Secretariat, Programme Beneficiaries, other Programme Secretariats.

The outputs of the Stakeholder Sparring activities and the case study analysis indicate that there is scope to develop the idea of clustering further. For example different models of clustering/cooperation could be encouraged involving clustering on a thematic and geographic basis and /or at a range of different

scales - national, transnational, and across transnational regions. Some project partners under the current Operational Programme have chosen to engage in cooperation under broader European frameworks. Examples are the engagement of the BioChar partnership in the Cost Action programme and cooperation of partners in the North Sea Supply Connect partnership with the Baltic and the Black Sea Region. 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 was felt that any future programme could benefit from the continuation of the cluster approach. This needs to be developed in a bottom-up way, with the clusters being self-organising, perhaps with some additional steering from the JTS. Flexibility was frequently described as a desirable feature of future cluster arrangements.

9. Prepare partners for wider cooperation and start clusters early.

Target audience: North Sea Programme Secretariat, Programme Beneficiaries, other Programme Secretariats.

In the case study analysis many partners stated that they neither knew other partners, nor the scope of their work when engaging in cluster partnerships. This condition has tended to favour the formation of 'partner clusters' within clusters under the present programme, involving partners that already knew each other and that were perceived by others as dominant. There is also evidence that unfamiliarity in cluster partnerships has also led to fast drop-outs by some partners. Such processes were accelerated by the diversity of rationales of partners that were brought together in clusters. In this respect, anticipation of new clusters in an early stage, including their potential scope, could be helpful for project partners to decide on participation and what this could entail for their project. If a cluster approach is continued it would be pertinent to start clusters earlier: it seems that defining the focus of a cluster can take quite a while. Establishing the purpose of clusters from the outset or at an early stage in cluster formation would provide greater clarity and focus to cluster activities.

10. Balance expected cluster results with funding and time provided.

Target audience: North Sea Programme Secretariat, Programme Beneficiaries, other Programme Secretariats.

It is evident from the case study analysis that many partners have perceived the scope of cluster projects as too ambitious compared with the amount of time and budget available. This has created difficulties. Many partners anticipated a restricted added value of cluster projects for their own organisation. They either did not participate or participated for other, unforeseen and practical reasons (such as prolonging funding for projects). An improved balance between expected results and available funds and time could stimulate higher levels of engagement. Approaches taken in clusters (such as an exchange of best practices based on regional specialization) indicate refined and promising strategies.

11. In order to promote on-going impact and a sustained legacy of projects, consideration should be given to more consistent approaches to dissemination of project results in the new Operational Programme.
Target audience: North Sea Programme Secretariat, Programme Beneficiaries, other Programme Secretariats.

Stakeholder sparring activities at the Halmstad conference noted that another way to support the on-going impact of projects following completion would be to encourage a more systematic approach to dissemination of project results. As noted above at present project websites can disappear soon after projects close and collation of information on the North Sea Region 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 that all projects produce a synthesis report which can be made available on the programme web portal. Stakeholders described this as the creation of a central infrastructure for dissemination like an E-library of project results.

C. Tools to Support Territorial Cooperation on Energy Related Issues

12. In order to effectively inform and monitor energy related activity and progress in the North Sea Region, greater standardisation and harmonisation of data sets across different territories and better sub-national information is required.
Target Audience: The European Union and national governments

The baseline mapping of the current energy situation in the North Sea Region 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 this data is collected in slightly different ways, reflecting different contextual factors in Member States. Because of this it is difficult to consolidate into a picture of what is happening across the region as a whole. Particular issues concern inconsistencies in the units of assessment used and varying interpretations of terminology. This issue has made it impractical for the North Sea STAR project to develop energy scenarios that were quantitatively informed. Progress on this and will require more consistent data inputs. Well informed harmonisation proposals that understand the reasons for the current situation and scope for practical change are needed to define the most appropriate indicators.

8. Further Research

Reflecting on the findings of the North Sea STAR project a number of areas for further research beyond the confines of the North Sea Region and ESPON programmes have emerged. Two areas seem to merit particular attention.

Firstly, the energy policy review and results from the case study analysis and stakeholder sparring activities highlight the intense complexity of European energy policy and practice. This complexity not only entails different national government priorities and different patterns of energy policy delivery with significant involvement of the private sector evident in some areas but not in others. However in addition the importance of ***social perspectives on energy policy*** have repeatedly been emphasised as significant. This relates in part to the need for wide societal support for potentially very costly energy transition activities at a national and international scale. It also relates to the potential of bottom up social innovation to break the national level lock in to less ambitious energy trajectories and the possible development of a more disparate model of energy innovation. Further research on the societal relationships with energy policy in different geographical contexts seems to be merited.

Secondly, investigations related to the legacy of projects funded under the North Sea Region Programme has clearly connected to underlying concerns among some stakeholders that the benefits of projects are often short lived. Such concerns are not unique to the North Sea Region Programme and indeed apply to many European and other funding programmes. How to sustain the legacy of projects beyond closure, promote deep seated ***organisational and social learning***, embed new way of thinking and engender resilience of project ideals are key questions for many funding organisations. In a time of resource scarcity such issues seem to be particularly worthy of attention.

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