ESPON

North Sea STAR
Spreading Transnational Results

Targeted Analysis 2013/2/23

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Scientific Report

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This report presents the draft 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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Scientific Report

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Energy Terms and Units

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

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.

Gross Inland Consumption (GIC)
Gross inland consumption represents the quantity of energy necessary to satisfy inland consumption of the geographical entity under consideration. It is calculated using the following formula:
primary production + recovered products +imports + stock changes – exports – international marine bunkers.

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.

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.

Conversion Units

Kilo = 1,000 or 10^3
Mega = 1,000,000 or 10^6
Giga = 1,000,000,000 or 10^9
Tera = 10^{12}
Peta = 10^{15}

To:	**TJ**	**Mtoe**	**GWh**
	Multiply by		
TeraJoule (TJ)	1	2.388×10^{-5}	0.2778
Million tonne of oil equivalent Mtoe)	4.1868×10^4	1	11630
Gigawatt hour (Gwh)	3.6	8.6×10^{-5}	1

1. Introduction and Outline of Methodology

As Europe emerges from the economic crisis a new 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 a project clustering approach; and
- Provide recommendations on accelerating the take-up of renewable energy technologies and supporting relevant green economic activities in the North Sea Region.

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

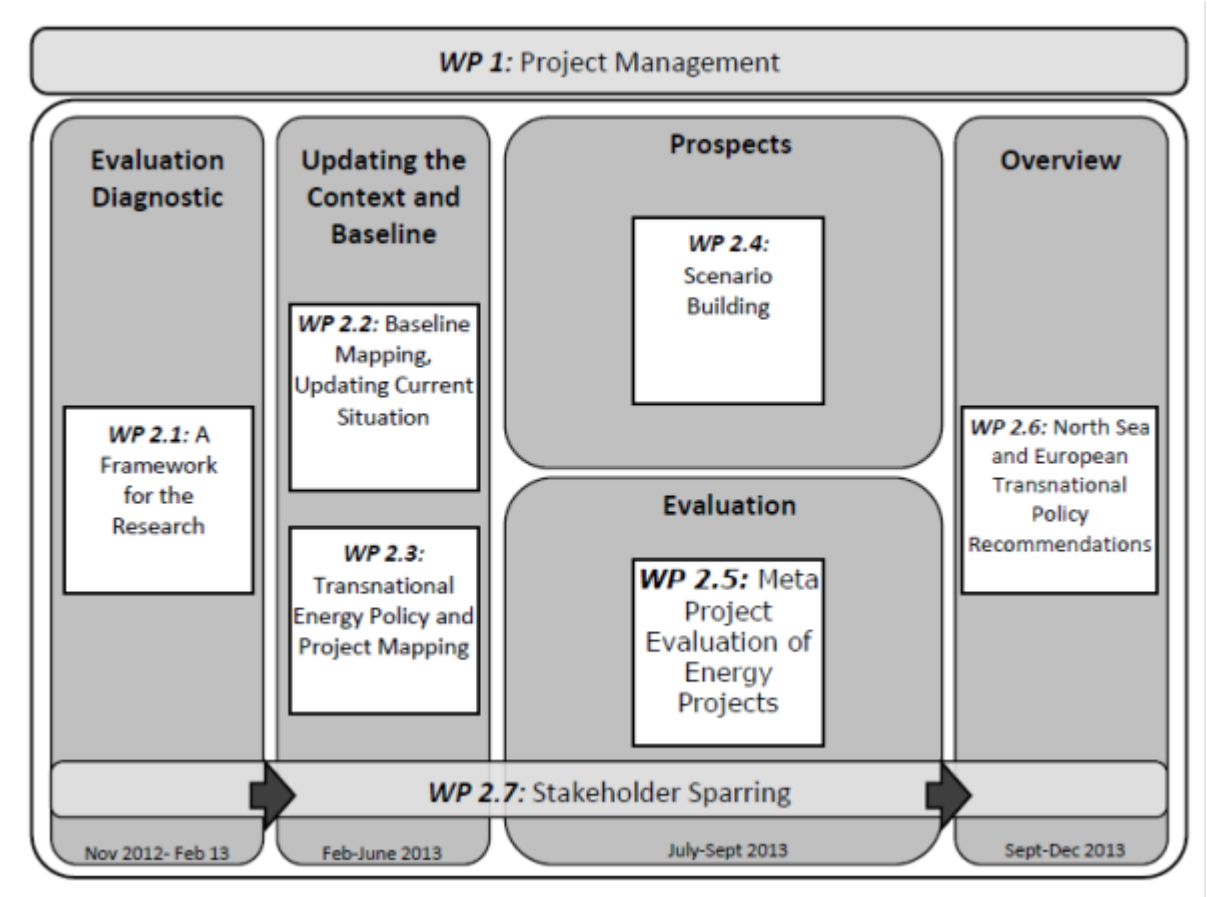
- To update and map the current energy situation in the North Sea Region (if possible both on land and within the marine environment) in terms of both the demand and supply of energy as a mechanism for beginning to build future energy scenarios;
- To evaluate the current European, national and regional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

However we recognize from the outset that the North Sea Region is not self-contained and behaves as a 'prosumer' in that it produces energy, it consumes/uses energy for regional development and it imports/exports its energy from/to other

regions. To this extent the concept of regional self-sufficiency is likely to be contested because energy production and consumption largely operates within national and international markets. Furthermore it is important to emphasise from the outset that the opportunities for projects within any transnational operational programme to make major impacts in wider energy debates are limited, however the scope for significant transnational learning should not be under-estimated.

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

Figure 1: Overview of Research Approach



In relation to the research methodology five key research stages can be identified and these are briefly outlined below

1.1 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 in order to assess 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. An overview and evaluation of the data sets is provided in Chapter 2, whilst 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 is also discussed. Overall, the evaluation of data sources revealed that there are a number of constraints in attempting to map the current energy situation. These mainly relate to the geographical scale at which information is provided, being either too broad (i.e. data reported at national level only, and not disaggregated for those countries which only are only partially in the North Sea Region, such as the UK and Germany) or unequal units at lower levels (e.g. UK data for Scotland as a whole and separate English regions). In addition, different terminologies make it difficult to combine information from different countries into one data set, for example *final energy consumption* is not the same as *energy available for final consumption.*

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

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

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

The provision of energy data at sub-national level and for areas falling within the North Sea Region is an on-going issue for the North Sea STAR project. Whilst considering energy data for each country in isolation is not ideal, this can still provide some useful indications of regional trends and strengths in particular energy dimensions, for example in increasing energy efficiency, or leading in the use of particular renewable fuels.

[1] See http://ec.europa.eu/energy/observatory/statistics/statistics_en.htm

1.2 Policy Review

A policy review of energy related policy activities was undertaken at a number of diiferent spatial scales. European, national and sub-national (regional and local) policies 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 the national and regional policy agendas.

For each of the countries within the North Sea Region each partner was asked to provide a 2000 word synthesis of the energy production and consumption trends paying particular attention to whether there were any sub-national variations in approach. The country reports were expected to be provided in a common format so that a synthesis report could be produced. The structure of the report is outlined below:-

- Context – some baseline data should be provided on energy production, consumption and main trends.
- What are the main dimensions driving energy policy towards Europeion, consumption and main t particularly on supply and demand issues?)
- Are there any specific trends in regional energy production/consumption or policies (within North Sea regions) that are different from national level?

1.3 Scenario Building

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

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

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

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

Tasks
The following tasks are considered to approach the objectives:

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

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

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

1.4 Case Studies

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

The objectives of the case studies were therefore:

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

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

The NSR programme has grouped many energy projects in so called clusters with the expectation of:

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

The above leads to the following main research question:

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

Sub-questions are:

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

Selection of Case Studies

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

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

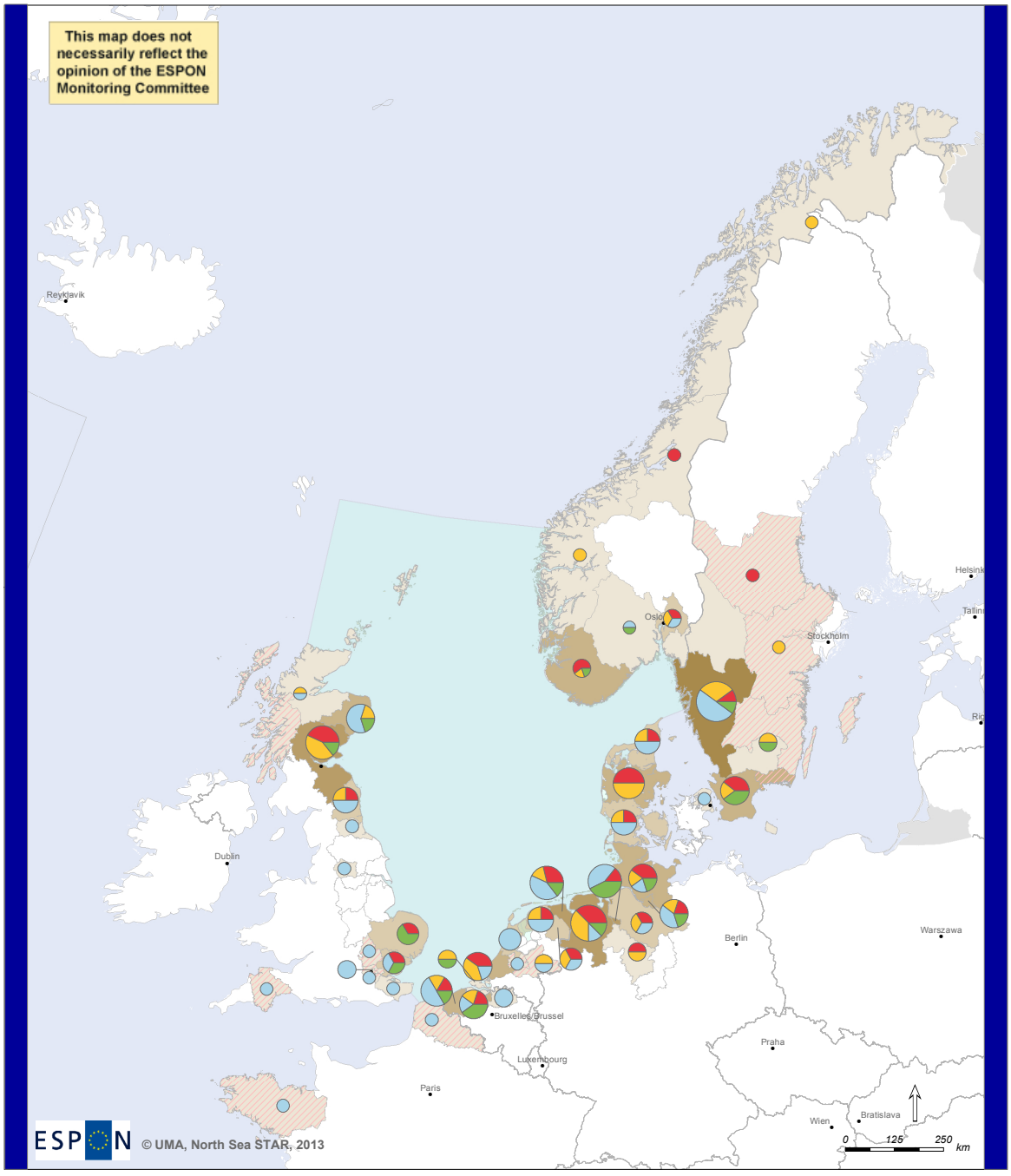
- Thematic scope: similar as clustered projects - carbon reduction and energy efficiency projects or renewable energy projects.
- End date: before 1 January 2014 in order to detect identifiable results.
- Geographic scope: similar as clustered projects (comparing primarily lead beneficiaries, but also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

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

Table 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

Distribution of Energy Projects in the North Sea Region Programme



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

Number of North Sea Region Programme energy projects

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

Project Theme

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

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

The full case study methodology is provided in Chapter 7. By means of documentary analysis, interviews with key stakeholders and evaluation of the individual projects and clusters, we:

- distinguish types of expected and realized impact associated with co-operation (spatial integration, technological innovation and organisational/policy innovation),
- analyse if and how knowledge dissemination in the form of learning at different levels has contributed to organisational/policy change,
- assess the effectiveness of a cluster approach, i.e. its ability to facilitate learning processes, in particular, and
- the outcome of the previous activities have been written up as a narrative that seeks to evaluate the impacts of each of the case study the projects using a common template, before synthesising the findings into a summary report.

1.5 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, both for this particular project and provide ideas to the Programme Secretariat as they developed their thinking towards the next programme.

Three stakeholder sparring sessions were held:

- 7thMay 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
- Engaging in challenging dialogue with key partners
- Knowledge exchange between research team and partners
- Providing an evidence base for future regional priorities
- Being innovative and creative with regards future transnational programmes

1.6 North Sea and European Transnational Policy Recommendations

The final task is to draw all the research elements together in a final report report containing a number of key elements which reports on the main findings from the research, develops policy recommendations aimed at various stakeholders which can be justified from the research and suggests further areas for investigation.

2. Energy Data and Mapping

2.1 Energy in the North Sea Region: Data Availability and Gaps

In order to produce maps of energy data for the North Sea Region, a first activity has been to analyse the potential sources of energy data, using a multi-scale approach. An initial overview of potential data sources was presented in Annex 2 of the Inception Report. First, different sources at international level were analysed, including mainly databases generated and updated by international organizations and boards, databases generated by research centres or enterprises and outputs from international collaborative projects. In the case of international projects the information produced has, in some cases, a good quality - that is the case of ESPON projects ReRisk, Climate or Greeco, however these cases also have problems in that they are not devoted to provide data regularly and hence there is no guarantee of updating. In the case of research centres (mostly funded by European Commission), the problem is that their goal is to assess present datasets rather than generating datasets, as JRC's Institute of Energy and Transport does. Sometimes both projects and research institutes face a lack of resources to update the information generated in their research projects. Enterprises are more focused on specific issues of their interest and the datasets they generate are not free to use, for example good energy infrastructure maps have been generated by Infield Systems Ltd or Wood Mackenzie.

The most important international organizations and boards providing energy data are either energy related organisations or statistics agencies. In both cases the data available is complete and the indicators provided are very well organized. As stated in Annex 2 of the Inception Report, the main organizations where consistent data exists are Eurostat and the International Energy Association (IEA, on behalf of National Statistic Offices and other energy institutions). The datasets from these sources are complex and useful for our aims in the North Sea STAR project, being the depiction of energy production and consumption in the region

The data produced by these two organizations is sufficient to cover the state of production and consumption of energy at national level because they cover almost all thematic fields related to energy. The connections between datasets of both organizations are clear, with Eurostat feeding into the database of the IEA. This coherence between databases decreases the uncertainty in filling the gaps between databases if needed and gives more robustness to the datasets generated. That is why the main statistics used for evaluating the state of the energy at national level (in this project) have been those produced by Eurostat.

The North Sea Region, as defined in the North Sea Programme, is a maritime region implying several coastal administrative units in some cases smaller than a country. The second goal, hence, was to find data at subnational level to have a clearer and more precise picture. Whilst some ESPON projects have been used to provide contextual data about the North Sea Region at lower levels, for example the GREECO project and CLIMATE, no international organization was able to provide data related to energy or energy trends at sub-national level. Therefore the main sources for these datasets are the national/local statistical offices for every country

of the North Sea Region. The North Sea STAR project team performed a search of their national statistical institutes and energy boards to find out if any further information was available. The results of this exercise (again, reported in Annex 2 of the Inception Report), was diverse depending on the country and on the thematic field, but in most cases the availability of energy data at a sub-national level is poor and not always coherent and compatible.

The research showed that for the most important indicators (data on production, consumption, electricity generation and energy intensity) most of the countries of the North Sea region don't have data available on a comparable basis at sub-national level. Denmark, Germany, Netherlands and Norway don't have data of these thematic areas at regional level. For those macro-figures Sweden has data on energy supply and consumption, UK has data at sub-national level on energy consumption.

Some specific datasets are provided by different countries at regional level, such as potential of wind energy or capacity of inland wind turbines (Belgium), energy budget and projections for solar energy (Germany), wind power or average consumption of gas per household (Netherlands) and renewable energy production (Sweden). The cases of Belgium and the UK are special in the sense of providing NUTS2, NUTS3 or LAUs data for specific territories only (e.g. Flanders, Wales). Table 2 (below) indicates the availability of data at sub-national level. The factors determining the availability of data are diverse. The data provided by the national offices of energy or statistics is influenced by the interests of the countries. Therefore, in terms of putting together national/ local datasets in a regional / North Sea context, a major problem is data comparability.

Table 2: Data availability at sub-national levels

	Data on production and consumption at sub-national level	Other ancillary data at sub-national level	Intra-regional disparities in the provision of data
Belgium	NO	YES	YES
Denmark	NO	NO	NO
Germany	NO	YES	NO
Netherlands	NO	YES	NO
Norway	NO	NO	NO
Sweden	YES	YES	NO
UK	YES	YES	YES

National statistical offices do not provide the same indicators in different countries. For example, UK's DECC provides data related to oil and gas by oil field and gas facility. At the same time, Norway, being a major producer of fossil fuels does not offer data about the location of their oil fields or gas facilities. Also, the size of the country seems to have an influence on the availability of data at different administrative levels. Small countries such as Belgium, Denmark or the Netherlands appear to have less data at sub-national level than bigger ones. Differences between the data compiled by different regions have been found, as is the case of Flanders and Belgium, or the case of Scotland (NUTS1 regions with non-disaggregated data) and England (NUTS1 region with data disaggregated into NUTS2 regions).

However, the main problem seems to be a general lack of interest from the countries to provide such energy statistics at a regional level. The result is that, with the information now available it is difficult to draw a picture of the supply and demand of energy at subnational level, and due to the size of some countries the national scale is far too small to provide useful conclusions for the North Sea Region.

The countries that provide the most subnational data are Sweden and United Kingdom. In Table 3 below the difficulties in providing comparable indicators for a common region are shown. No indicator is available for both countries, as energy consumption is not available at NUTS2 level for Scotland. Besides, the statistical definition of the indicators can have small variations (e.g. Final energy consumption is not the same as Energy Available for Final Consumption)

Table 3: Comparison of Sweden and UK energy indicators

	Sweden	***UK***
Energy supply	NUTS2 and NUTS3	NUTS0
Renewable energy production	NUTS2 and NUTS3	N/A
Installed capacity of sites generating electricity from renewable sources	N/A	NUTS1 (Scotland) and NUTS2 (England)
Energy consumption	NUTS2 and NUTS3	NUTS1 (Scotland) and NUTS2 (England)

Regarding energy infrastructures, the lack of information is also notorious. Some relevant maps were produced by private companies, as in the above mentioned examples, but the methodology is not easily accessible and the information is not available free of charge.

2.2. Mapping Activities

For the purposes of this Interim Report a series of maps were produced from Eurostat information. Based on the publication EU Energy in figures, Statistical Pocketbook (2011, 2012 and 2013[2]) and the formulas to calculate the energy indicators provided by Eurostat, 4 indicators have been generated and represented in maps:

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

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

In addition, mapping of NSR project partners involved in energy related projects has been undertaken, using lists of project partners from the North Sea Region website and NUTS2 regions as a common basis for locating partners that may be regions, municipalities, academic or other public institutions and private sector bodies.

2.3 Data Gaps

A major problem in trying to produce maps of energy data for the North Sea Region is that national statistics are diverse, making it difficult to build up a dataset with regional data for the whole area. In order to try and overcome these difficulties it has been necessary to analyse thoroughly the data provided by the national statistic offices compiled by members of the project team, which are those statistics provided on a regional basis. The coincidences between data from different countries are few.

In order to reduce data gaps in future, the way to proceed would be to agree on a specific core set of indicators and apply a top-down approach. National statistical offices or energy boards should be committed to compile these statistics. With energy being a sensitive issue (sometimes commercially sensitive), the recommendation is to have a very limited number of core indicators and geographical information about energy facilities (production and transportation, including main national grids). These indicators could help to understand what the regional energy balance is.

The Eurostat Statistical Pocketbook is an annual publication of Eurostat showing the main figures in the energy sector for Europe. Some key indicators are selected from the Eurostat comprehensive statistics every year. Minor changes have been observed between different editions but a number of indicators remain from one

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

edition to another. This set of core indicators should be used as the basis for a recommendation to the national statistical offices or boards to gather energy indicators at regional level.

The Eurostat Pocketbook provides a good starting point to define a core set of indicators, and a thorough analysis should be undertaken by experts to define what the most relevant indicators for future collection are. Production, transformation and consumption of energy are maybe the clearest themes to be covered. However, energy can be consumed without being processed into electricity. This is the case of heating and water heating from geo-thermal facilities. In addition, transport is the largest consumer of energy directly from processed commodities without being transformed into electricity. Finally, information about infrastructure (location and power of infrastructures devoted to energy) would also be useful, as environmental and social impacts depend on the specific location of energy infrastructures. Energy experts should be involved in the definition of most relevant indicators.

2.4 Usefulness of Data Sets for Monitoring Purposes

At the moment, for monitoring purposes, data provided by Eurostat is fully comparable. Although only present at NUTS0 level, Eurostat datasets are stable in the time and the time series are long. The indicators produced at this level can be easily updated and fit the requirements for monitoring purposes at the North Sea level.

As far as there is no uniform data at sub-national level it is not possible to assess the monitoring potential of the set of indicators. If a methodology to build up regional indicators form national datasets is developed, the potential for monitoring would depend on the indicators (proxies) used to assign the values of energy to every region and/or to every specific place. Such a methodology needs to be data driven, and needs to focus on the comparability of the datasets among the different countries/ regions.

2.5 Possibilities for Building up Data Sets from National to North Sea Level

Potentials

To build up datasets from national level to regional level is one of the possibilities to solve the problem of lacking regional datasets. A potential method for building up regional data is to use proxies to assign national data to the different regions of the North Sea or even to a predefined grid, for example using a 1km^2 grid to map the datasets in a regional North Sea context. The success of this methodology would depend on the different groups of indicators such as: energy production, energy consumption, electricity, heat, CHP and transport.

Primary energy production is an indicator for which applying a proxy is expected to be difficult because data for production from different production plants (or the energy grid) is needed. The way to downscale national data into regions would be to

set the different origins (by fuel: solid, petroleum, gas, nuclear, renewables and waste non-renewables) of energy production and to use a proxy to approximate the location of such activities spatially. Location and installed capacity of nuclear plants would be the proxy for downscaling the national figure of energy production by nuclear. Location and installed capacity of thermal power stations would be the proxy for downscaling the analysis units of energy production by fossil fuels, oil and gas, and so on. Regarding electricity, heat and CHP, information about the power of plants would be absolutely necessary to assign production data to the regions, however intra-regional flows through the grid system would also need to be taken into account.

The downscaling of energy consumption to provide a lower level indicator is an easier problem to resolve. Consumption depends mainly on human activities. Domestic consumption will depend on the population or number of households, but also on other factors like the temperature. Industrial consumption can be addressed by knowing the number of industrial facilities or enterprises together with the size of their installations or number of employees (finer assignation of values could be based on the sector the company belongs to). Energy consumption in the transport sector could be addressed with the number of vehicles (or vehicles/km), size of the transport network plus urban/non-urban stretches, or employment in the transport sector.

Constraints

The use of proxies to build up regional datasets from national data makes the results more dependent on different databases to be updated. These proxies should be as robust and simple as possible. And of course, the proxies used should be available at regional level for all North Sea countries, so the only present solution is to make use of Eurostat data.

The ancillary datasets should be clearly defined. An example related to energy consumption would be to define a proxy for household consumption (given that information at household level is very difficult to obtain). In this case the number of inhabitants or households (which is usually fully available) could be a proxy for domestic consumption. However, other information like the KWs installed in industrial facilities should be gathered as well to have a proxy of industrial consumption.

2.6 Use of Other Data and ESPON Tools Relevant to Operational Programmes

Alongside the mapping of specific energy data sets, the development of tools and indicators by both the ESPON Transnational Support Method for European Cooperation (TransMEC) and Key Indicators for Territorial Cohesion and Spatial Planning (KITCASP) projects may help to inform the work of the North Sea Region Secretariat.

The KITCASP project is a targeted analysis project which aims at providing an appropriate core set of indicators for the preparation of territorial development strategies. The set of core indicators produced will draw on the territorial development goals set out in key European and national policy documents, existing ESPON data, stakeholder views and relevant policy indicators from the five participating countries in the project (Republic of Ireland, Basque Country, Iceland, Latvia and Scotland). Although at the time of writing the KTICASP project had not published a final report, the Interim Report highlights the importance of energy, not just in terms of Member States having to reach the energy 20:20:20 goals set out by the EU (20% reduction in Greenhouse Gases, 20% increase in renewable energy and 20% increase in efficiency), but also in terms of realising renewable energy potential as a driver of economic growth. This is most clearly demonstrated in the workshop reports for Scotland and Ireland (ESPON and KITCASP, 2012). The final set of indicators produced may offer examples of new indicators that can be used within the North Sea Region to measure energy performance over the course of the next Operational Programme and progress towards both national and European targets.

TransMEC aims to support the delivery of evidence based results within the context of territorial cooperation programmes. The TransMEC project has developed a range of applications based on available ESPON data and other sources (for the area covered by the Interreg IVb North West Europe Programme) that allows new overlay maps to be produced, for the purposes of:

- Identifying key territorial potentials, themes and regional stakeholders
- Visualising Programme achievements
- Monitoring of on-going Programme performance, and
- Assisting future decision making.

The potential use of the 15 TransMEC applications to provide information for the North Sea Region Programme in relation to energy issues is discussed in Table 4. Given the paucity of energy data at NUTS2 level or below and the relatively small number of ESPON projects with a distinct energy theme, the most useful of the applications outlined in the Table are those relating to the distribution and type of project partners and funds (Applications 2, 3, 8, 9 and 11). These can be used to build up a picture of achievements in Interreg IVb energy projects, and be used to track the type of projects and partners that may engage with the energy theme during the next programming period. In particular, these applications could be used to steer project development towards those regions in greatest need of building capacities related to the low carbon economy, efficiency or renewable energy, or help in the formation of project partnerships and new clusters with appropriate expertise to deliver tangible and long-lasting outputs.

Table 4: Potential Use of TranSMEC Applications for the North Sea STAR Project

Application	Relevance/ Usefulness	Justification
1. European Wide Context Visualising the NWE programme area in a wider European context	Medium	Using territorial indicators (maps) that show North Sea Region in the wider context of Europe may help to demonstrate where the North Sea leads in specific thematic fields, e.g. energy production from renewables.
2. Partners/ERDF variation Variation between the number of participating partners OR the ERDF budget spent and comparing both maps	High	Besides providing an overview of geographical distribution of partners/projects, this information can be combined with other indicators to show how distribution of beneficiaries corresponds to other evidence available, e.g. low carbon transport projects/metropolitan areas.
3. Scale variation Variation of scale between NUTS 2 or NUTS 3	Med/High	Mapping at NUTS2 may provide clearer visualisation but lacks sufficient detail. NUTS3 level can provide greater detail of individual partner or project achievements and will be used in relation to the North Sea STAR case studies.
4. Zooming in Zooming into parts of the NWE territory	Medium	The application can be used to present the territorial evidence of a specific section of the North Sea area in detail in combination with the precise location and volume of North Sea interventions in the related field. For energy this may rely on territorial evidence presented at NUTS2 level or below, where there is a lack of suitable pan-European data, but could be applied within a specific country if lower level data (e.g. for municipalities) is found.
5. ESPON maps revisit Reassessment of ESPON maps used in the INTERREG Operational Programme	Medium	ESPON data may provide useful baseline evidence for defining programme strategies and priorities and can be updated over the course of an Operational Programme to demonstrate the achievements of programme activities. Whilst lack of lower level energy data is problematic, the maps created by North Sea STAR could be retained and updated by the Secretariat over the next Operational Programme.
6. Filtering Extraction of selected data layers from ESPON maps for specific thematic foci	Low	This requires the disaggregation of complex data sets developed by ESPON (e.g. typologies) and requires that the original datasets used are available. In this instance energy related data in the ESPON database from the ReRisk project is not sufficiently up to date for future programming.
7. Annual performance update Annual update of the programme performance against a constant background map	Medium	Mapping new projects against a constant background map at regular intervals would allow for monitoring of progress against particular calls or themes, enabling the programme Secretariat to steer territorial impacts more effectively.

Table 4 Continued: Potential Use of TranSMEC Applications for the North Sea STAR Project

Application	Relevance/ Usefulness	Justification
8. Thematic foci of cooperation Checking thematic concentration vs. broad thematic orientation of NWE projects in a defined region.	High	Mapping specific sub-priorities can help to steer and monitor projects in order to develop targeted actions, for example ensuring regions do not over-specialise. In the context of energy projects this might be used to ensure that energy, if not a specific theme in its own right, is adequately addressed under other themes such as innovation.
9. Comparison of programme performance Comparing/Aggregating the programme performance from two different programming periods (IIIB/IVB)	Med/High	Mapping projects over two Interreg periods may provide some useful perspectives on different themes that have been covered and could facilitate further dissemination/exchanges between projects on similar themes, or help to target future beneficiaries in regions that have not previously had a high level of participation.
10. Demarcation of targeted calls Assisting the demarcation of thematically targeted calls through identification of territorial challenges	Low/Med	After the first calls for proposals, gaps in thematic or territorial coverage can become apparent and this approach would enable targeted calls to compensate for underrepresented regions. (The North Sea STAR project will be completed before first calls for Interreg Vb projects are announced).
11. Partnership composition Assisting project development respectively project actors to select partners in highly profiled territories	Med/High	This would enable potential beneficiaries to select partners with relevant competences/territorial characteristics to help meet project aims, or enable the Secretariat to profile the types of partners involved. For energy projects this may be useful to ensure a suitable mix of beneficiaries from local government, research and the private sectors.
12. Use of ESPON typologies Working with ESPON typologies for new, emerging themes	Medium	Combining Interreg Programme data with ESPON typologies can provide better understanding of territorial development in relation to certain themes (e.g. the ReRisk typology might cross-referenced with energy projects to determine differentiated patterns of development with respect to energy efficiency).
13. Differentiation of partners' institutional background Sub-differentiating different participant groups within one or more priorities	Medium	The differentiation of partner institutions (e.g. private sector, municipality, NGO etc) and mapping these against relevant typologies can demonstrate which types of partner are attracted to particular themes or projects, enabling a more refined approach to partnership composition in future activities.
14. Use of typologies combined with partners' institutional background Assessing the performance of sub-groups in the programme against new typologies: Combining Application 12 and Application 13	Low	This is a combination of applications 12 and 13 and may be used to understand the territorial dimension of new or existing themes – or to explain it another way, which partners in which places are more likely to engage in transnational cooperation.

Table 4 Continued: Potential Use of TranSMEC Applications for the North Sea STAR Project

Application	Relevance/ Usefulness	Justification
15. Application at regional level "Changing the perspective" – Assessing territorial needs and choices of project actors at regional level	Low	This is a more qualitative application that requires direct contact with project beneficiaries at regional level and their views on how available evidence may change their perspective on territorial development linked to their region or a particular theme. For North Sea STAR the lack of lower level energy data would prevent rigorous use of this approach.

With respect to Application 2, mapping the number of partners or budget spent per NUTS region, this has been classified (in the initial assessment carried out as part of the Interim Report) as highly useful for the North Sea Region Programme for providing an overview of the geographical distribution of partners and projects. Given the relatively small number of energy projects within the programme (17 projects out of a total of 71 across the programme were identified in relation to case study selection) it is less helpful to map them in this way and draw any useful inferences from the data. Map 1 in the Introduction illustrates the location of project partners in relation to energy projects and this reveals some notable gaps in geographical coverage, for example in the east of England. However this does not mean that these regions are not participating in the North Sea Region Programme – rather that their thematic priorities may lie elsewhere, for example in health or ICT.

Application 3 (varying scales) has been used to map the locations of partners in energy projects (as explained in relation to Application 2 above) and in particular for the partners involved in project clusters at NUTS3 level. This can provide limited insights into regions where organisations are taking a more proactive approach to energy issues, however as with Application 2, considering the partners in energy projects in isolation from other projects the results of such an exercise only reflect interest in one topic of concern.

Application 8 (thematic foci of cooperation) has been identified as a tool that may be used to check that regions do not over-specialise in one particular area. Whilst this would be more helpful if applied to the full range of projects in the North Sea Region Programme, Map 1 provides an illustration of how energy projects relate to specific priority themes of the current programme, for example accessibility. Taking this analysis further, Table 18 within the case study chapter displays projects in relation to priority themes and sub-objectives of the Operational Programme, demonstrating an added level of diversity in relation to project focus and ambitions.

Application 9, Comparison of Programme Performance again is a future-oriented tool that can be used to measure project outcomes and identify areas where there has been less activity related to a particular topic or theme. Whilst this is helpful in a broad sense for identifying gaps, this needs to be considered in the context of changing priorities for the new Operational Programme, where it may be difficult to map outcomes related to old thematic priorities onto new priorities.

Application 11, partnership composition, has also been explored in relation to the makeup of project partners in the case studies. Here the classification of partners into local authorities, NGOs, private sector firms, research institutes and so on has been predefined in the project application process and relates mainly to the legal status of the partners rather than specific competences, which have been derived from further research by the TPG (both desktop studies and interviews). Whilst this can help to ensure a broad coalition of public-private-research partners or the “triple helix” when a project application is being considered, a more proactive approach may be needed to ensuring that potential beneficiaries in future projects communicate their interests and expertise more clearly. This might enable more effective partnership formation in terms of ensuring the necessary expertise required to achieve project goals.

2.7 Use of Existing ESPON Results: Policy Options and Recommendations with Relevance for the North Sea

In the following Tables (5 to 8), recommendations from ESPON projects are assessed in terms of high, medium or low relevance for the North Sea STAR project and a justification for their categorisation is given. In addition to identifying recommendations by their level of relevance, those with high or medium relevance can be further distinguished with reference to their most likely target audience. This could be:

- The North Sea Region Programme Secretariat,
- The North Sea STAR project team or ESPON community, in terms of providing methodological insights, e.g. for data collection and capitalisation upon project results,
- Interreg project partners and future beneficiaries, in terms of highlighting areas where new projects could be developed.

As the North Sea STAR is one of ESPON Targeted Analysis projects, the focus is on recommendations that are of most use to the North Sea STAR project team and the North Sea Region Programme Secretariat. Therefore whilst some recommendations may be important for overall energy policy and actions towards Europe's 20:20:20 goals, those recommendations which are directed at national and European level policy makers are considered to be of lower relevance here.

Table 5: Recommendations from the ESPON ReRisk Project

Recommendation	*Relevance for NSS Projects*	*Comments*
Governance		
Promote energy solidarity between regions and territories	Medium	Ensuring complementary development of energy infrastructures across regions requires a strategic approach at the EU level, although the production potential of both renewables and fossil fuels means within Europe, the North Sea Region is well placed to support neighbouring regions through its export potentials.
Strengthen regional and local networks	Medium	Strengthening networks could help increase local resilience, but improvements to these networks are partly a function of how much control local and regional agencies have over managing energy supply and demand.
Fund and stabilize transnational research agencies	High	Focus on innovation and transnational working could add value. Stronger links between academic, business and government organisations which can be promoted through the North Sea Region Programme could assist here.
Promote awareness among regional policy makers on the impact of rising energy prices and the need for economic diversification	Medium	The role of dissemination and project results may become important here in signposting ways to minimise the impacts of rising energy prices (e.g. through alternative energy sources). Economic diversification will be dependent on local and regional structural conditions.
Define a vision for a regional energy model 2050	Low	The relative importance of national v regional planning makes this challenging, particularly as different nations within the North Sea Region have diverging ambitions for renewables. However the EU's Energy Roadmap 2050 may help to guide the formulation of broad principles.
Push municipal leadership in public-private partnerships	Medium	This kind of arrangement is beyond the scope of North Sea Region projects – the payback period for such investments needs to be carefully considered in the current economic situation.

Table 5 continued: Recommendations from the ESPON ReRisk Project

Recommendation	*Relevance for NSS Projects*	*Comments*
Spatial Planning Policies and Strategies towards a more Sustainable Territorial Management		
Develop integrated spatial planning instruments	Low	This is generally beyond the scope of North Sea Region Programme projects and not the aim of this study, but the spatial implications of the low carbon economy need greater recognition in spatial planning.
Establish urban planning principles for solar energy use	Low	New projects could have a role to play in demonstrating techniques to model solar energy potential in domestic energy settings.
Implement Urban Metabolism procedures	Medium	Studies of urban metabolism using case studies from around the North Sea Region could be an interesting transnational project.
Promote industrial symbiosis and/or industrial eco-parks	High	There are already projects designed to promote such interventions, though the benefits of such schemes should be more widely disseminated. Initiatives that support more efficient district heating could be particularly relevant for the North Sea Region.
Environmental Protection and Risk Prevention		
Sustainable use of biocrops	Low/Med	Further investigation into the use of biocrops could represent opportunities for new projects.
Prepare for climate change impacts in the regional energy infrastructure	Med/High	Although this recommendation is geared towards areas that may experience longer periods of hot, dry weather in summer, climate change mitigation is a serious issue for the North Sea Region with regards to low lying coastal areas and extreme weather events that can put stress on energy systems. Planning to increase the flexibility and resilience of energy infrastructures at local and regional levels can contribute to this.
Policies to Accelerate Deployment of Renewable Energy Sources		
Evaluate the feasible potential of all renewable sources in the region	Low	This is beyond the scope of the Programme Secretariat - the cost of such an assessment is likely to be high and shaped by national subsidy programmes in changing economic conditions.
Incorporate solar and wind facilities in urban areas	Low/Med	This may be a suitable activity for new projects, though it is difficult to see the added value of transnational working.

Table 5 continued: **Recommendations from the ESPON ReRisk Project**

Recommendation	Relevance for NSS	Comments
Policies to Promote Energy Efficiency		
Improve the data on energy use and efficiency in Europe	Low	An investigation of energy data availability through Eurostat and other European/international sources for the North Sea STAR project has revealed that this is an area where large improvements could still be made, and this should be a priority at national and European levels.
Accelerate the transition to non-fossil fuels in the aviation industry	Low	This is beyond the scope of the North Sea Region Programme.
Create a market for energy efficiency (White certificates)	Low	Needs to be developed and approved at a larger scale, either national or European level.
Improve efficiency of office design and work arrangements	Low	Changes to working arrangements and possibilities for the "networked office" could provide potential for projects in the next funding period, however the need for a transnational approach could be questioned given the diversity of building styles and cultures throughout the region.
BAT (Best Available Technologies) for industrial energy efficiency	Medium	For sectors identified as having a high energy purchase (e.g. iron and steel production, chemical processing) adopting more efficient technologies requires economies of scale that are beyond what the Programme can fund. However, the possibility for innovative transnational working in industrial sectors that work on a smaller scale should be considered.
Policies to Fight Energy Poverty		
Improved transparency and information on energy consumption	Low	These actions should be taken by others such as national governments and energy companies.
Consumer awareness and education; involvement of end-users	Medium	Informing consumers and end users about efficiency and low carbon sources of energy and small scale training programmes for improving skills in energy related occupations could be appropriate activities for future projects.

Table 6: Recommendations from TERCO

Recommendation	Relevance for NSS	Comments
Impact of European Territorial Cooperation (ETC) on socio-economic development		
stability of funding for European Territorial Co-operation (ETC) activities should be assured to exploit its benefits	Med	Stability of funding is crucial for ensuring that the successes of previous projects can be built on, however this is a matter for the European Union and Member States to deliver.
In order to achieve more territorial integration via ETC, it seems that the issue-based approach to ETC and good governance practices need to be implemented	Low/Med	Territorial (cross-border) integration is not the main purpose of the NSR Programme. However, adopting energy as a theme for the next Operational Programme, if not explicitly then as a cross cutting issue, could help to stimulate territorial integration.
Geographical areas of territorial co-operation		
There is no immediate need for geographical expansion of ETC programmes… However, ETC efforts would benefit from increased inter-programme cooperation	High	This recommendation supports current thinking within the North Sea STAR project regarding the proposed clustering of energy projects across Programme Areas in order to support greater synergies between projects and deliver Energy 20:20:20 targets.
If, however, new areas of co-operation are considered within ETC, there is potential for extension within Transnational and Transcontinental Co-operation.	Low	(Possible areas for inclusion in additional transnational cooperation programmes are specified within the TERCO report, including north west Germany, but it is beyond the scope of this project to consider the boundaries of Programme Areas).
Decisions on eligible areas for ETC programmes should depend on the boundaries of the issues/problems they aim to resolve rather than on arbitrary distance or the administrative boundaries of the regions.	Low	This recommendation is aimed more specifically at Interreg A programmes, but shows that the issues addressed by Operational Programmes may have a wider relevance that can assist in the development of inter-programme activities.

Table 6 Continued: Recommendations from TERCO

Recommendation	Relevance for NSS	Comments
Thematic areas (domains vs. issues) for territorial co-operation		
Rethinking the issues addressed by ETC would be beneficial…	Low	This is beyond the scope of the North Sea Region Programme.
The solution could be to specify a list of priority issues that ETC should address, but the choice of domains to tackle those issues should remain open.	Low	The recommendation/list of issues provided is more suited to cross-border cooperation programmes. Priority themes for the North Sea Region Operational Programme will be derived from the Common Strategic Framework and stakeholder engagement.
…Policy-makers could consider 'Territorial Keys' (proposed by Böhme, Doucet et al., 2011) as possible thematic issues that ETC could tackle.	Low	
Key determinants of success in territorial co-operation		
Strengthening the wider participation of actors in ETC, assuring availability and sustainability of ETC funding, allowing different forms of co-operation at different stages of co-operation (from easy to more advanced), and providing a wide range of domains for ETC (within a restricted range of issues) would be appropriate actions to generate more effective ETC policy.	Med	Ensuring wider participation should be a standard objective of transnational programmes, and in particular SMEs might be a particular group of stakeholders to focus on in delivering energy projects. Different forms of cooperation may be more difficult to implement within Interreg projects, but clustering could allow for some stakeholders to take on different roles over the lifetime of a project. As before, the range of domains and issues covered by the Programme are a more strategic matter.

Table 6 Continued: Recommendations from TERCO

Recommendation	Relevance for NSS	Comments
Governance structures and good practice in territorial co-operation		
New TC support structures could promote collaborative forms of policy formulation and delivery.	Low-Med	This recommendation talks specifically about partnerships of the State, private sector and civil society and the importance of such partnerships in peripheral regions where multiple support mechanisms are needed to support entrepreneurial activity – such partnerships are also to be encouraged within the North Sea Region.
Co-operation of sustainable partnerships, rather than mere projects, should be a target of multi-annual support.	High	This is a key challenge for ensuring the legacy of Interreg projects – the recommendation suggests supporting the creation of new networks to assist private and social entrepreneurs. Such networks could be formed through project partnerships or clusters of projects, but would require additional financial support over the longer term.
Continuity and consistency of co-operation in TC must be supported as key factors of its efficiency.	Med	The North Sea Region Programme cannot provide continuous funding (as proposed in this recommendation) to support long term projects, but should try to encourage greater private sector involvement in project implementation or in communicating project results to lever in additional financial resources. Providing more opportunities for exchange between projects (e.g. through clustering) can promote continuity of ideas.
A change in focus within TC opportunity structures	Low	This recommendation suggests that "civil society networks and local-regional co-operation are prioritised and eligible for more generous and specifically targeted support". However it may not be possible to steer the composition of project partnerships in such a specific manner.
Policy recommendations by TC types - Interreg B		
Extending the eligibility criteria	Low	This recommendation specifies regions that could benefit from being included in more than one cooperation area within the Interreg B programme. It is not the purpose of this project to redefine the boundaries of the North Sea Region.

Table 7: Recommendations from Territorial Trends of Energy Services and Networks and Territorial Impact of EU Energy Policies (ESPON 2006)

Recommendation	*Relevance for NSS Projects*	*Comments*
Availability of statistical data	Low	The availability of comparability across Member States is a problem we have encountered as well, and beyond the scope of NSS to do anything about.
Local energy agencies	Low	The establishment of local energy agencies is an interesting idea, and would provide greater continuity for some of the activities already being undertaken by North Sea Region projects with regards to informing energy efficient behaviour and promoting local renewables, however funding this is beyond the scope of the current Programme. In addition to this, the need for a transnational approach can be questioned given that such organisations would have to be integrated with country or region specific governance structures and energy markets.
Local versus national policies	Low	This is a within country issue rather than a transnational issue or concern, although national or regional variations inevitably shape the take up of energy efficiency/lower carbon energy production processes.
Renewable energy development	Low/Med	Potential for capital projects is limited within the Programme, though enhancing skills and developing SMEs that service the renewables sector could be a more realistic aim for projects.
Flexibility in price policy	Low	Pricing policy issues are beyond the scope of this project, although flexibility in pricing will inevitably have influences on demand and supply.
Promoting full costing of energy use	Low	This is largely shaped by national and international markets.
Promote R&D on energy efficiency and use of renewables	Low	Large scale R&D into these areas more likely to be funded by bigger European research programmes such as Horizon 2020
Need for an integrated approach to energy policy	Low	This recommendation focuses on large scale and strategic matters to be dealt with at European and national scales. Since its proposal, the EU has developed a number of policies aimed at a more integrated policy: 'Energy 2020: A Strategy for Competitive, Sustainable and Secure Energy' (CEC, 2010) and the 'Energy Roadmap 2050' (CEC, 2011) and the provisions within the Common Strategic Framework represent examples of the efforts being made in this regard.

Table 8: Recommendations from ESPON CLIMATE

Recommendation	Relevance for NSS Projects	Comments
For metropolitan/urban regions, high impact, but strong resilience and adaptive capacity, with spatial planning needing to promote greater resilience in various ways	Low	Fairly generic, limited relevance beyond contextual information.
Coastal Regions: high impact due to sea level rise and potential for increased tourism in the North	Low	Fairly generic, limited relevance beyond contextual information.

Within the ESPON Climate project, recommendations associated with metropolitan/urban and coastal regions have the greatest pertinence to the North Sea Region, however their specific relevance from an energy perspective is limited. Within metropolitan/urban regions, “Efficient spatial structures” would undoubtedly help increase energy efficiency but such ambitions require large scale actions that may not be possible in existing urban settlements. In relation to coastal zones, these are becoming increasingly important sites as for energy production and storage, however the Climate project also highlights the potential vulnerabilities of infrastructure in such areas and this should be taken into consideration when designing future North Sea Region Programme energy projects.

2.8 Conclusions on the Use of ESPON Project Recommendations

With regards to the recommendations offered by the different ESPON projects, many of these recommendations are aimed at national and European policy makers or attempt to tackle issues that must be resolved at a strategic level beyond the capacities of the North Sea Region Programme Secretariat, for example in relation to capital investment, energy pricing policies and infrastructure planning. However a number of recommendations suggest activities that could be the focus for new projects to be supported by the next Operational Programme, including:

- Investigating the feasibility of renewables deployment in urban settings, e.g. solar and wind use,
- Raising consumer awareness of alternative energy sources,
- Education and training related to renewable energy/energy efficiency,
- Expanding eco-innovation/energy services in industrial parks.

In addition to suggestions for projects, the recommendations provide some points to consider about partnership building and ensuring long-lasting impacts of Programme (or project) activities. While the North Sea Region Programme is unable to fund long term networking, the process of partnership building and clustering projects could support the creation of new networks with the capacity to and resources to continue transnational cooperation. As suggested by the TERCO project, developing synergies with other projects and funding streams that enable the upscaling of pilot projects could also support this. Providing opportunities for inter-programme initiatives, whether this is merely dissemination of project results and exchanges of best practice, or developing joint projects and themed project clusters could also help to increase the impacts of projects, but to some extent the formation of such arrangements depends on the political will of project partners and funding bodies to facilitate this type of joint working.

Lastly, the broadening out of partnerships to engage SMEs and facilitate entrepreneurial activity needs to be carefully considered in future programming activities. Whilst complex administrative requirements for European funding programmes can be a disincentive to private sector involvement, Interreg programmes could provide valuable learning experiences and opportunities for economic development in relation to innovation and low carbon/renewable energies. In the context of the current economic crisis, private sector partners may become more attractive as the ability of local and regional government actors to co-finance projects is diminished, and thus ensuring the right administrative support is in place to help SMEs participate in Interreg is crucial.

3. The North Sea Region in Context

The focus of this section is to provide a very brief overview of the North Sea region as defined by the Interreg IVB North Sea Regional Programme Area. The North Sea Region extends beyond the North Sea basin and parts of the neighbouring countries of United Kingdom, Belgium, Netherlands, Denmark, Sweden and the whole of Norway. Hence its maritime reach extends into the Artic. The section can be divided into two parts. The first describes some of the characteristics of the region, particularly in relation to energy and the second part identifies the changing context within which the future operational programme is likely to be framed.

Structural Funds 2007 - 2013: Transnational Cooperation North Sea

EU27 Cooperation areas

Other cooperation areas

0 500 Km

Source: DG Regio

Map 2: The North Sea Region

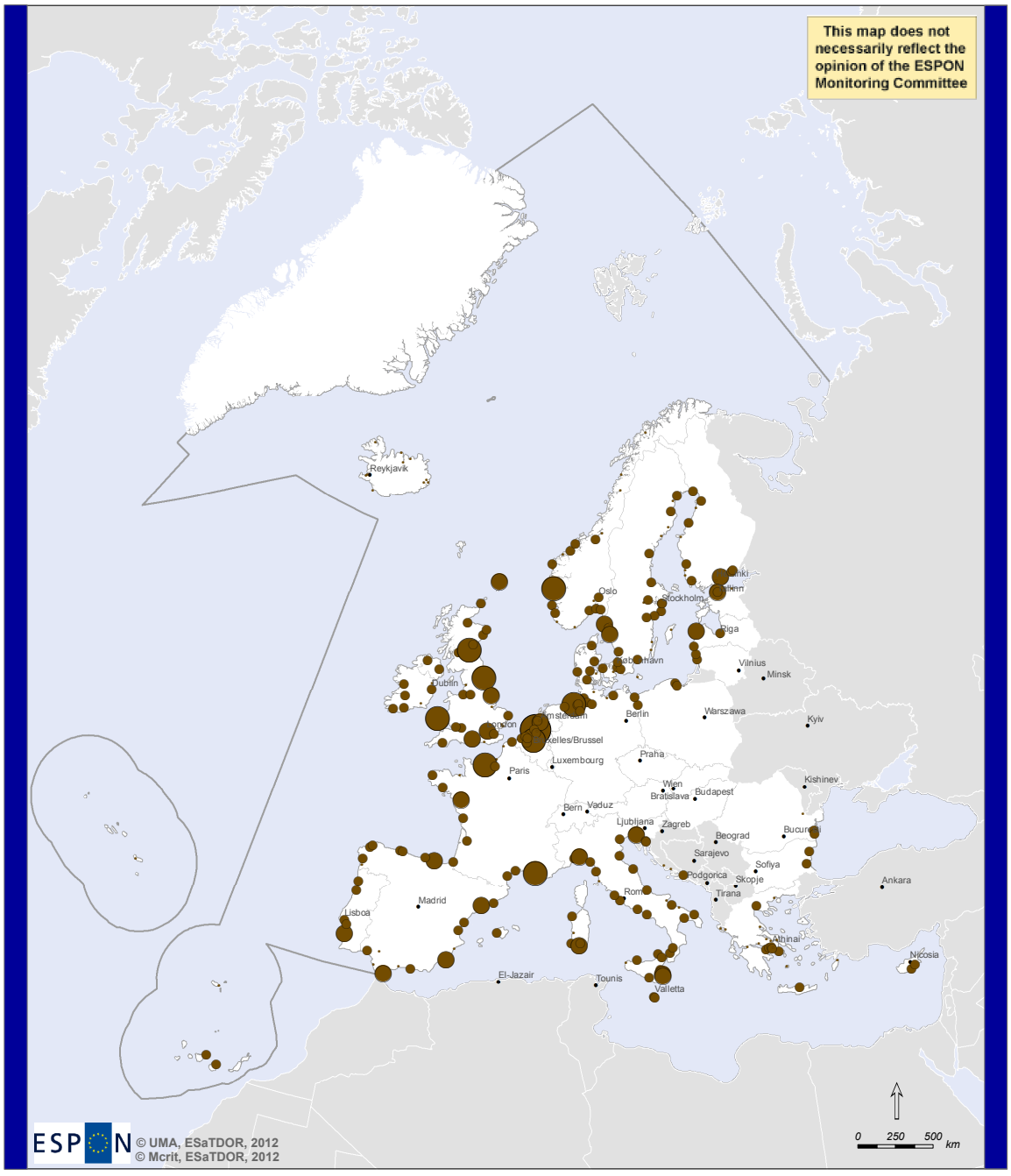
3.1 Energy Related Characteristics of the North Sea Region

This section seeks to briefly describe its dominant characteristics and its current role and potential with regards energy production and consumption. However we recognize from the outset that the North Sea Region is not self-contained and behaves as a 'prosumer' in that it produces energy, it consumes/uses energy for regional development and it imports/exports its energy from/to other regions. To this extent the concept of regional self-sufficiency is unlikely to be realised in practice, although it is a reasonable aspiration that the North Sea Region as an entity can become more regionally self-sufficient.

Our analysis of the key characteristics of the region 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 out of date, nevertheless the key messages are pertinent.

The current and future North Sea Region Programme Area is characterised by the high density of population and economic activities in the southern North Sea. This is largely associated with the existence of large ports such as Rotterdam, Antwerp and Hamburg and its connectivity and gateway function to Europe's "core" region. This means that ports and short sea shipping activities to and within the North Sea Region are a dominant characteristic (see Map 3). The more northerly parts of the North Sea, in particular the coasts of North East England and Scotland, Sweden and Norway are more sparsely populated and remote.

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.

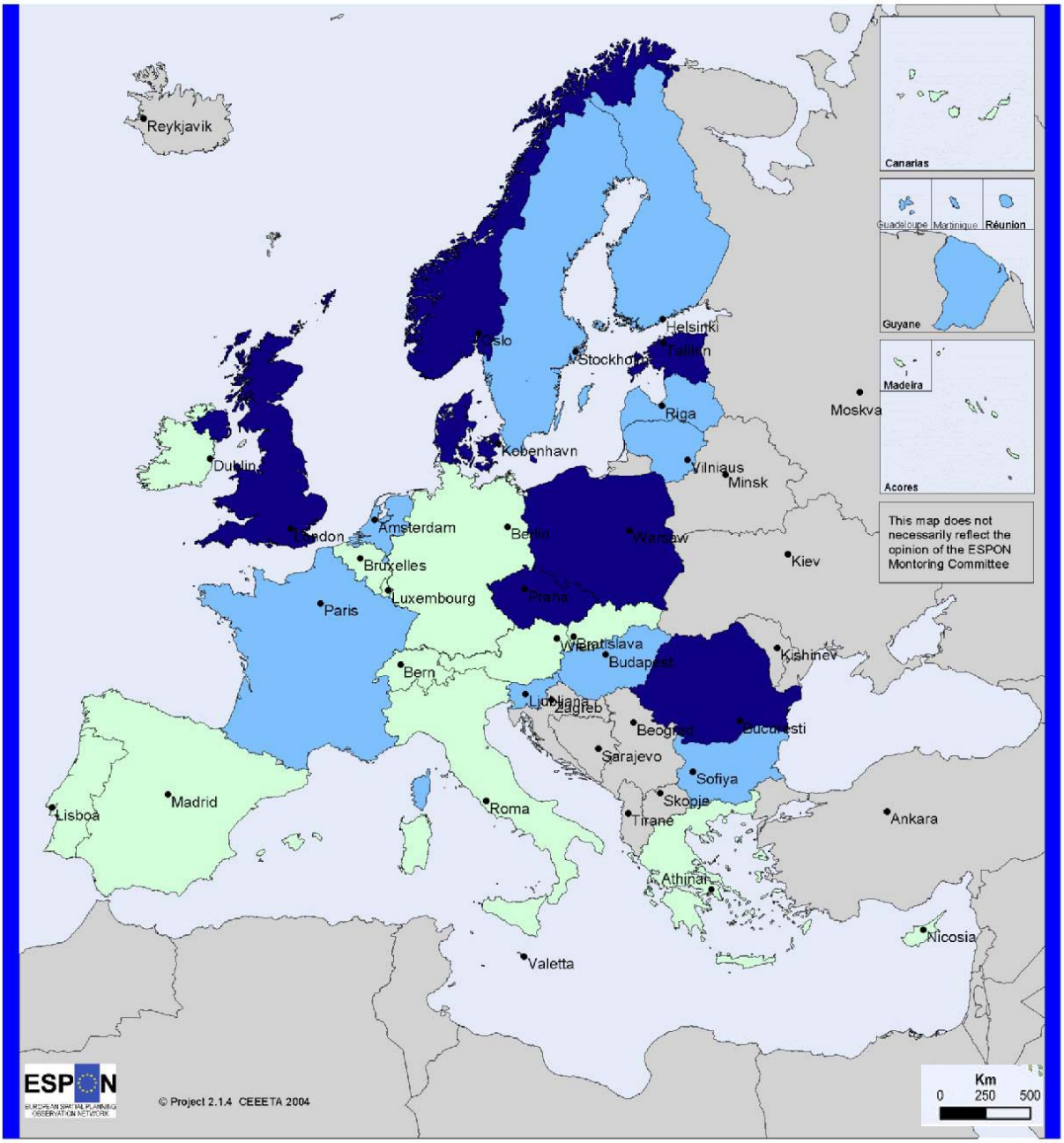
Liquid bulks goods by port, 2008 (thousand tonnes).

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

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

Map 3: Liquid Bulk Goods Shipping by Port (2008, million tonnes)

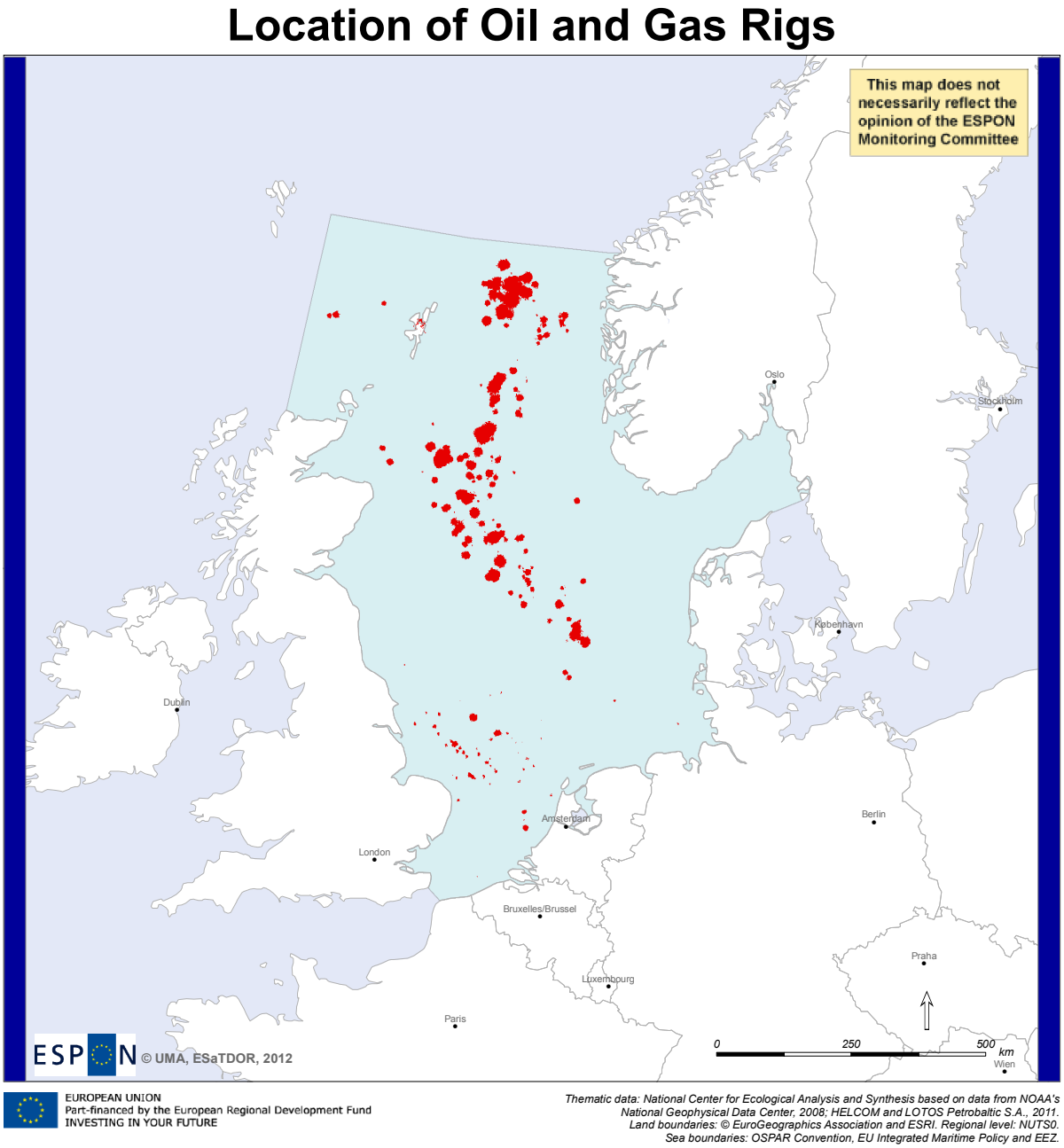
As a region many of the countries are amongst the most energy self-sufficient countries in Europe, to a large extent based on the availability of fossil fuel resources in the North Sea and the Arctic (see Map 4). Whilst this is based on 2002 data, the 2010 figures reveal a similar pattern, with Denmark, Norway, Sweden and the UK being the most energy self-sufficient and Belgium the least.



Source: ESPON and CEETA (2005:181)

Map 4: Typology of Self-Sufficiency of European Countries in Energy Resources (2004)

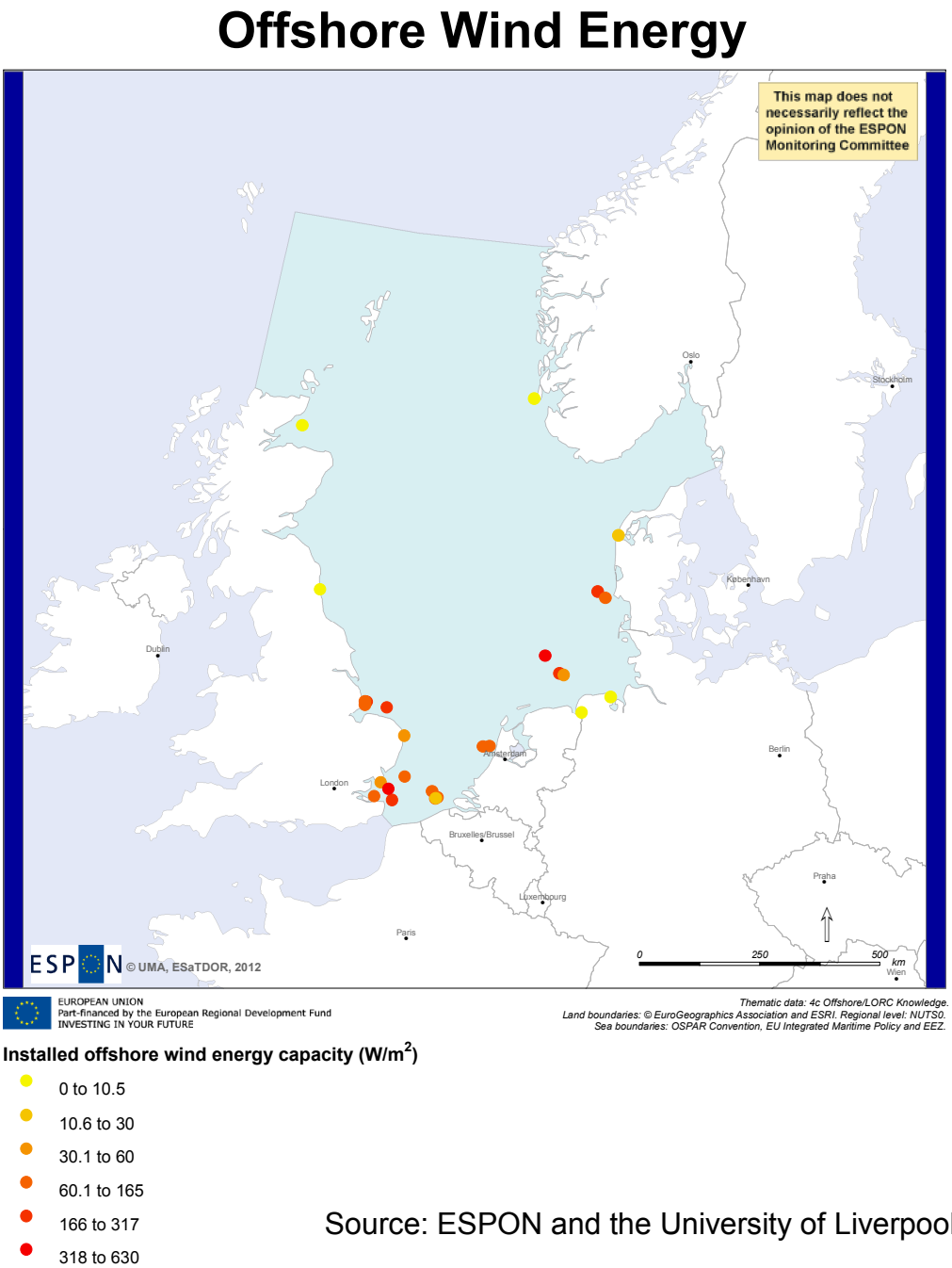
Based on the North Sea's recent economic history this is one of Europe's main energy producing regions. According to the ESPON ESaTDOR project, large-scale oil and gas production mostly in Norwegian, UK and Danish waters (Map 5) has been significant over the past 40 years but output is declining and there is a shift to more, smaller fields, and exploration is being extended in what is seen as potentially the more ecologically vulnerable Arctic.



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

Map 5: Location of Oil and Gas Installations in the North Sea

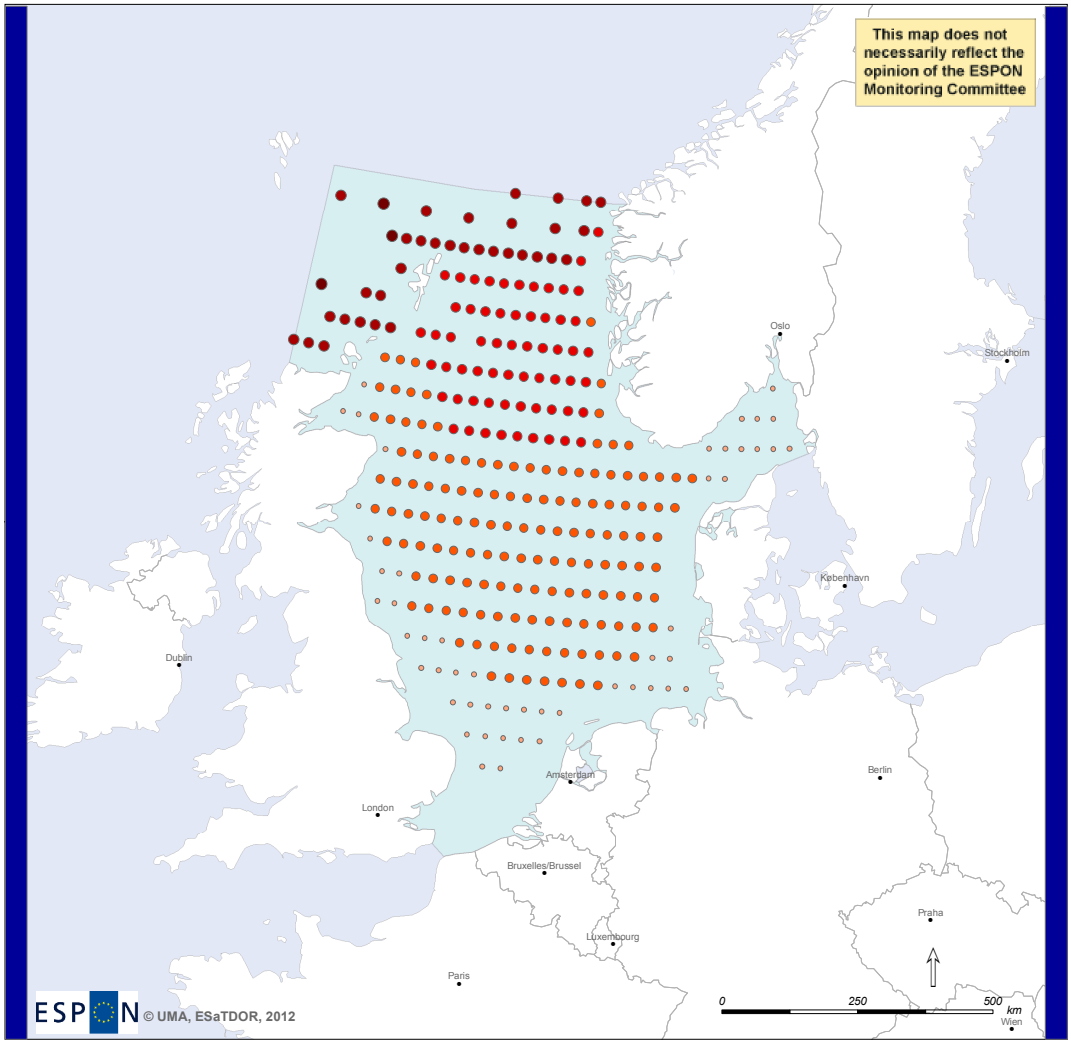
The region is also home to the greatest concentration of offshore wind farms in the world and further expansion is planned, particularly in UK and German waters (Map 6). In Scotland, the European Marine Energy Centre (EMEC) based in the Orkney Islands is a centre of excellence for testing wave and tidal energy devices, and wave energy potential is highest in the northern parts of the North Sea (Map 7). In addition, the North Sea Countries Offshore Grid Initiative, a major infrastructure project proposed by the EU and supported by Norway aims to develop an integrated offshore energy grid to connect wind, wave and tidal power with the North Sea Region, making use of Norway's hydro-electric power stations to store energy until it is needed. Looking to the future, the North Sea is well placed to make the transition from being a centre of fossil fuel production to a renewable energy region.



Source: ESPON and the University of Liverpool (2013)

Map 6: Existing Wind Farm Generation Capacity in the North Sea

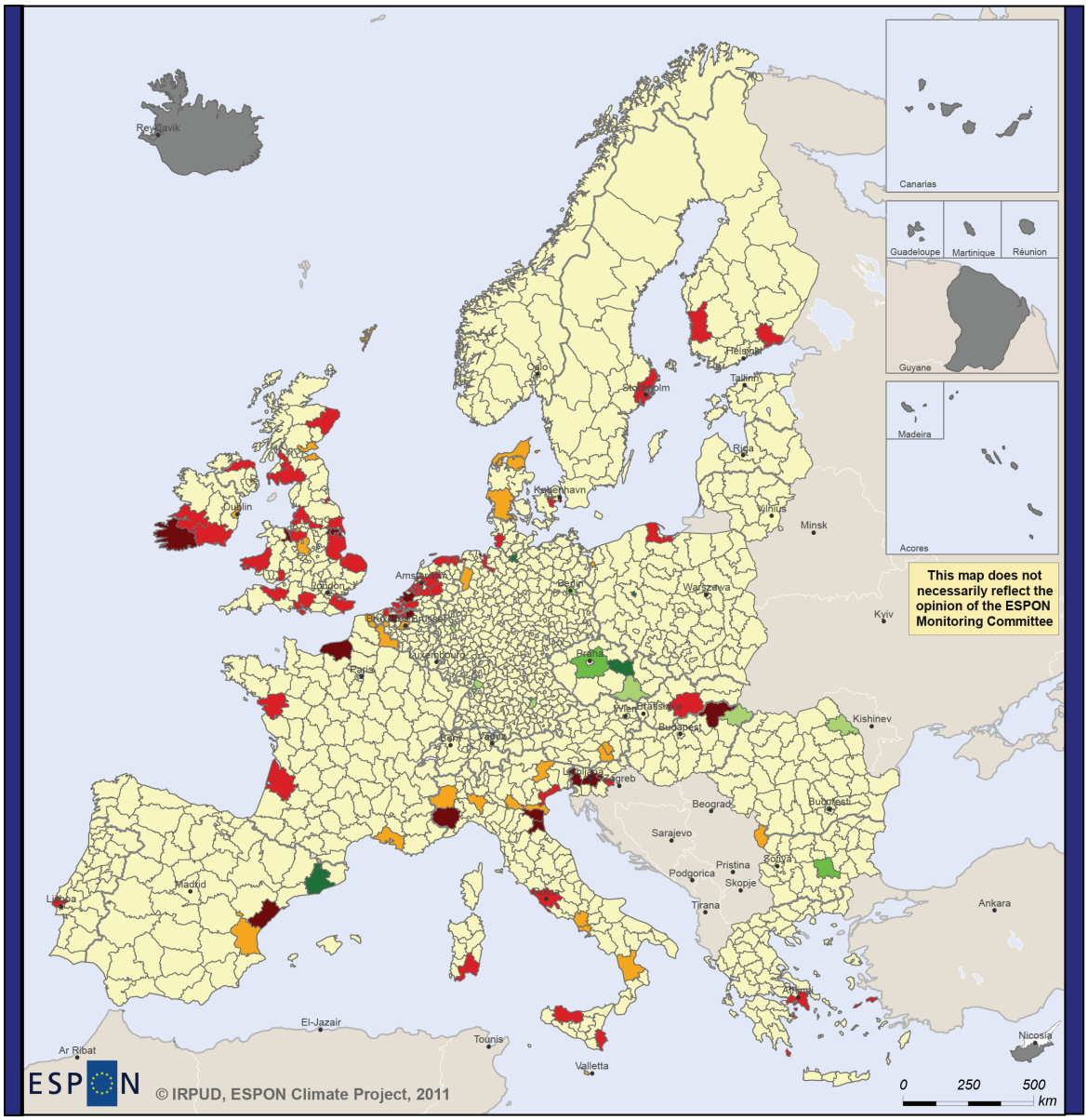
Wave Power Potential



Source: ESPON and the University of Liverpool (2013: Annex 7, p46)

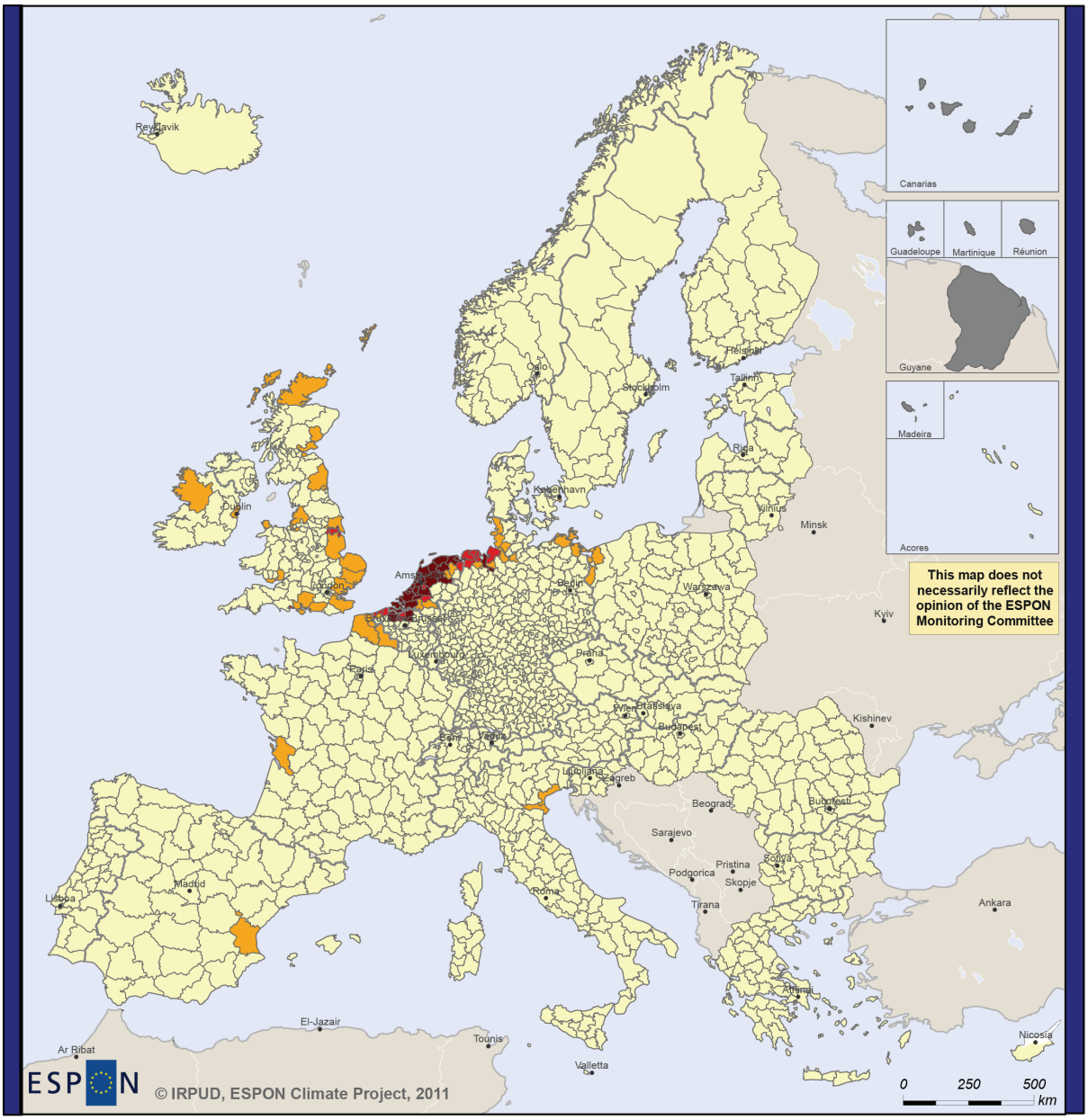
Map 7: Wave power potential

In terms of vulnerability to climate the greatest challenge to the area is seen as a function of rising sea levels and the threat of increased coastal flooding and tidal surges affect the many low lying areas of the east coast of England and in the Netherlands (for example in December 2013). The risks to people and energy land based energy infrastructure was examined in detail by the ESPON CLIMATE project (see Maps 8 and 9). These areas are also vulnerable to flooding from inland sources as many of Europe's main rivers discharge themselves into the North Sea.



Source: ESPON and IRPUD (2011:89)

Map 8: Potential Impacts of Climate Change on Power Stations and Refineries



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Origin of data: own calculations based on CCLM A1B Lautenschlager et al. 2009, Gallego et al. 2009/2011, USGS Hydro1K, DIVA 2004

Potential impact of sea level rise on population

- highest negative impact (0.5 - 1.0)
- medium negative impact (0.3 - <0.5)
- low negative impact (0.1 - <0.3)
- no/marginal impact (>-0.1 - <0.1)
- no data*

Potential impact of changes in inundation depths of a sea level rise adjusted 100 year coastal storm surge event on population.

Impact calculated as combination of regional exposure to climatic changes and recent data on regional sensitivity. Climatic changes derived from comparison of 1961-1990 and 2071-2100 climate projections from CCLM model for the IPCC SRES A1B scenario. Regional coastal storm surge heights projected by the DIVA model and adjusted with 1 m sea level rise.

*For details on reduced or no data availability see Annex 9.

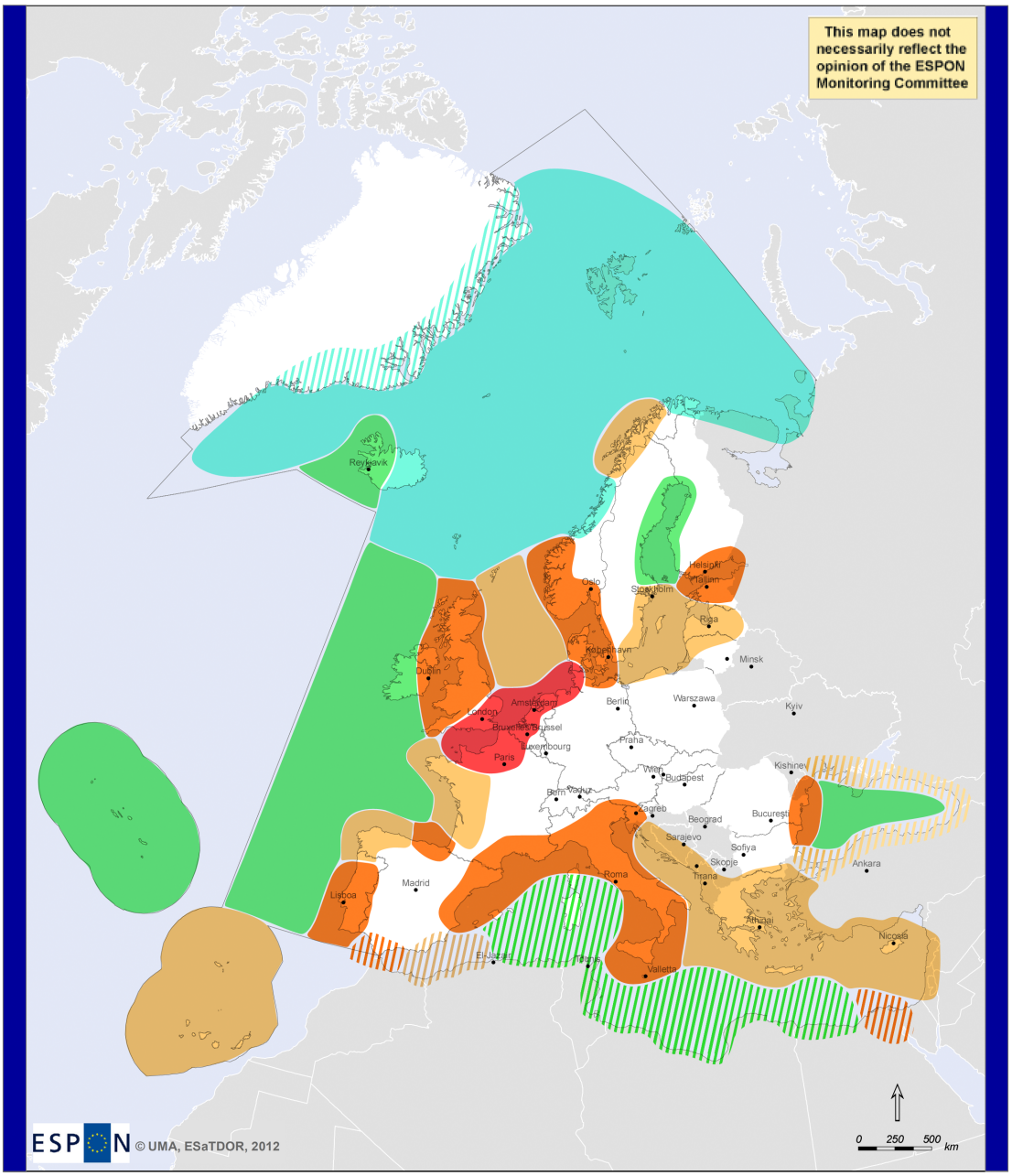
Source: ESPON and IRPUD (2011: 93)

Map 9: Potential Impacts of Sea Level Rise on Population

3.2 General Characteristics

Finally based on land and sea interactions the ESPON ESaTDOR project has created a an initial typology which differentiates different parts of the North Sea Region based on an analysis of hot and cold spots, based on intensity of relevant activities for which information was available, relating to economic activity (land based) flows of goods services an people and environmental pressure (Map 10). Whilst the North Sea Region is generally an intensively used space, although within the region itself there are significant difference in regional characteristics, with different parts of the region having different opportunities and risks. The European Core which exhibits an intensity of land sea interaction is focused at the southern end of the North Sea region and extends into the Atlantic through the English Channel. This European core is coincidental with what has been recognised for many years, as the pentagon. The importance of land sea interactions for this European core is based on this area acting as the predominant gateway between Europe and the rest of the world, and from this entrance a great deal of goods and services are transhipped throughout Europe, either via short sea shipping activities of through inland transport networks. Beyond the core two regional hubs can be identified, and the lack of available data 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 already being extensively used for a variety of different uses. For much of Norway north of the Oslo region the intensity of use is low and much of this in relative terms has been described as a wilderness area.

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 10: Typology of European Maritime Regions

3.3 The Changing Policy Context for the North Sea Region Operational Programme

This research project was taking place at the same time that considerable effort was being made to prepare the next North Sea Operational Programme scheduled to start in 2014 and last until 2020.

Within the current programme (2007-13) four key strategic priorities were 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:

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

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 recast as three thematic objectives, six investment priorities and nine specific objectives (see Table 9). These were submitted to the Commission for approval in November 2013.

Table 9: 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	c) Promoting business investment in innovation and research, and developing links and synergies between enterprises, R&D centres and higher education, in particular product and service development, technology transfer, social innovation and public service applications, demand stimulation, networking, clusters and open innovation through smart specialization supporting technological and applied research, pilot lines, early product validation actions, advanced manufacturing capabilities and first production 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, innovation 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	Demonstrate new and/or improved methods for improving the climate resilience of target sites
6) Protecting the environment and promoting resource efficiency	d) Protecting and restoring biodiversity, soil protection and restoration and promoting ecosystem services including NATURA 2000 and green infrastructures	Develop new methods for the long-term sustainable management of North Sea ecosystems
	g) S pporting industrial transition towards a resource efficient economy and promoting green growth	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 environment- friendly and low-carbon transport systems including river and sea transport, ports and multimodal links	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: www.northsearegion.eu

4. Synthesis: European and North Sea Region Energy Policies

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

4.1 European Energy Policy Debates

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

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

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

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

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

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

The EU *Energy 2020* strategy focuses on five priorities:

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

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

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

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

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

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

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

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

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

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

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

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

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

4.2 Energy Production and Consumption in the North Sea Region Countries

The North Sea's importance as an energy producing region is demonstrated by the European Seas and Territorial Development – Opportunities and Risks (ESaTDOR) project, which highlights the location of offshore oil and gas installations (Map 5 in Chapter 3) and ports handling large volumes of liquid bulk cargo (Map 3), particularly in Antwerp, Rotterdam, Amsterdam and Bergen. Map 11 below shows primary energy production in the wider context of European countries, further demonstrating the North Sea Region's importance as an energy producing region.

For these reasons it is assumed that the North Sea Region is relatively energy self-sufficient, however there are significant variations across the region. In the ESPON 2006 project, "Territorial Trends of Energy Services and Networks and Territorial Impact of EU Energy Policy", Norway, the UK and Denmark, were seen as having particularly high levels of energy self-sufficiency and Belgium the lowest (Map 4, previous Chapter). Whilst Norway, Denmark and the UK remain high primary energy producers and net energy exporters based around their exploitation of oil and gas reserves in the North Sea (see Maps 11, 12 and 13 below), they are following an overall European trend of declining self-sufficiency (European energy dependency has increased from 46.7% in 2000 to 52.7% in 2010), as shown in Table 10. For other 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.

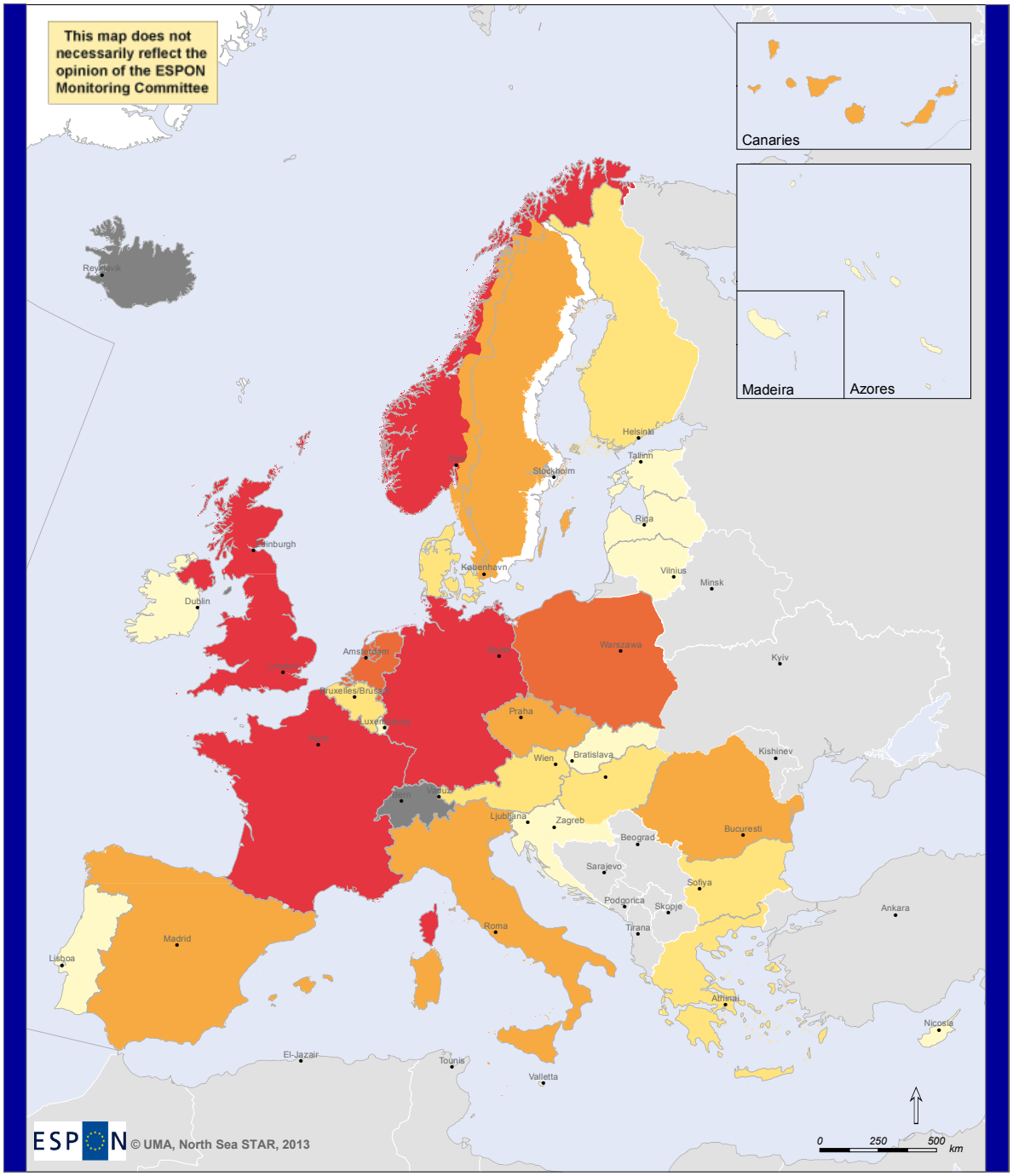
Table 10: Energy Dependency Ratios by Countries Adjacent to the North Sea (all products)

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

Note: negative figures denote the country is a net exporter of energy.

(Source: DG Energy, 2012)

Primary Energy Production, 2011
(Tonnes of Oil Equivalent)



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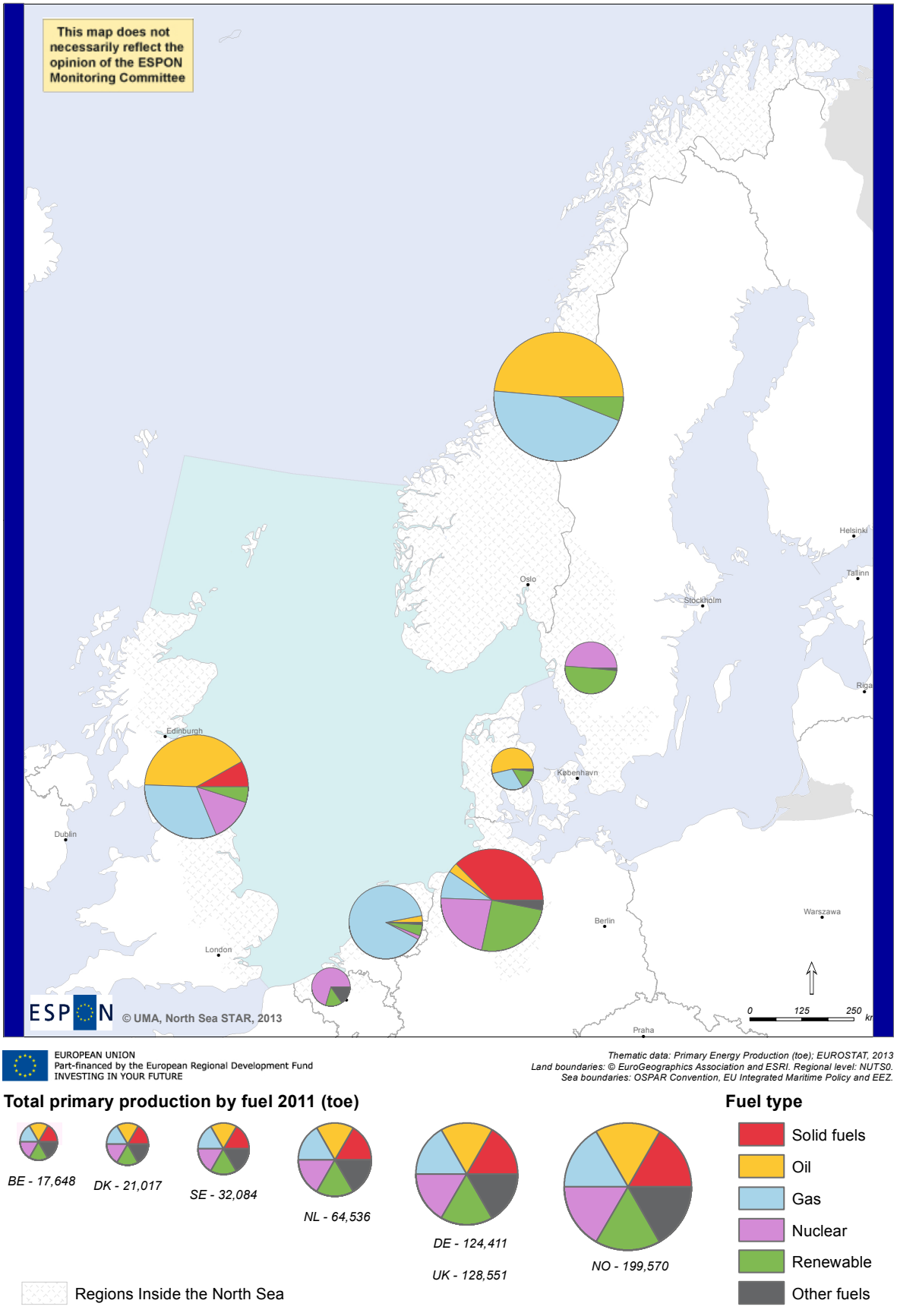
Thematic data: Primary Energy Production (toe); EUROSTAT, 2013
Land boundaries: © EuroGeographics Association and ESRI. Regional level: NUTS0.
Sea boundaries: OSPAR Convention, EU Integrated Maritime Policy and EEZ.

Total Primary Production 2011 (toe)

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

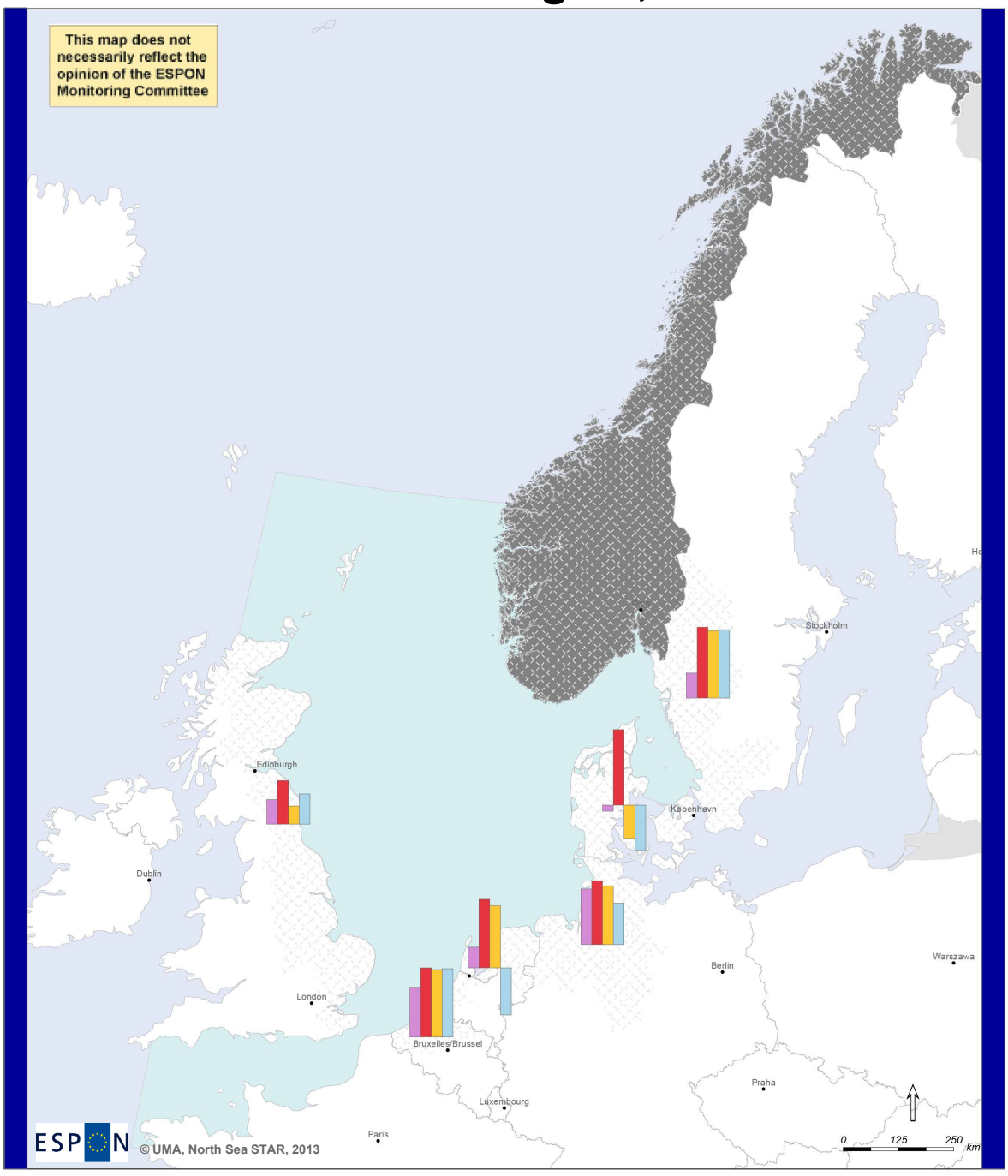
Map 11: Primary Energy Production in European Countries, 2011

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



Map 12: Primary Energy Production by Fuel in the North Sea

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



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

Imports Dependency by fossil fuels 2011 (%)

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

Negative rate indicates a Net Exporter

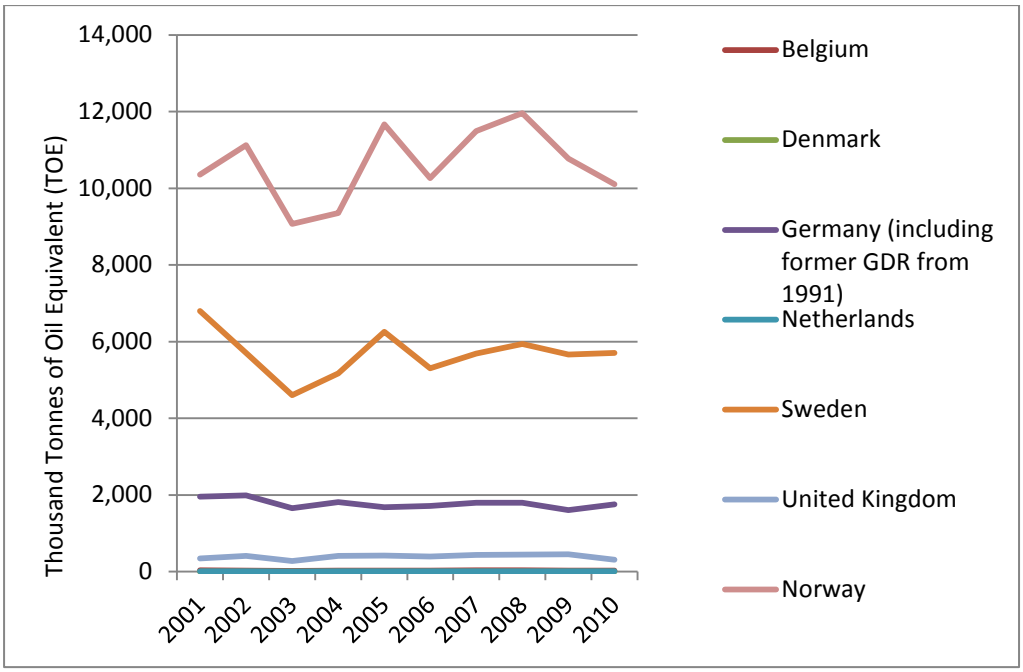
Values over 100% indicate stocks build up during the period

Regions Inside the North Sea No data

Map 13: Imports Dependency by Fossil Fuels in the North Sea Region, 2011

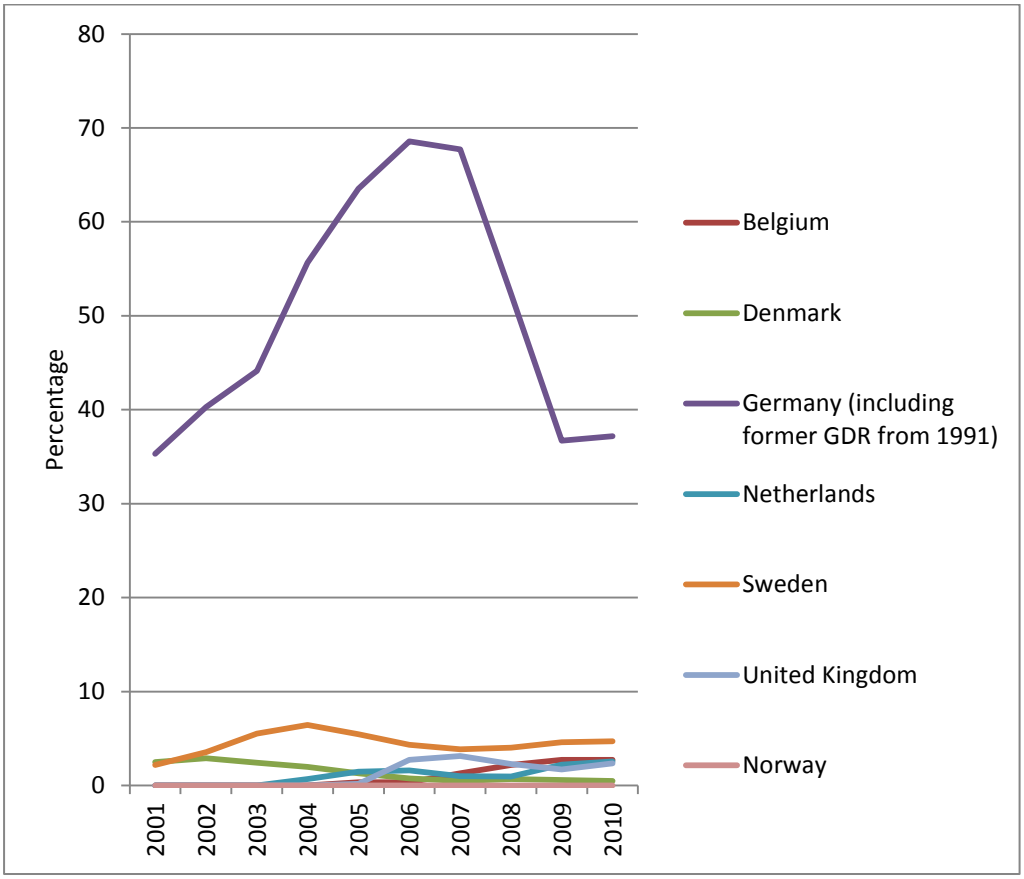
Furthermore a regions propensity to meet its energy needs from renewable resources in part depends on its natural resource asset base. Renewable energy is divided into two broad categories, renewables utilizing natural assets (wind, water and photovoltaic) and renewables that have been produced or manufactured,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

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



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

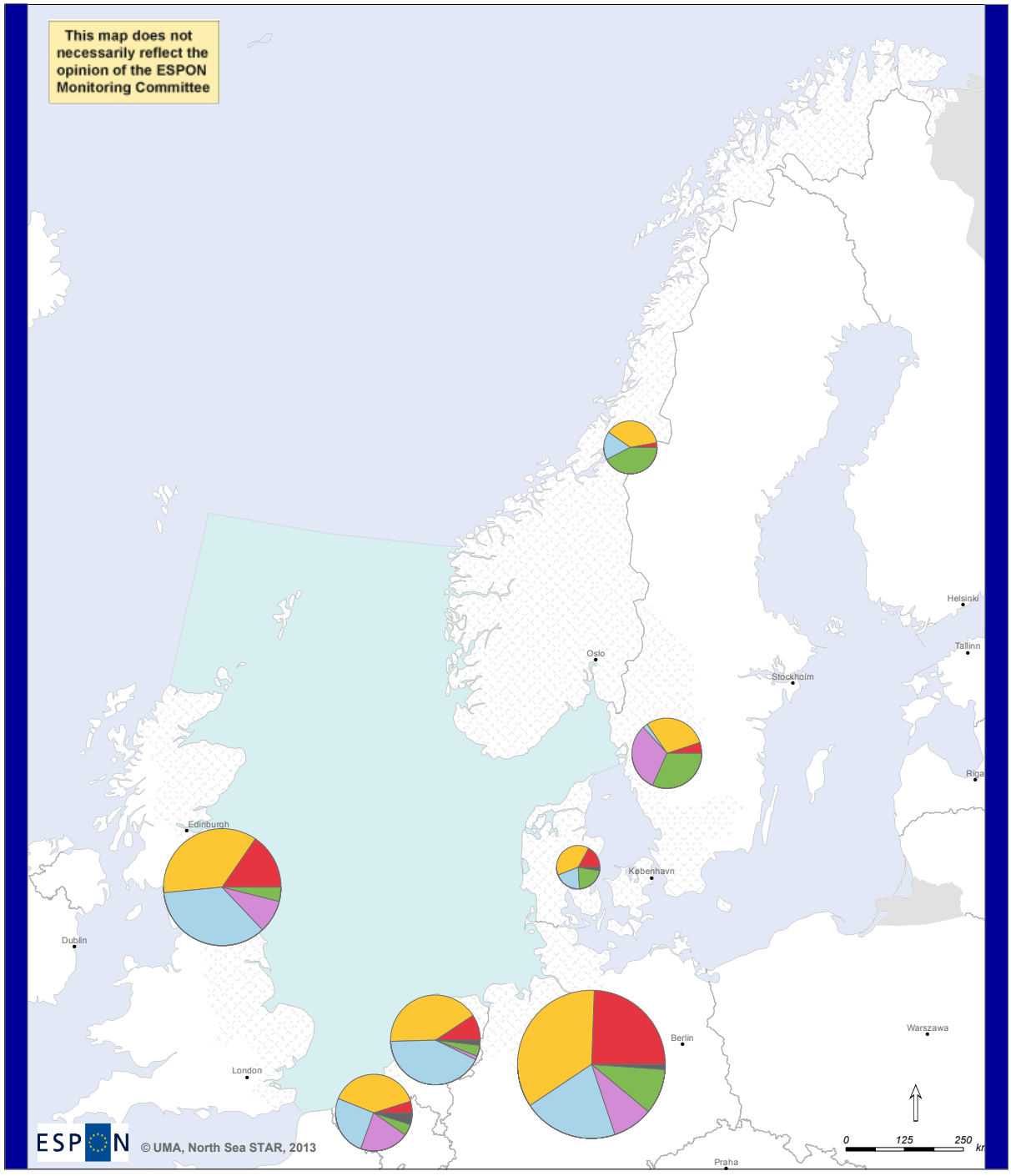
Figure 3: Production of Biofuels as a Percentage of Total EU Biofuel Production by Countries Adjacent to the North Sea, 2001-2010



Source: Eurostat (2013)

The share of renewables in meeting energy demands in the North Sea Region is also shown in Maps 14 and 15. Gross inland energy consumption, the total energy demand of a country or region (or the quantity of energy necessary to satisfy inland consumption) is depicted in Map 14, with renewable sources contributing significantly to meeting demands in Norway and Sweden whilst other countries are still more reliant on oil, gas or nuclear. However final energy consumption – consumption by end users, not including the energy sector itself (Map 15), shows a much smaller contribution of wind, water and photovoltaic renewables to the energy mix, but a larger use of "other" fuels, which includes processed renewables such as biofuels.

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



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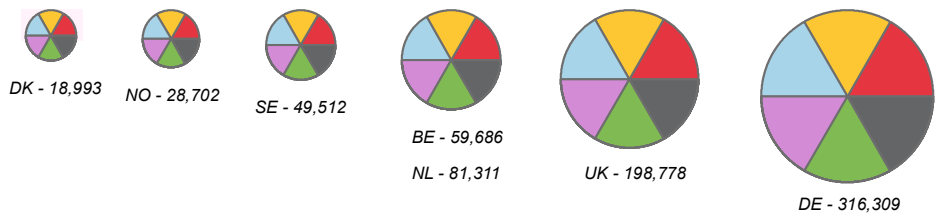
Thematic data: Gross inland energy consumption by fuel 2011 (toe); EUROSTAT, 2013
Land boundaries: © EuroGeographics Association and ESRI. Regional level: NUTS0.
Sea boundaries: OSPAR Convention, EU Integrated Maritime Policy and EEZ.

Gross inland energy consumption by fuel 2011 (toe)



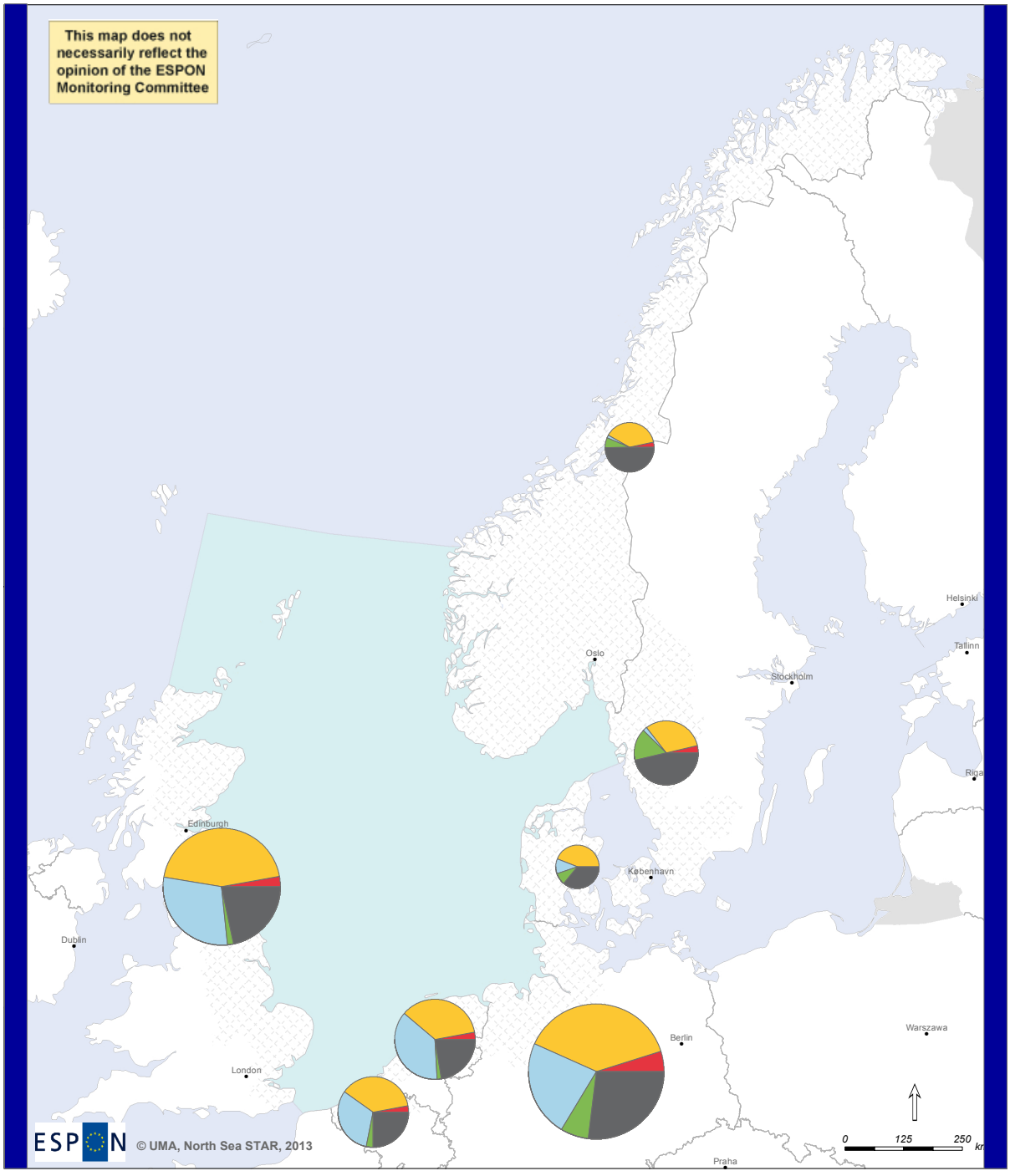
Regions Inside the North Sea

Fuel type

- Solid fuels
- Oil
- Gas
- Nuclear
- Renewable
- Other fuels

Map 14: Gross Inland Energy Consumption in the North Sea Region, 2011

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



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Thematic data: Final energy consumption by fuel 2011 (toe); EUROSTAT, 2013
Land boundaries: © EuroGeographics Association and ESRI. Regional level: NUTS0.
Sea boundaries: OSPAR Convention, EU Integrated Maritime Policy and EEZ.

Final energy consumption by fuel 2011 (toe)

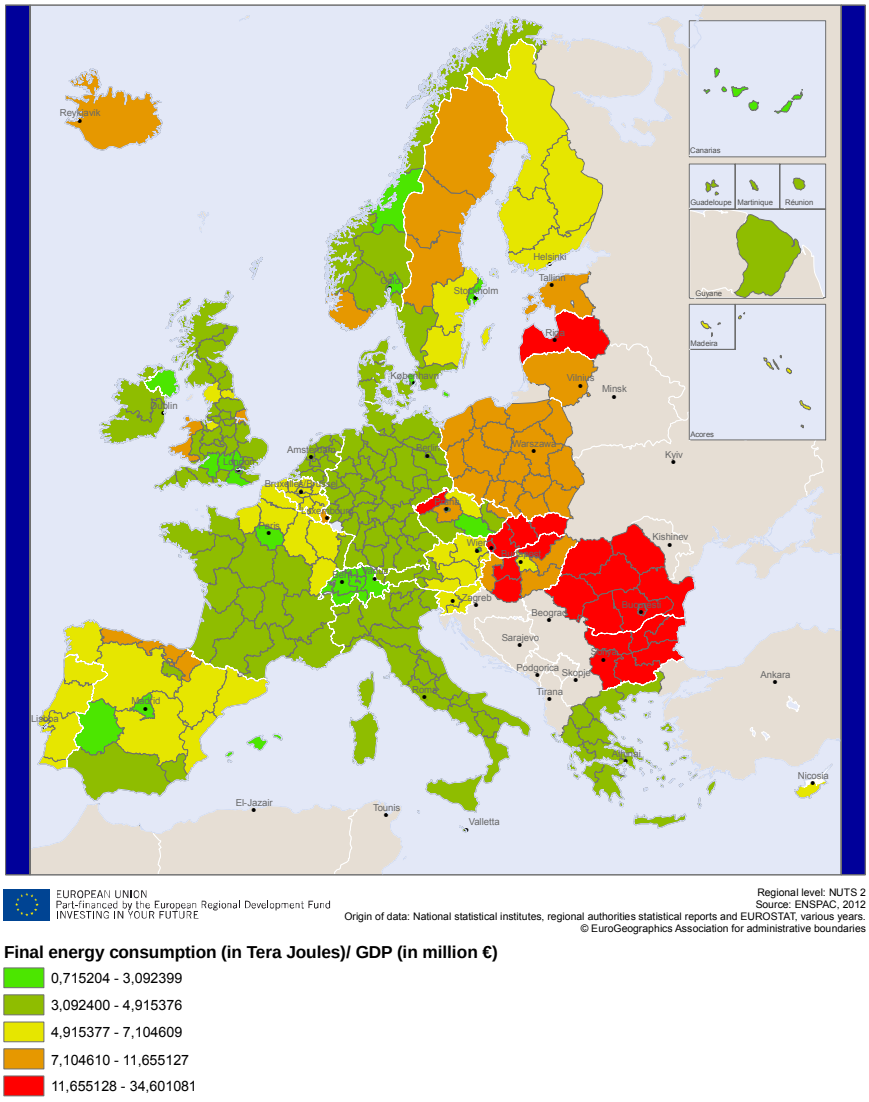
Fuel type

- Solid fuels
- Oil
- Gas
- Nuclear
- Renewable
- Other fuels

Regions Inside the North Sea

Map 15: Final Energy Consumption in the North Sea Region, 2011

In terms of decoupling energy use from economic growth, which is seen as a key component of increasing energy efficiency, the North Sea Region is already performing relatively well compared to other parts of Europe. Taking Final Energy Consumption as a proxy for economic activity, the ESPON GREECO project (Map 16) shows that energy intensity by NUTS2 region is low in the North Sea, with some exceptions in southern Norway, Belgium and east Yorkshire (UK).



Source: ESPON and Tecnalia (2012:29)[3]

Map 16: Average Energy Intensity by NUTS2 Regions, 2000-2010

A note of caution should be applied in this case, as the dataset is based on national rather than NUTS2 figures where these are not available, and does not take into account losses in the energy industry which may occur due to the energy source or technology chosen, or the number and efficiency of energy consuming appliances. However, notwithstanding the more positive position of the North Sea with respect to delinking energy use and growth, greater ambitions for energy efficiency need to be realised by each country in order to meet their own and European targets.

[3] Referred to as Map 1 in the GREECO Interim Report.

4.3 European Energy Policy – Key Challenges

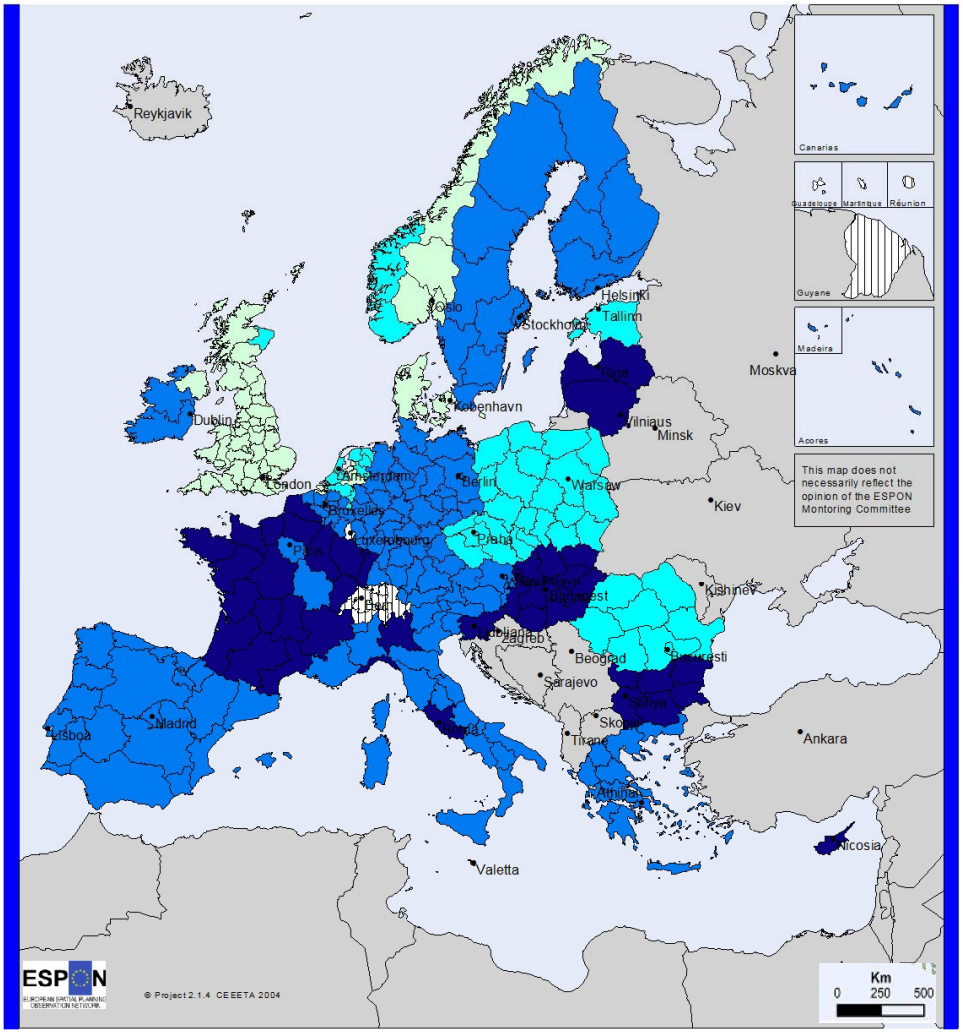
The policy debate in Europe has changed somewhat in recent years. The economic crisis has redirected political attention from climate change issues to economic recovery. The Emission Trading Scheme (ETS) is in turmoil and global investments in renewable energy fell in 2012, carbon Capture and Storage (CCS) has not taken off and there was a shortfall in delivering the EU's 2020 energy efficiency target. However, the 20-20-20 targets seem to be surpassed by 2020 but mainly due to economic recession. Reducing patterns of consumption and the goal of 80-95% decarbonisation by 2050 is still in force (Hanrahan, 2013). 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 set out in the new 2030 framework are related to target setting for 2030, balancing national and European dimensions, competiveness, energy security, the EU position for a 2015 global deal, policy coherence and getting the policy right.

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

The second issue (after targets) relates to the tension between a re-nationalisation of energy and protecting the integrity of the Internal Energy Market. EU Member States are given a rather free scope on how they should implement the headline targets. There exist numerous instruments and support schemes for renewable energy across the Member States, some of which for North Sea countries are illustrated in Section 4.4 below. These create barriers to cross-border operation and several unilateral decarbonisation strategies generate risk for fragmenting the Internal Energy market.

A third challenge for the 2030 package is how to ensure the best outcome from a competitiveness point of view and how to minimise price impacts for domestic consumers. This is a significant issue, particularly since the energy competitiveness gap between Europe and the US is widening. In 2012, industry gas prices in Europe were four times higher than in the US. Similarly, real electricity prices for industry in Europe increased by 38% between 2005 and 2012, whereas they decreased in real terms in the US by 4%. (Hanrahan, 2013). This affects particularly energy-intensive industries and may force them to relocate to lower cost countries.

Socio-economic impacts arising from changes in energy supply and pricing for the North Sea Region are most clearly highlighted in the ESPON Territorial Trends report. Although this predates the Europe 2020 Strategy and the current economic crisis by some time, they typology of "sensibility [sensitivity] to variations on energy prices and energy self-sufficiency" and associated analysis has resonance for current energy policies. The central premise of this typology (Map 17) is that increasing the energy self-sufficiency of a country or region may require significant and costly investment, and thus different energy dependency policies can be applied that would help to achieve greater resource efficiency and thereby increase resilience to increasing energy costs.



Source: ESPON and CEETA (2005:191)[4]

Map 17: Sensibility (Sensitivity) to Variations in Energy Prices and Energy Self Sufficiency

[4] Referred to as Map 39 in the Territorial Trends Final Report

For North Sea countries that remain more self-sufficient (defined here as higher net exporters of energy – UK, Denmark and Norway), they may play a role in assisting other countries that are less self-sufficient. For regions that are also self-sufficient but more sensitive to price changes (Netherlands), increasing energy efficiency is seen as the most appropriate measure to stabilise pricing before significant investment is made in new energy sources. For countries with low sensitivity to price changes, but also low self-sufficiency (such as Belgium, Sweden and Germany), investment in renewable energy is seen as the most effective way to ensure more reliable supplies. Within the North Sea Region, this suggests that energy efficiency and more decentralised forms renewable energy production should be the focus of future energy policies.

Both European consumers and businesses are facing mounting energy costs and national support schemes for renewables are a part of that picture. This is particularly so in post-2030 high renewable scenarios and this underlines the importance of getting more cost effective support regimes for renewables.

Enhancing energy security is a fourth challenge that will have to be addressed. Europe is the world's biggest energy importer and its dependency could increase from 54% to 70% in 2030. In addition, the imports come from just a few countries; Russia, Norway and Algeria together account for 85% of Europe's natural gas imports, and 50% of the crude oil imports (Hanrahan, 2013). This calls for more integrated and efficient energy markets and more indigenous European energy resources, i.e. more renewables. With regard to energy security a three target regime seems to be most appropriate. The EU Commission recently presented a report on "Implementation of the Communication on Security of Energy Supply and International Cooperation and of the Energy Council Conclusions of November 2011" 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 which should come into force in 2020 (Durban Platform for Enhanced Action). Such a deal must be both economically feasible and politically palatable from a European perspective.

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

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

4.4 North Sea Region Country Energy Profiles (Current Situation)

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

4.4.1 Context – production and consumption

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

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

The Netherlands: In 2011 the primary production of energy in The Netherlands lay at roughly 2,700 PJ. 90% of this production stemmed from

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

Norway: The Norwegian energy system utilises both renewable and non-renewable resources. Renewable energy is converted from resources such as water, wind, bio mass and tidal water to electricity or heating. Norway is a net exporter of energy, but mainly of non-renewable energy such as fossil fuel. Norway is also the sixth largest producer of hydro power in the world and the largest in Europe (NOU 2012:19). According to the Energy balance sheet for Norway the production of primary energy commodities was 2,314 Terawatt hours (TWh) in 2011. The main bulk of this - 2 058 TWh - which is mainly oil and gas, was exported. Extraction of crude oil and gas on the Norwegian continental shelf amounts to more than 90 per cent of the total production of primary energy carriers in Norway. The third largest energy source is waterfall and wind, but wind power represents only about 1% of the electricity supply in Norway (http://www.vindportalen.no). There is no energy production from nuclear power in Norway.

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

Sweden: In 2011, Sweden's total primary energy supply (TPES) was 48.9 million tonnes of oil equivalent (Mtoe), a level which has remained fairly stable over the last three decades, growing 2.8% since 2000 and with a sharp drop in 2009 amid the global financial and economic crisis. Fossil fuels, oil, coal and natural gas, represented 31.8% of TPES in 2011, in addition to 35.5% renewables and 32.5% nuclear. Sweden is the International Energy Agency (IEA) member country with the lowest share of fossil fuels in its energy mix (without nuclear). The average share in IEA member countries was 81% in 2011. Sweden's share of coal accounted for 4.1% and natural gas for 2.4%,

compared to the IEA average of 20% and 25% respectively. The TPES per capita was 5.2 toe compared to the IEA average of 4.7 toe. Oil accounts for the lion's share of the fossil fuels supplied to Sweden, amounting to 25.3% of TPES and 78.2% of all fossil fuels. Nuclear makes a large contribution to the Swedish electricity mix, accounting for 15.9 Mtoe or 40.5% of its total electricity generation at the level of 150.5 TWh in 2011. Other larger contributors are hydropower which represents 44.1% and biofuels and waste with 8.5%. Additional contributors are wind 4%, natural gas 1.2%, coal 0.8%, oil 0.5% and peat 0.4%. Sweden's share of nuclear in TPES was the second-highest among IEA member countries after France. Inland energy production in 2011 was 33.9 Mtoe, approximately 69.3% of TPES while the country relies on 15 Mtoe import, approximately 30.7% of TPES. The industry sector consumed the largest share of energy, accounting for 13.3 Mtoe or 39.3% of the country's final consumption. It was followed by transport (24.1%) and the residential sector (22.5%), while the commercial, public services and agricultural sectors amounted to 14.1% of total final consumption in Sweden in 2011.

Denmark: Domestic energy production in Denmark is based on crude oil (470 PJ), natural gas (265 PJ) and renewables (152 PJ) (all numbers: 2011). Denmark is a net exporter of energy, mainly of fossil fuels such as crude oil, oil products and natural gas. Nonetheless Denmark also imports energy. These imports mainly encompass processed oil products, crude oil to operate Danish refineries with full capacity, and coal. Nearly one quarter (42 PJ) of the renewable energy consumed in Denmark in 2011 was imported. Denmark's energy consumption rests upon a small number of energy carriers. Before transformation (e.g. production of electricity and heat) oil has the largest share with 39% in 2011 followed by renewables with 22%, natural gas with 20% and coal with 17%. After transformation oil remains the largest energy product with 37% followed by electricity with 32%, natural gas with 12% and district heating with 11% (all numbers: 2011). Renewables have a share of 8% in these statistics which considers the consumption of renewables by end-users, mainly households. About one half of the energy provided by renewables is transformed into heat and electricity.

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

national consumption statistics mainly from the year 2002 onwards while savings in households stagnate. These numbers are based on total consumption. Under consideration of growth of both the Danish economy and population an increase of energy efficiency can be stated for all sectors. On average energy efficiency in Denmark increased by 1.1%/year since 1990.

The UK: In 2009, total primary energy supply (TPES) was 197 Mtoe and natural gas had the highest share with 39.7%, oil 32.5%, coal/peat 15.2% nuclear 9.2% and renewable 3.3% (IEA 2011). In 1970, fuel consumption was dominated by solid fuels use (47 per cent of all energy consumption in the UK) and petroleum (44 per cent), with gas contributing a further 5 per cent and electricity 4 per cent. By 1980 the fuel mix had evolved with natural gas making up 20 per cent of all energy consumption in the UK, solid fuels (36 per cent) and petroleum (37 per cent). In 1990, the split between fuels was similar to that in 1980, however by 2000 with changes in electricity generation, natural gas consumption had become the dominant fuel responsible for 41 per cent of all energy consumption in the UK, whilst solid fuels had fallen from 31 per cent in 1990 to 17 per cent in 2000. By 2011 more renewable fuels had entered the energy mix for both electricity generation and bioenergy consumption. Between 1970 and 1990 industrial consumption had fallen from 40 to 24 per cent of total final energy consumption in the UK, whilst transport consumption had risen from 18 to 31 per cent. Domestic use had increased slightly from 24 to 26 per cent whilst other final users (mainly agriculture, public administration and commerce) and non-energy use remained at 12 per cent and 7 per cent respectively. The decreasing trend in industrial consumption continued and in 2011 was 18 per cent of total final energy consumption in the UK, with transport consumption responsible for 38 per cent and domestic 26 per cent.

4.4.2 Drivers of National Energy Policy

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

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

highly industrialized Flemish region effects are (as the environmental balance in general) strongly influenced by ups and downs of economic development.

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

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

The Netherlands: Policies to achieve benchmarks are largely taken by the Dutch Ministry of Economic Affairs. Many measures seek to realize CO2 reductions while sustaining the important role that the Dutch grey energy sector takes in the production, refinement and trading of energy carriers in North West Europe. The most important building block in Dutch energy policies is the European Emission Trade System (ETS). The Dutch government intends to broaden the application of this system by including other than the up until now defined economic sectors in the trading of rights. Gas plays a significant role in Dutch energy market structures and in the Dutch economy and it causes relatively low CO2 emissions. The Dutch government supports a transition of the gas sector from focusing on production to trading and refinement of gas by facilitation of carbon capture and storage (CCS), transport capacities and diplomatic and trade missions (Ministerie van Economische Zaken, Landbouw & Innovatie, 2011). Increased use of renewables has also been encouraged by subsidies and obligation of the transport sector to replace fossil fuels with bio-fuels. All Dutch provinces that are part of the North Sea region as well as a range of governance

arrangements in the area have drawn up structural visions to guide spatial development that leads to more sustainable production and consumption of energy. Regional energy self-sufficiency is a re-occurring theme of these visions under construction. There are, however, currently neither regional energy authorities nor policies to address specific trends in regional energy production and consumption.

Most recently, in 2013, the Dutch national government has investigated societal support to implement ambitioned changes to Dutch energy production and consumption patterns. For this purpose it addressed several types of non-governmental organisations, notably civil, employee, financial, entrepreneur and housing organisations. Under the guidance of the Dutch Sociaal Economisch Raad (Council for Social and Economic Affairs) these groups negotiated with the government on a refinement of the general benchmarks set out earlier as well as measures to meet them. In the Energy Agreement (SER, 2013) civil and housing organisations agreed that all houses in The Netherlands should be energy neutral in 2050. Ambitions related to transport were refined to a 60% reduction of CO2 emissions in 2050 and 15-20 PJ energy savings in 2020. Most measures proposed to meet these targets are fiscal and provinces and municipalities are expected to consider benchmarks for sustainable transport in land use planning. The ambition is that all newly sold cars in 2035 should be CO2 emission free, employer's and employee's organizations agreed to create at least 15,000 new jobs in the sustainable energy sector and entrepreneurs intend to support the creation of these jobs by education and training programs. The Dutch government promised in turn to invest in innovative clean tech pilot projects, act as a launching customer for these projects and reduce regulations for the benefit of experimental approaches. The agreements comprise several economic sectors, such as the agriculture sector (green houses) and intensive energy industries and energy producing industries.

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

Sweden: Sweden's energy policy – integrated with climate policy – is guided by two government Bills 2008/09:162 and 163) which were approved by the Swedish Parliament in 2009. The bill on En integrerad energi- och klimatpolitik ("integrated climate and energy policy") sets out ambitious targets in support of and beyond the 20/20/20 objectives of the EU, in pursuit of a sustainable policy for the environment, competitiveness and long-term stability (Energy Policies of IEA Countries: Sweden 2013 IEA/OECD Paris, 2013. 34) . Short- to medium-term targets for 2020 are 40% reduction in greenhouse gases (GHGs) or about 20 million tonnes of carbon dioxide equivalent (Mt CO2-eq), compared to 1990, to be achieved outside the European Union Emissions Trading Scheme (EU-ETS) with two-thirds in Sweden and one-third by investments in other EU countries or the use of flexible mechanisms; at least 50% share of renewable energy in the gross final energy consumption; at least 10% share of renewable energy in the transport sector; and 20% more efficient use of energy compared to 2008. The long-term priorities are that by 2020, Sweden aims to phase out fossil fuels in heating; by 2030, Sweden should have a vehicle stock that is independent of fossil fuels. Sweden is committed to develop a third pillar in electricity supply, next to hydro and nuclear power, with increased co-generation, wind and other renewable power production to reduce vulnerability and increase security of electricity supply; and by 2050, the vision is that Sweden will have a sustainable and resource-efficient energy supply with zero net emissions of GHGs. Sweden sees a role for natural gas as a transition fuel in industry and co-generation. The Swedish Environmental Agency, supported by the Swedish Energy Agency and other national authorities, presented a proposal for a Climate Roadmap in December 2012. The Roadmap identifies scenarios for achieving the long-term 2050 priority and is to be adopted in the course of 2013.

Denmark: In November 2011 the Danish government passed an energy strategy (Danish Government, 2011) aiming for an ambitious goal: the entire energy supply – electricity, heating, industry and transport – is to be covered by renewable energy by 2050. This goal of 100% renewables has been renewed by the Energy Agreement passed in March 2012 (KEMIN, 2012). With this strategy the Danish Government plans to over-fulfil Europe's 20-20-20 goals. The national energy strategy includes a few milestones which illustrate how the implementation of this goal shall be achieved. Energy savings play a major role to achieve this strategy. By the year 2020 the share of renewables in final energy consumption shall be more than 35% and approximately 50% of the electricity consumption shall be supplied by wind power. To achieve this both offshore and onshore wind farms shall be expanded and new planning tools shall encourage an increase in net capacity of onshore wind power (repowering). Even more important than wind farms shall be the role of biomass, e.g. as a substitute for coal and natural gas in combined heat and power plants. Denmark's economic policy encompasses intensive green growth ambitions including intensified development of various kinds of renewable energy products. However, competitiveness has deteriorated in the past decade and productivity growth has been weak, eroding potential growth (OECD, 2013). The OECD (2013) currently states a potential of these green growth ambitions to translate into new sources of growth, but recommends also to review energy and climate change policies to

achieve better results at low cost. Further challenges are the development of storage techniques and facilities as well as the reorganisation of electricity and pipeline networks. Another yet unsolved question is how the increasing consumption of oil products by the transport sector, especially road traffic, can be decreased and substituted by an alternative energy carrier.

The UK: Central Government sets the broad approach to energy policy and whilst most of its activities are designed to shape domestic production and consumption patterns it is interesting to at least note some of the production challenges are in part being met by international collaborations. For example, recently (January 2013) the UK and Irish governments have signed a Memorandum of Understanding focusing on the potential of importing substantial gigawatts (GW) of green energy (predominantly produced by wind) from Ireland to the UK. The broad policy framework is set out in the Renewable Energy Roadmap which was updated in December 2012. Given the broad range of producers and consumers the incentive packages to encourage production and reduce consumption are very wide ranging. Furthermore as noted earlier, whilst the direction of travel is the same the devolved administrations (most notably in this case Scotland) are able to set their own policy objectives and within their own devolved competencies provide the framework for this to happen. For example, the aspiration that 100% of Scotland's electricity demand will be generated by renewables is driving the development of both onshore and offshore wind farms and with it local planning controversies.

4.5 Conclusions/Key Challenges for the North Sea Region

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 medium term goals of Energy 2020 combined with a longer term strategy of decarbonising the economy by between 80-95% by 2050. Whilst in recent years the policy debate may have perhaps shifted somewhat to respond to the immediacy of the economic crisis and the promotion of economic recovery, the challenges responding to climate change, promoting energy security, extending European leadership in energy technology and innovation and energy supplies remain affordable and competitive nevertheless remain of paramount importance.

National policy whilst framed within the Energy 2020 targets remain 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 respond 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.

In the future growing populations and reduced household size is likely to increase the demand for domestic energy and economy recovery is likely to bolster demand from industry (see for example Norway), unless energy efficiency schemes can be promoted. Many countries are promoting new energy efficiency standards in new buildings and advocating more carbon neutral modes of domestic transport (see Netherlands and Sweden). Once again there are questions regarding the extent to which such policy pronouncements are largely symbolic and to a certain extent beyond the control of national governments (for example are vehicle emissions really a national competence). Nevertheless national governments can and should provide strong leadership.

Innovation is a key driver in the transition to a green, sustainable economy. A highly relevant research approach to this fundamental challenge is the sustainability transitions perspective. Being broad and trans-disciplinary, the starting point for transitions research is a recognition that many environmental problems, such as shift in energy systems, climate change, loss of biodiversity, resource depletion (clean water, oil, forests, fish stocks), are formidable societal challenges, whose solution requires deep-structural changes in key areas of human activity, including our energy, agri-food, housing, transport, manufacturing, leisure and other systems. Realising a new energy system based on renewables and a green economy more generally will require fundamental socio-technical changes implying a radical transition towards a more sustainable society (Grin, Rotmans & Schot, 2010). 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 teh 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 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.

5. Stakeholder Sparring

The Stakeholder Sparring work package of the research 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 work as they emerged and shape future activities and policy recommendations.

Three stakeholder sparring sessions were held:

- 7thMay 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 research team and partners
- Providing an evidence base for future regional priorities
- Being innovative and creative with regards future transnational programmes

The key results of the sparring sessions are outlined below.

5.1 Session 1 - Programme Evaluation Steering Group, Edinburgh

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

The main item for consideration was however the focus of the second stakeholder sparring session which would form part of the North Sea Programme annual conference. Initially the project team had proposed that this would focus on the scenario work package, but it was felt that the 3 x 20 minute workshop format wouldn't allow sufficient time to deal with this material. It was agreed that stakeholders would be more likely to participate in

the workshops if they could see an obvious benefit, such as helping to shape future policy or project development and that the focus of the workshop sessions should be devised with this in mind. It was agreed instead that the scenarios should be included as a key element of the final project focussed stakeholder sparring event in Delft where more time would be available and a more targeted audience would be invited to attend.

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

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

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

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

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

The focus of the workshops proved to be popular and between 10 and 20 delegates attended each of the sessions. Each included a mix of stakeholders including project partners involved in previous energy related projects and national contact points. After a short introduction the issues were open to the floor for discussion and stakeholder responses were recorded on a flip chart. As time was short, delegates were also provided with post-it notes so that they could record any observations that they were unable to express within the sessions themselves. These were collected at the end of the sessions and the combined results are presented Tables 11, 12 and 13 below in as faithful a format as possible for each workshop. There is no doubt that the workshops produced some very useful stakeholder inputs that can help to inform the development of the next operational programme and have provided a significant reference point for the team's options for policy development set out later in this Draft Final Report.

Table 11: Workshop - Added Value of Cluster Projects

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

Table 12: Workshop - Ensuring On-going Impact of Projects

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

Table 13: Workshop - the Future of Energy Related Projects

Where should the priorities for future energy related projects be?

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

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

This might suggest a focus on:

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

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

5.3 Session 3 Stakeholder Workshop – TU Delft

The main purpose of the final stakeholder workshop was to validate different scenarios for progress towards Europe's 2020 energy targets and beyond and obtain stakeholder views on how these may assist in future programme and project development. In addition the workshop provided a further opportunity for stakeholder reflection on the added value that energy project clustering may bring and the scope of future energy projects and programme development more generally.

The workshop was attended by 7 stakeholders drawn from across the North Sea Programme area including national contact points from the UK and the Netherlands and partners from energy related projects and clusters. In addition representatives of the North Sea Region Programme secretariat and the ESPON Coordination Unit were present together with members of the North Sea Star project team.

The remainder of this section provides details of the workshop discussions related to Scenario Building. This section outlines the key findings from the discussions in relation to:

- Project Clustering
- Energy Project Development
- Programme Development.

Project Clustering

The discussion about energy project clustering was wide-ranging but centred around two key themes – 1) the purpose of project clusters; 2) the process of project clustering.

In terms of the first of these, it was felt that greater clarity in establishing the purpose of 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 clustering 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 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 (e.g. Power Cluster) 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 convenor such as used in some Framework 7 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.

Energy Project Development

The discussion here was initially based around the emerging themes of the new North Sea Region Operational Programme – Thinking Growth, Environment – now titled as Renewable North Sea Region and Transport - now titled Green Mobility. It was informed by the team's draft ideas for potential future energy projects which had been extracted from the earlier stakeholder sparring sessions. These together with the key points to emerge from the discussions are summarised below.

Under the **Thinking Growth** thematic priority the team suggested that the following types of energy related projects could be promoted: local energy storage; building local flexibility into energy systems; encouraging integration across different sources of energy; technology transfer between research institutions and the market; and institutional innovation related to supply and demand. From the discussion 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 priority 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 priority also applied here. There was some discussion about the riskiness and environmental concerns associated with bio-based options which suggested that they not be a good

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

Programme Development

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

- Encouraging projects to set out ideas about wider dissemination of findings and legacy in funding applications;
- Developing the future orientation of clusters encouraging them to consider legacy issues and initiatives that encourage ongoing impact where relevant.
- Possible development of a North Sea Region Programme Seminar Series targeted at disseminating a collection of projects outputs to policy makers. 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 this.

6. Scenario Building

This section provides further details of the scenario building work undertaken. It discusses the reasoning behind our scenario building, the analytical framework that has been developed for scenario evaluation and assessment together with the outputs in the form of three scenarios for the North Sea Region. The scenarios have been discussed with stakeholders during a stakeholder workshop and the feedback from the stakeholders is presented in Section 6.7 and Annex B.

6.1 Reasoning of Scenario Building

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

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

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

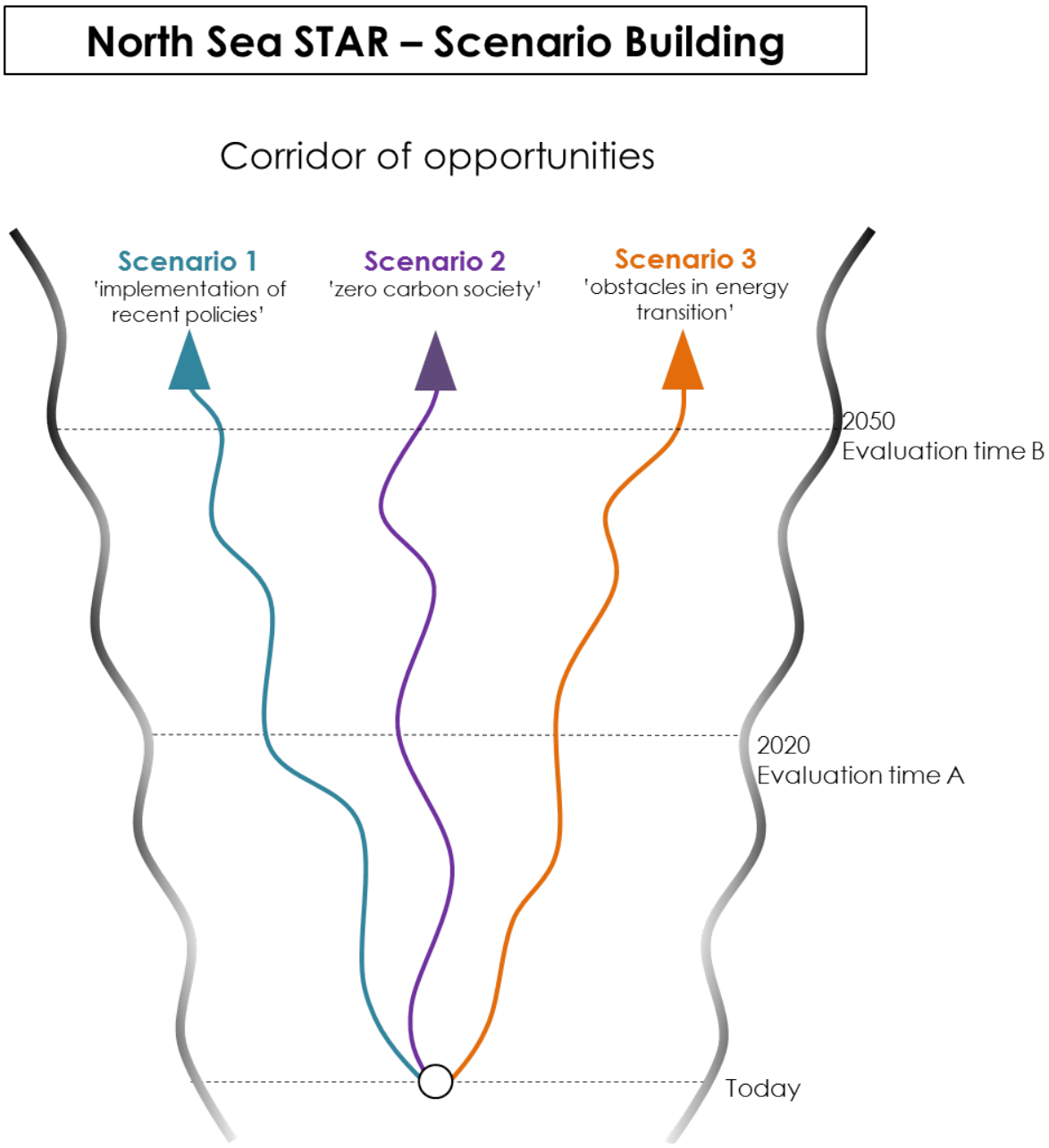
Scenario 1 - Implementation of recent policies - This scenario reflects the successful translation and implementation of recent energy policies from the EU to the local level. Current ambitious energy and climate goals will be achieved and any amendments to recent policies will continue to follow existing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

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



6.2 Analytical Framework for Scenario Evaluation and Assessment

In order to evaluate the performance in implementing energy policies and monitor the progress of the crucial processes, a set of enablers needs to be considered. These 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 indicators can be examined using qualitative, semi-quantitative and quantitative approaches. Information and data will be gathered from various documents and by contacting relevant institutions and experts. The resulting matrix highlights the differences of the three scenarios (Table 14).

Table 14: Assessment Matrix - Criteria and indicators of the three scenarios

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

Table 14 *continued*

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

Table 14 *continued*

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

6.3 NSS-Energy Scenarios for the North Sea Region

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

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

By about 2020 the impacts of climate change do not differ very much from scenario to scenario because of the climate lag of about 40 years, the time between the cause (increased greenhouse gas emissions) and the effect (increased temperatures, changes in precipitation etc.). By this time the UK is not noticeably 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.

The sections below describe the likely implications of each energy scenario for the North Sea Region.

6.4 Scenario 1 - Implementation of Recent Policies

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

Energy Production – The North Sea Region is a core region of the EU's energy transition where the total power capacity installed in Europe will reach more than 1,200GW by 2050. Renewables will represent more than half of newly installed capacity, requiring an investment of around €2 trillion (at 2005 prices) for the period up to 2050. In the North Sea region, power generation will rise by more than 20% until 2050, with renewables representing 55% of total generation by 2050. The share of solid fuels in the electricity mix will be cut by half by 2050. In some regions, remaining coal fire plants are converted to cofire generation[5] and fitted with carbon capture and storage (CCS) devices. Since the mode and localities of power generation will change considerably in the next decades, investments are needed to adjust the grid infrastructure both onshore and offshore and to improve the reliability of an aging energy infrastructure.

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

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

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

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

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

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

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

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

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

Economic development - With the global economic crisis from 2008 and a subsequent recovery the price of crude oil has been stable for several years. With

the return of world growth, to slightly below pre-crisis rates, the price of Brent crude increases to far above early-2012 levels by 2020. From 2020 onwards, greater independence from global energy markets and imports turns into a benefit for economy in the North Sea Region. Some firms heavily benefit from the trend towards more renewables and more efficient technology. Major companies in the energy sector gain about half of their revenues from energy-saving and green technologies.

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

6.5 Scenario 2 - Zero Carbon society

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

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

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

Energy efficiency -Transport is organised in the most energy efficient way. Long distance travels, for example, are as far as possible done by train instead of flights or

individual traveling by car. Deteriorated energy infrastructure is without exception replaced by modern and efficient technology supporting a mix of renewable energies together with selected fossils (mainly natural gas). Gasification of electric energy (Power-to-Gas), e.g. from wind farms, is established not only in pilot projects but also on larger scale. This technique is yet not too efficient by itself but allows a quick transformation into a zero carbon society by using existing infrastructure, e.g. pipelines, storage facilities and heat systems for natural gas. Energy efficiency has become a core interest of regional and national governments as the mid-term economic benefit has been clearly understood and is publicly accepted.

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

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

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

Social changes – The harmonious evolution of the socio-ecological and socio-technological spheres is a key feature of the significant progress in decarbonisation

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

Policy making - Public awareness of climate protection and sustainable energy policy is high. Governments therefore develop strong frameworks for energy efficiency and accelerate implementation by stimulating investment, monitoring, evaluation and enforcement. The expansion and conversion of energy grids is prioritised by legal frameworks. Research and development are heavily involved in developing a holistic energy concept and the necessary technologies. Regions around the North Sea cooperate intensively and contribute to a stable and climate friendly energy mix.

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

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

6.6 Scenario 3 - Obstacles in energy transition

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

Energy production - The North Sea region is confronted with an un-easy process in shifting the energy production to renewable sources. This is documented by a slight increase in overall energy production in the whole region. In 2020, 25% of the energy

production will be related to renewable sources, slightly increasing to 35% in 2050. Onshore wind will be the main source of electric energy from renewables, while the contribution from offshore wind will increase only slightly due to difficulties in the acquisition of investments. The share of solid fossil fuels in the electricity mix will cut by half until 2050 and be replaced by fossil gas. In some regions, remaining coal fire plants are converted to co-fire generation and fitted with carbon capture and storage. Overall, the energy landscape in terms of infrastructures and producer-consumer relationships will not change fundamentally.

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

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

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

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

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

Social changes - Changes of the societies interacting with energy behaviours and policies are constricted by market crisis and socio-ecological impacts over the decades to come. An aging population tends to continue economic preferences. This also sustains traditional approaches to the energy sector both in terms of the fossil sources and market partners.

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

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

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

6.7 A Stakeholder perspective: Strengths, weaknesses and recommendations

The three energy scenarios as described above have been 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 (cf. chapter on stakeholder sparing) the used scenario building methodology 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 5.

Figure 5: 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. Several of them go together with the question about the role of nations and regions in forming a common energy policy around the North Sea. Stakeholders stated that most of the member states are not in favour of a macro-regional energy approach. 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 an own economic benefit in collaborations bringing the energy sectors forward. Those alliances do not have to be limited to either renewable or fossil energies.

Attractive for joint activities on SME level are also coupled approaches from both energy types, e.g. using same technics, markets or infrastructure.

Stakeholders named also a number of interfering elements which slow progress down or impair the development towards a sustainable, modern and cooperative energy landscape. Among others those elements are:

- Inconsistency of national policy priorities makes stakeholders and investors insecure.
- A confused 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 B.

Hindrances like those mentioned above need to be solved to reach the goal which was unanimously recommended by stakeholders: A zero carbon society (scenario 2). It was clearly stated that the most ambitious scenario should be what the North Sea Region is aiming for. Support could come from the energy assets of the North Sea Region which could help to take the way towards a zero carbon society. One of these assets is the capacious energy infrastructure. There is no question that the infrastructure requires intensive reorganisation but the North Sea Region might be able to transform parts of the fossil energy infrastructure into a comprehensive renewable energy grid. An example for this are natural gas pipeline networks and fields which possibly could be used to transport and store renewable energy, e.g. methane or hydrogen produced with Power-to-Gas technology (P2G). At the same time stakeholders ascribed the North Sea Region a large energy potential from various energy carriers (fossils, wind, hydro, biomass, marine energy). This allows the North Sea Region a transformation from fossil to renewable energies based on own resources and competences. Knowledge about, and experience with, different energy technologies, their processes and also with the social and political dimension of the transition into modern energy systems could be a true heavyweight of the North Sea Region.

Based on these strengths and weaknesses of the North Sea Region and its riparian states stakeholders gave following recommendations necessary for the achievement of a zero carbon society, not all of which can be delivered through programmes such as the North Sea Operational Programme, although it can continue to make a contribution.

- Decommissioning of old energy infrastructure should be managed on the basis of a macro-regional long-term energy grid concept to avoid a loss of still valuable and needed infrastructure.
- Transnational energy cooperation should be further intensified, best 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.
- More public investments in both training and new technologies are required to achieve a breakthrough.
- 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 of 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 more 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. Because of the long time-span in the realisation of large infrastructure projects those energy efficient transport systems need to be adjusted to future needs already now.
- Challenges, political expectancy and political statements should be consistent. There is no doubt that policy makers will be in the need to readjust measures over time but statements should be made considerate and carefully.
- Transparency needs to be assured in various fields, e.g. in decision making, formation of energy prices, or payment of subsidies.

Reconsidering the ranking of scenario criteria as given in Figure 5 it becomes apparent that stakeholders are not much concerned about the production techniques anymore. 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 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.

7. Case Studies

One of the aims of the North Sea STAR project is to help the North Sea Programme Secretariat reflect on the effectiveness of energy related projects in the current (2007-13) Operational Programme and prospects for including such activities in future programmes. A second aim was to ascertain the added value of a project clustering approach. This chapter provides results and analysis of case studies of individual and clustered energy projects to assess this effectiveness and added value.

The clustering approach to projects was developed in respect to a set of objectives. To bundle the insights and results that were generated in single projects was expected to stimulate knowledge dissemination, inform strategies to transnational territorial integration and raise awareness for innovative technological solutions that were applied in regions. The stepped approach to increase the impact of transnational cooperation was reflected in the approach taken in this case study. Research has focused first on a distinction of expected and realized impact associated with co-operation in projects, secondly an analysis of potentials and barriers to knowledge dissemination within these projects and finally an assessment of effectiveness of cluster approaches to overcome barriers and make use of potentials.

Below results from the analysis are described. In section 7.1, the general approach and methodology which were employed are described. Section 7.2 is focused on the assessment of impact generated by projects as well as perceived barriers and potentials to disseminate and facilitate results among in broader transnational cooperation. Section 7.3 focuses on the cluster approach. Reasons for single organisations to participate (or not) in cluster projects are summarized first. Secondly experiences with the cluster approach reported from partners in projects and clusters are compared to these expectations. In Section 7.4 recommendations and reflections are made.

7.1 Case Study Approach and Methodology

7.1.1 *Case study approach*

The aim of the case studies was to examine how the take-up of policies aiming at the production of renewable energy has been accelerated through the clustering of projects. For this purpose an evaluation framework developed by Colomb (2007) to assess learning and policy change was employed. The framework was specifically developed to evaluate the performance of horizontal, transnational cooperation in the context of INTERREG programmes. Transnational cooperation under these programmes involves actors at sub-central levels of government who ‘voluntarily choose to engage in an active search for new ideas as a rational response to the emergence of a problem or dissatisfaction with the status quo’ (Colomb, 2007,

p.350). Next to outputs in the form of identifiable project results, INTERREG programmes provide opportunities to realize such expectations.

Colomb describes projects, funded by INTERREG programmes, as aiming at 'a Europeanization of problems, a comparison of situations in all the countries, allowing for the sharing of some common representations, opening the way to a common perception of problems, and enlarging the choice of possible responses, thanks to the exchange of 'good practices' (Colomb, 2007, p. 351, referring to Bruno et al., 2006, p. 533)'. This description resembles the main objectives of the cluster approach that was employed by the North Sea Region Programme secretariat (see Section 7.3 for a full account of cluster objectives).

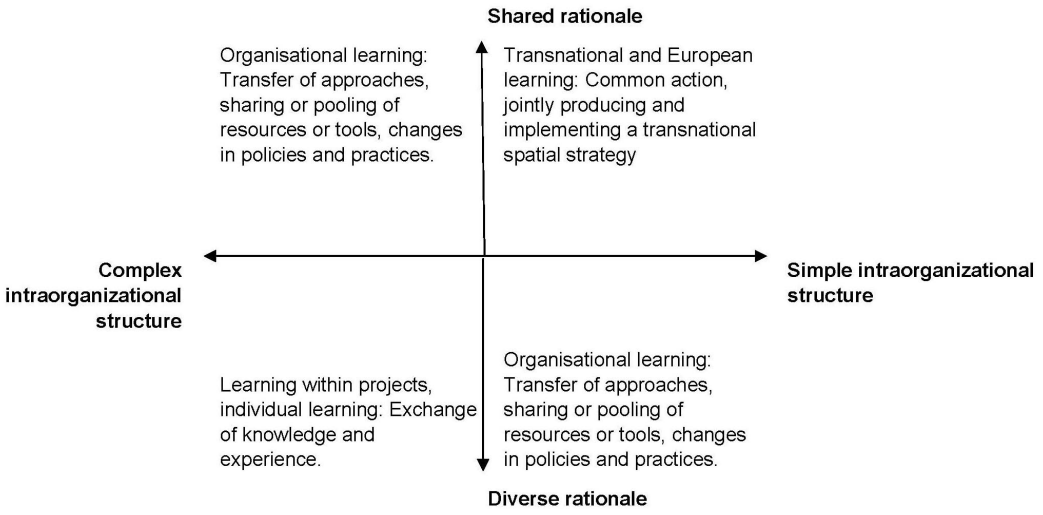
To assess learning in transnational cooperation Colomb distinguishes levels of learning, among them (1) learning within projects, (2) organisational learning and (3) transnational and European learning. Learning within projects means that people participating in a project have gained new knowledge and/or have changed practices. Organizational learning means that learning has spilled over into the organizations represented by individuals during project meetings and activities. Transnational and European learning means that organisations participating in projects have gained an understanding of the importance of transnational cooperation had have adapted their practices accordingly. The framework has been applied to specifically asses the achievement of high levels of learning through the clustering of projects (Table 15).

Table 15: Expectations of a combined project/cluster approach

	Project approach	Cluster approach
Learning within the project	Exchange of knowledge and experience.	
Organizational learning	Transfer of approaches, sharing or pooling of resources or tools, changes in policies and practices.	Transfer of approaches, sharing or pooling of resources or tools, changes in policies and practices.
Transnational and European learning		Common action, jointly producing and implementing a transnational spatial strategy.

Reaching levels of learning is influenced by two main aspects of co-operation: (1) the intra-organisational structure of co-operations (the internal composition and the geographic distribution of single partners across territories) and (2) rationales for cooperation (the balance among interests and the way interests relate to geographies). Shared and geographically balanced rationales and intra-organisational structures support high levels of learning and organisational change. Co-operation among partners with divergent and geographically unbalanced rationales and structures may also produce learning effects, although these are likely to be restricted to the exchange of experiences and remain within partner organisations (Figure 6).

Figure 6: Learning in Types of Transnational Cooperation



The case study methodology which is described in more detail below has been set up in respect to these aspects. To finally assess the added value of a cluster approach, the following criteria have been considered in the overall syntheses of case study results:

- Partners consider a wider and more generally applicable range of solutions,
- Cooperation shows a greater coverage geographically,
- There is an increase in horizontal and vertical coordination,
- There is an increase of awareness, acceptance and take-up of the results developed,
- Cooperation shows more effective action and
- There is a faster change from the baseline to the policy objective.

We note that learning effects as they were ambitioned by the North Sea Region cluster approach are often difficult to trace. The case study results that are presented here can therefore be seen as both, a report from results generated by the application of a comprehensive framework to asses learning in transnational cooperation as well as a report from a struggle with this framework. Both results lead to practical recommendations.

7.1.2 Case study methodology

The purpose of case studies was to analyze how the take-up of policies aiming at the production of renewable energy in the North Sea Region was accelerated through clustering projects. This was achieved (1) by distinguishing types of expected and realized impact associated with co-operation (spatial integration, technological innovation and organisational/ policy innovation), (2) by analysing if and how knowledge dissemination in the form of learning at different levels has contributed to organisational/policy change and (3) by assessing the effectiveness of a cluster approach, i.e. its ability to facilitate higher levels of learning, in particular.

Evidence was acquired in two ways, first via a documentary analysis and secondly by interviews. The documentary analysis aimed at a description of project aims and results (1A), a critical and reflective evaluation of the impact of energy related

projects in the North Sea Region (1B) and the distinction of types of partnerships (1C). Interviews aimed at an assessment of levels of learning within projects and clusters (2).

1A Document Analysis: Basic Characteristics of the Projects - Description

Based on available documents – especially project applications but also other documents published by partnerships such as communication strategies or early publications on project websites – a number of basic characteristics of projects were identified in a first part of the documentary analysis. The analysis differed from the second part (evaluation, see below) as it was entirely descriptive and expected to speak for itself as much as possible. Characteristics concerned general accounts (time span, financial budget), the relation of projects with policy frameworks (priority themes and areas of intervention of the North Sea Region INTERREG IVB programme, other policy frameworks to which reference was made in applications), aims and objectives of single projects as well as more detailed expected project results.

In a synthesis accounts were ordered according to more general rationales of projects or impact indicators. It was expected that some aspects such as a better use of resources for policy making, an improved and more active commitment of actors or the change of formal or semi-formal practices were not written down in project documentations. These expectations were investigated in more detail in interviews. Impacts were considered to be of three main types, namely:

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 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.

1B Document Analysis: Project Impact - Evaluation

In the second step of the documentary analysis the domain of mere description was left and what has been realized by the projects was evaluated. Next to prime documentation (activity reports) other written material was used, such as reports, programmes, minutes/reports of meetings and conferences. Also websites (obligatory for projects) were analysed. We note that some of the expected impacts were difficult to record due to the limited time horizon of projects. After evaluating impact in respect to objectives and project results, accounts were allocated to the same impact factors that were addressed in the previous steps (territorial impact, technological impact and policy impact).

1C Geography of the partnership

As described above, learning and policy change are influenced by two aspects of co-operation: (1) the intra-organisational structure of cooperation (the geographic distribution of single partners across territories and their internal composition) and (2)

rationales for cooperation (the balance among interests and how interests relate to geographies). There were a large number of partners involved in the eight case study projects: 119 in total. To assess geographical coverage the distribution of these partner organizations across countries and NUTS3 regions was analyzed. The internal composition was analysed by distinguishing partner organisations that were single and clearly identifiable (such as public authorities and companies) and partner organisations that themselves consisted of multiple organisations (such as business development networks, governance arrangements, foundations and boards).

To distinguish interests and how interests relate to geographies, rationales of organisations were first broadly assessed and then grouped. When applying for INTERREG IVB co-finance all partners had to describe themselves in the application forms. Descriptions in applications turned out to be sub-optimal for use in this case study, because 1) the number of categories used by project partners was large; 2) the different categories which have been used were not interpreted consistently across the projects and 3) not all categories were relevant in the light of the objectives of the case study work package. For this reason interests (and compositions) of partner organisations were assessed through an analysis of publicly available documents in which partner organisations express their interests and explain their organisational structure. Documentary evidence used included project applications, web pages/ documents in which partner organizations present themselves as well as broader descriptions of organizational structures, such as planning or education systems. All notions were compiled in a database which allowed for the detection of broader domains of interests. The three prime categories with sub-categories that were discerned are listed below.

- Partners have a **territorial interest**; the object of their interest is spatial development and they apply planning measures within more or less well-defined territories. Territorial interests can be **broad**. Then partners are engaged in the coordination of sector interests and have competences and/or resources for this (spatial planning). Territorial interests can also be **specific**. Then partners focus on a specific aspect of spatial development and measures to address these.
- Partners have a **knowledge interest**. They are interested in the development of basic knowledge and/or the application and dissemination of this. Interests can be **broad**. Partners are simultaneously active in research and education/consultancy and/or their knowledge fields are broadly defined. Interest can also be **specific**. Then research objects are closely defined and partners engage in research or education/consultancy. Knowledge interests are sometimes geographically confined. They can be deducted from problems or opportunities that occur in specific areas.
- Partners have an **economic interest**. They are interested in welfare, a general business climate, the performance of economic segments and/or profit. Interests can be **broad**. Partners are interested in the welfare of larger areas, the economic performance of a range of economic segments or a general business climate. Interest can also be **specific**. Then partners are interested in profit and/or the performance of distinct economic activities. Economic interests are often geographically confined. They are deducted from the presence of economic segments in areas/territories.

To analyze the intra-organizational structure of project partners and partnerships two prime categories were discerned:

- **Single:** Partner organization consists of one clearly identifiable organization.
- **Composed:** Partner organization consists of several organizations who share an interest. They form a partnership, board, association, alliance or network.
-

2 Interviews with key stakeholders: project evaluation and cluster experiences

In a second step of the case study a critical perspective on projects and cluster projects from the point of view of key actors was assessed in interviews. The original intention was to carry out 4 interviews per project, however in the course of the case studies it turned out that it was more difficult to find interview partners than expected. A broad range of partners were addressed in the interview phase but many partners declined to participate. In requests for interviews the purpose of the case study research (evaluating the cluster projects) was mentioned. Several partners responded that they did not take sufficient account of the cluster projects.

One aim of interviews was to explore the views of project partners on the factors set out above, more specifically providing a qualitative assessment of outputs in the form of realized project results. Interviews were mainly used to assess learning at different levels. Achieved levels were investigated through questions concerning the quality of transnational partnerships, novel forms of cooperation, changes in the focus and conduct of projects, changes in policy frameworks and an estimation of the transferability of results including barriers to and potentials for knowledge dissemination. A specific number of questions related to the cluster approach. These were structured according to the belonging of projects to cluster projects (participation in one or two cluster projects, or participation in no cluster projects). Questions concerned the formation of cluster projects, expectations expressed in respect to the approach and experiences.

In outline questions in interviews were semi-structured along the following issues:

Formation of the partnership: assessment of the formation of transnational cooperation, including the motivation of single partners and practicalities.

Characteristics and strengths of the partnership: assessment of the level and quality of cooperation.

Technological innovation/learning: perceived success stories of technological innovation, technology improvement and transfer, perceived barriers, opportunities and obstacles for technological innovation vs. learning levels.

Territorial impact: perceived success stories on spatial integration; territorial co-operation, perceived dilemmas, controversies and conflict, opportunities and obstacles for spatial integration/transnational co-operation vs. learning levels.

Policy impact: The core interest of the case studies is to investigate how the clustering of projects has supported policy making by knowledge dissemination.

3 Synthesis

In a last phase of the case study research results from single case studies were synthesized in respect to the main research question. The synthesis was broadly structured as comparisons among expected and realized results. Comparisons were made in two steps. In a first step results generated by project cooperation were

analysed. In this comparison expected and realized project results defined in early project descriptions were compared. Conclusions from this step led to a broad assessment of learning within projects. In a second step expected and realized impact generated by cluster project cooperation was analyzed. Next to defined project results, European and transnational learning was assessed. Finally it was concluded if and how the cluster approach has accelerated learning by responding to opportunities and barriers to learning occurring in (1) distinct project partnerships (geography of the partnership) and (2) distinct projects (thematic scope).

Criteria used for this final assessment were

- Cooperation shows a greater coverage geographically,
- Cooperation shows more effective action,
- There is an increase in horizontal and vertical coordination,
- Partners consider a wider and more generally applicable range of solutions,
- There is an increase of awareness, acceptance and take-up of the results developed and
- There is a faster change from the baseline to the policy objective.

7.1.3 Selection of cases

In the case study eight projects and two cluster projects were analyzed. All selected projects were funded as part of the North Sea Region INTERREG IVB programme. Projects fell within two categories: projects under a cluster approach and stand alone projects. The relevant clusters were Low Carbon Regions in the North Sea (LOWCAP) and Energy Vision North Sea Region (EVNSR). The LOWCAP cluster project focused on carbon reduction and energy efficiency projects. EVNSR focused on renewable energy projects.

In order to select standalone projects several criteria have been used. The most important criteria were the thematic scope of projects. Projects with a similar scope as the cluster projects were chosen, notably carbon reduction and energy efficiency or renewable energy. A second condition was the end date of projects. In order to be able to detect identifiable results, projects with an end date before 1st of January 2014 were selected. We note that one of the projects ends slightly later. E-Logistics in North Sea Region Harbour Cities (E-harbours) will conclude end of February 2014. A last condition that was considered was the geographical scope. Here a comparison of the location of primarily lead beneficiaries, but also other beneficiaries, was made. Projects that were selected are listed in Table 16 below.

Table 16: Selection of Case Study Projects

Project Name	Acronym	Member of LOWCAP Cluster	Member of ENSVR Cluster
Low Carbon Regions in the North Sea	LOWCAP	-	-
Energy Vision North Sea Region	ENSVR	-	-
Built With Care	BWC	Y	Y
Carbon Responsible Transport Strategies for the North Sea Region	CaRe-North	Y	N
North Sea Sustainable Energy Planning	North Sea-SEP	Y	Y
Innovative Forsight Planning for Business Development	IFP	N	Y
North Sea Supply Connect	NSSC	N	Y
Climate Changing Soils	BioChar	N	N
BlueGreen Coastal Energy Community	EnerCOAST	N	N
E-Logistics in NSR Harbour Cities	e-Harbours	N	N

7.2 Levels of Learning in Project Cooperation

Introduction

All projects which were considered as case studies in this research were located in the North Sea Region and carried out under the INTERREG IVB programme. The North Sea Region covers 242 NUTS3 regions from seven countries around the North Sea. The programme started in 2007 and concluded in 2013. A total of 71 projects have been carried out in this period. The total budget of 138.5 million Euros was made available in the time period. Funding for projects was allocated through nine application procedures.

When looking at the eight projects that were selected for this case study research in conjunction, a set of general observations can be made. Except the project E-harbours which started in September 2010, all other projects started in the period between June 2008 and October 2009. Projects lasted on average 3.7 years. The EnerCOAST project covered the longest period, 4.5 years, and the project IFP was shortest, lasting 3.3 years. The total eligible budgets differed. On average projects had a budget of roughly 4.5 million Euro. The largest budget was allocated to the project BWC. This project had a total eligible budget of 7.4 million Euro. The projects IFP and NSSC had with 2.5 and 2.7 million Euro respectively the smallest budgets available. ERDF Grants were on average approximately 2.4 million Euro. Grants for the IFP project were the smallest (800,000 Euro), and grants for BWC the largest (3.7 million Euro).

7.2.1 Objectives and expectations

General aims

Grouped together the eight case study projects under investigation have a large number of aims and objectives. Table 17 shows the general aims in a condensed form. The information is derived mostly from the project applications. Various categories can be distinguished. First there are projects which seek to stimulate the development of enterprises in a number of sectors which are – compared to other regions in Europe – concentrated in the North Sea Region. These are the IFP and the NSSC projects, the latter a kind of spin-off of a similar project in the Baltic Sea Region. Both projects are partly focused on energy related sectors and enterprises.

The six remaining projects focus exclusively on energy related aims and objectives. There are three projects focusing solely on energy demand. These are CaRe-North, North Sea-SEP and BWC. EnerCOAST focuses on the production of renewable energy from biomass. E-harbours focuses on demand as well as supply of (renewable) energy. BioChar focuses primarily on carbon capture and re-use in an emerging and experimental technology field.

Table 17: General aims of the eight case study projects

Project	General aims
CaRe-North	Development of electric mobility, low carbon fuels, carbon budgeting and compensation and encouraging a low-carbon mobility culture
North Sea-SEP	New tools for regional planning and development to increase the use of sustainable energy in the NSR
BWC	Mainstreaming of energy efficient building design and construction to mitigate human impact on climate change
IFP	Innovative foresight planning to stimulate business development and innovation in four economic clusters: food, energy, technology and finance
NSSC	Economic performance and innovation potential of small and medium sized enterprises to increase involvement in transnational business networks in maritime, food and health, energy and public infrastructure industries
BioChar	BioChar relates to biomass-to-energy processing systems, a technology to Capture CO2 from urban, industrial and agricultural biomass residues and reuse this in soil amendment
EnerCOAST	Strengthening the regional production of terrestrial and marine biomass as a source of bio energy through (sustainable) supply chain management
E-harbours	Creation of a sustainable energy model in harbour regions on the basis of smart grids in order to reduce energy consumption and increase renewable energy production

So there are a lot of different ways to deal with energy related issues and themes. When applying for a project subsidy the project applicants are expected to relate their project proposal to the priorities and objectives of the NSR INTERREG IVB operational 2007-2013 programme. The structure of this programme is as follows:

Priority 1: Building on our capacity for innovation

Objective 1: Building the innovation-capacity of businesses
Objective 2: Building the transnational dimension of clusters and research and innovation networks
Objective 3: Building society and the institutional capacity for innovation
Objective 4: Promoting the adoption and use of ICT applications

Priority 2: The sustainable management of our environment

Objective 1: Sustainable development of the coastal land and sea areas through integrated coastal zone management
Objective 2: Developing preventative and responsive measures to address acute and chronic marine pollution
Objective 3: Adapting to and reducing risks posed to society and nature by a changing climate
Objective 4: Promoting environmentally-responsible energy production practices

Priority 3: Improving the accessibility of places in the NSR

Objective 1: To promote regional accessibility strategies
Objective 2: To promote the development of multi-modal and transnational transport corridors
Objective 3: To promote the development of efficient and effective logistics solutions

Priority 4: Promoting sustainable and competitive communities

Objective 1: Tackling the needs of areas in decline
Objective 2: Promoting sustainable growth solutions for expanding areas
Objective 3: Promoting energy efficiency in settlements

Of the fourteen objectives two are explicitly related to energy: objective 4 of priority 2 (Promoting environmentally-responsible energy production practices) and objective 3 of priority 4 (promoting energy efficiency in settlements). On the basis of the project applications the case study projects can be related to the priorities and the objectives of the NSR programme. Table 18 gives an overview. The bold marking in combination with 1 means that this particular project is in applications mainly related to one of the four themes. Also objectives can be related this way. A faint marking in combination with 2 means a relationship of lesser importance but were also noted in project applications.

What can be noticed is that all NSR programme priorities and a majority of objectives can be related to the case study projects. IFP and NSSC are strongly connected to priority 1, which is about innovation. Above we have seen that these projects seek to stimulate the development of enterprises so this is a logical relationship. Three projects are strongly connected to priority 2, which is about the sustainable management of the environment. These are North Sea-SEP, BioChar and EnerCOAST. The two mobility/transport projects (CaRe-North and E-harbours) are solely connected to the 3rd priority while BWC is related to the 4th priority. The two project clusters can be related to priorities in the same way.

Table 18: Themes and areas of interventions in projects and clusters

Acronym	THEME_1	A_O_I_1.1	A_O_I_1.2	A_O_I_1.3	A_O_I_1.4	THEME_2	A_O_I_2.1	A_O_I_2.2	A_O_I_2.3	A_O_I_2.4	THEME_3	A_O_I_3.1	A_O_I_3.2	A_O_I_3.3	THEME_4	A_O_I_4.1	A_O_I_4.2	A_O_I_4.3
Cluster																		
LOWCAP															1			
ENSVR											1							
Project																		
CaRe-North			2	2					2		1	1	2					
North Sea-SEP				2		1			2	1						2		2
BWC															1			1
IFP	1	2	1	2					2	2						2	2	
NSSC	1		2	1	2												2	2
BioChar		2				1			1	2								2
EnerCOAST			2			1				1								2
E-harbours					2					2	1			1				

The above suggests there is a great deal of diversity between the case study projects. This is what can be expected as in the application procedures projects are not expected to copy or duplicate approaches. As is shown by various ESPON-INTERACT studies carried out under the ESPON 2006 programme, INTERREG projects tend to have a certain variety of sub-projects albeit to various extents. This creates another level of diversity between projects. The two project clusters have to deal with this. We will come back to this later in this Chapter.

In project applications the initiators of projects usually relate their projects to a number of policy frameworks because it is expected that projects contribute to the implementation and application of such frameworks. Table 19 gives an overview of policy frameworks which are mentioned in the project applications and project documents investigated in the project case studies.

The most commonly mentioned framework is the European Union 20-20-20 strategy. Next to that a number of frameworks are mentioned which deal with specific energy related issues like clean fuel (CaRe-North) or the 2001 Directive on Electricity Production from Renewable Energy Sources (EnerCOAST). BioChar stands out because for this project the post-2012-Copenhagen agenda of the UN Framework Convention on Climate Change (UNFCCC) is important. For NSSC the EU policy frameworks on SMEs are the most relevant ones. Also from the perspective of relevant policy frameworks we can observe a certain degree of variation. To get support at home so to speak, project applicants have to position the case study project and their sub-projects in 'domestic' policy and strategy frameworks. As this goes beyond the objectives of the case studies this has not been taken into account.

Table 19: Policy frameworks relevant for the case study projects

Project	Reference to policy frameworks
BWC	EU 2007 Strategic Energy Technology Plan; EU 2010 Energy Performance of Buildings Directive; EU 20-20-20 targets
CaRe-North	Kyoto Protocol; EU White Paper and Action Plan on Urban Mobility; EU 20-20-20 targets; Lisbon Agenda; EU clean fuel strategy
North Sea-SEP	ESDP/Territorial Agenda; NorVision; EU 2001 Directive on Electricity Production from Renewable Energy Sources; Gothenburg strategy
IFP	Lisbon and Gothenburg strategies.
NSSC	European Commission 2008 "Small Business Act"; European Commission 2008 Code of Best Practice Facilitating Access by SMEs to Public Procurement Contracts
BioChar	Post-2012-Copenhagen agenda of the UN Framework Convention on Climate Change (UNFCCC)
EnerCOAST	EU 20-20-20 targets; EU 2001 Directive on Electricity Production from Renewable Energy Sources
E-harbours	EU 20-20-20 targets

7.2.2 Expected impact: Territorial, technological and policy innovation

Above the relationships of projects with priority themes and objectives set out by the INTERREG IVB programme and broader policy frameworks have been described. In this section the expected impact is analyzed. The variety of aims and objectives of the various projects made it necessary to order impact by broader themes. As has been explained above we distinguish between territorial, technological and policy impacts.

Expected territorial impact

In discussing territorial impact in this sub-section we seek to address the expected geographical renewable energy potential within the participating areas as well as all sorts of benefits and impacts stemming from cooperation on these issues in case study projects.

Not all case study projects have explicit territorial objectives or ambitions however. CaRe-North in short seeks to stimulate post-fossil and low-carbon mobility. Territorial ambitions are therefore partly indirect. It is expected that the project will contribute to a reduction of transport-related carbon emissions, improving air quality and 'health for all'. In addition to these environmental ambitions the project supports measures to improve accessibility through smarter use of existing infrastructures and encouraging alternative methods of transport. This should reduce the amount of street space needed for transport infrastructure, freeing up areas for social and ecological functions: a relevant direct territorial impact.

North Sea-SEP is directed to the development of new tools for regional planning and development to increase the use of sustainable energy. So the ambition is to support the making of renewable energy strategies. Energy neutral regions are an important underlying policy concept. The ambition is also to experiment with a limited number of pilot projects. These projects could have a direct territorial impact themselves but

if they are successful it will be likely that they will be adopted and diffused on a wider scale, which will have a far wider (territorial) impact. This kind of application is beyond the life cycle of the actual project.

The ambitions of the BWC project are primarily at a small scale, at the level of individual buildings. The focus is on energy efficient buildings and the idea is that this will become a general approach across the NSR. However, local industry within the NSR is stimulated to take the lead so that the economic benefits will not leak away to areas outside the NSR. Territorial cohesion is the overall objective behind this ambition.

The expected territorial impact of IFP is indirect. The project seeks to stimulate so called foresight planning: probing the future of science, technology, the economy and society with the aim of identifying emerging generic technologies and to adopt these in the North Sea Region. The focus is on four economic clusters. As most of the (project partners) in the North Sea Region are rather peripheral in their national setting the idea is that – like the BWC project – IFP will contribute to territorial cohesion. IFP is seeking to support North Sea Region industry.

North Sea Supply Connect does not have a primarily territorial scope although the economic clusters on which the NSSC is focusing are concentrated within certain North Sea Region areas. So positive outcomes will be of benefit for these areas and the North Sea Region at large.

Territorial ambitions are undefined in the BioChar project but are nevertheless indirectly and implicitly present. If successful, BioChar will contribute to climate change mitigation which will beneficial for the NSR. The technology is also seen as a plausible way to improve the economic position of farmers in the regions; specifically as they would be able to trade carbon capture certificates. As with all other projects there are assumptions underlying the rationales. Some are to a higher level surrounded with uncertainties. This counts especially for BioChar as we will see below.

The expected territorial impacts of EnerCOAST are direct. Firstly this is the case because this project is focussing on a specific type of territories, namely coastal areas. Secondly as the project seeks to stimulate the production and use of biomass as an energy source there will be effects on land-use. Direct territorial impact will be dampened as the project partly focuses on energy production from terrestrial and marine biomasses which do not need to be cultivated. The project also seeks to promote the use of waste biomass, which also has a direct territorial impact. Energy production from biomass specifically stimulates decentralised energy production in small plants, partly because the transport of biomass is relatively expensive compared with energetically higher (traditional fossil) fuels. Decentralised energy production could bring with it a necessary adaptation of power grids, again a (direct) territorial effect.

Finally, the expected territorial impacts of E-harbours are direct as well as indirect. Direct impacts result from the fact that – like EnerCOAST – this project is focussing on a specific type of area, namely port areas. Second the project seeks to stimulate smart grids and so called Virtual Power Plants: grids and energy production facilities

which are connected in such a way that fluctuations in energy production and use can be balanced. Thirdly the project seeks to reduce the environmental impact of ports through a reduction of emissions and noise by stimulating electric mobility.

Table 20: Expected territorial impact of the case study projects

Project	Expected territorial impact
CaRe-North	Direct although this is not what the project is predominantly about: reducing the amount of street space through smarter use of existing infrastructures and modal switch – social and ecological functions will benefit; indirect: environmental improvements through better air quality
North Sea-SEP	Mainly indirect/implicit: support the making of renewable energy strategies; direct: a limited number of pilot projects
BWC	Direct: energy efficient building through eco-friendly materials and sustainable construction to be realized by local building and construction industry so the economic benefits will stay within the NSR (territorial cohesion)
IFP	Mainly indirect/implicit: the adoption of foresight planning in four economic cluster will contribute to the competitiveness of NSR regions and localities (territorial cohesion).
NSSC	Mainly indirect/implicit: cluster formation in economic sectors concentrated in NSR areas will have spatial-economic benefits (territorial cohesion)
BioChar	Mainly indirect/implicit: 1) BioChar contributes to climate change mitigation; 2) economic position of farmers could improve.
EnerCOAST	Direct: 1) focus on coastal areas; 2) stimulates the use of marine and terrestrial biomasses; 3) biomass especially fit for decentralized energy production; 4) possible adaption of power grids
E-harbours	Direct: 1) focus on port areas; 2) reduction of environmental impact through e-mobility; 3) smart grids and Virtual Power Plants; indirect: stimulating innovation which has positive spatial-economic spin-offs.

Table 20 summarizes the above analysis. There are four projects which have an anticipated direct territorial impact: CaRe-North, BWC, EnerCOAST and E-harbours. Of these four projects EnerCOAST and E-harbours are the projects which are – at least partially – framed within a territorial logic as they are focussing on specific types of areas. A great part of their foreseen impacts are also of a territorial nature. This notion counts somewhat less for CaRe-North and BioChar. The remaining four projects (North Sea-SEP, IFP, NSSC and BioChar) are more indirect and implicit in their territorial impact although of these BioChar has probably the highest territorial impact through effects on agricultural land-use. The territorial impact of this second group mostly stems from the anticipated improvement of the competitive position of certain groups of companies or economic clusters. This would have positive effect on certain areas and locations and therefore on the level of territorial cohesion in the NSR and between the NSR and other transnational areas in Europe.

Expected technological impact

The expected technological impact especially in terms of innovation – like expected territorial impact – varies across the projects but is of lesser importance compared to the foreseen territorial but above all the policy impacts. CaRe-North definitely tried to stimulate the diffusion of innovation, especially in the field of e-mobility. Partners with territorial interests – partners with a political responsibility towards municipalities and

regions – dominate the partnership though so there is great emphasis on policy change. CaRe-North is on the whole therefore a policy based project.

The general aim of the North Sea-SEP project is to bring about new tools for regional planning and development to increase the use of sustainable energy in the NSR as we have seen above. Technological innovation is therefore not a prime goal, instead it is the generation of new organizational models. A number of (technological) pilot projects on renewable energy – if successful – are expected to serve as input for models.

BWC seeks to mainstream energy efficient building design and construction by companies within the NSR. In terms of technological innovation the aims are therefore modest: the project is concerned about the adoption of mainly existing technologies. So here again the focus is on organisational issues. A few demonstration projects are intended to provide evidence for the way forward to adopt technologies on a wider scale.

IFP does not have ambitions to directly influence technology and innovation but through foresight approaches seeks to support a transition towards a knowledge-based economy. Indirect impacts are also foreseen in the NSSC project. The project seeks innovation in organisational matters. The support of SMEs will also be beneficial for technology oriented firms.

BioChar seeks the adoption and diffusion of technologies applied elsewhere in the world. BioChar is not a fully tested approach toward carbon capture. There are thus a number of objectives related to technological innovation like the testing of current and emerging BioChar production processes to determine whether these are appropriate for a wider adoption across the NSR.

EnerCOAST has similar technological ambitions namely to determine the potential for the use of biomass from various origins (terrestrial and marine) in energy production. The main emphasis is on organisational issues: the development of business chains which bring producers and consumers of biomass together.

Of the entire sample of eight case studies possibly E-harbours has the highest ambitions in relation to technological innovation. This is to a high extent related to the concept of Virtual Power Plants which seek to bring together energy demand, supply and storage and related actors via intelligent grids and ICT infrastructures.

Table 21: Expected technological impact of the case study projects

Project	Expected technological impact
CaRe-North	Diffusion of innovation but on the whole a policy based project
North Sea-SEP	Not primarily focused on technological innovation but pilot project on renewable energy are expected to provide input for policies and (new) organizational model.
BWC	Limited innovation ambitions: focus is on mainstreaming energy efficient building design and construction by NSR enterprises.
IFP	Indirect: foresight planning is expected to create a business climate which stimulates a knowledge-based economy.
NSSC	Indirect: The support of SMEs will also be beneficial for technology oriented firms.
BioChar	Limited: mainly testing of current and emerging BioChar production processes and alignment of methodological standards.
EnerCOAST	Limited: mainly to determine the potential for the use of biomass from various origins in energy production; the emphasis is on organisational issues: the creation of chains of supply and demand.
E-harbours	High ambitions mostly related to the Virtual Power Plant concept

Table 21 summarizes the results of the analysis in this section. Territorial cooperation through INTERREG is primarily not meant for technological innovation. Nevertheless technological innovation is the ambition of a number of projects, albeit limited or indirect: to establish the necessary organisational conditions for innovative enterprises to flourish. The uptake of renewable energy or the mitigation of environmental and climate impacts of the use of traditional energy sources is still in need of technological innovation. Some projects have therefor this ambition: North Sea-SEP, BioChar and EnerCOAST and probably above all E-harbours.

Expected organisational and policy impact

This sub-section deals with the expected benefits stemming from organisational and policy innovation. Organisational innovation is about networks between actors and agents. Policy innovations addresses plans, strategies and regulatory frameworks.

Starting with CaRe-North, this project seeks the downloading (or implementation as it is called) of key international, European and national policies in the fields of climate protection, energy supply and sustainable transport. The project also seeks the uploading of policies and instruments and tools particularly in the field of low-carbon accessibility at various levels of scale. This policy impact runs to a great deal through all sorts of pilot and demonstration projects and learning processes related to these.

The North Sea-SEP project was primarily seeking new tools for regional planning and regional development to increase the use of sustainable energy. The idea was to ‘inject’ renewable energy strategies into overall regional energy strategies and other strategies which (seem to) have an impact on energy use and production. Again uploading and diffusion of results of the project was a prime objective.

BWC’s main aim is to mainstream energy-efficient building design as we have seen. First the project would like to bring together a number of projects which demonstrate how barriers to successful mainstreaming of low energy building design can be

overcome. Second the project is also addressing policies and politics, basically for two prime reasons - to stimulate policy makers to draft policies which support energy efficient building design, and to stimulate policy makers to take away obstacles in policies and regulative frameworks and construction.

IFP is targeting various groups of stakeholders within and outside politics. The project was targeting four business clusters (see above) but also regional development agencies and it also tried to stimulate effective relationships ('networking') between these two worlds. Organisational and policy impacts were a prime objective: the project was seeking to improve institutional structures, co-operation arrangements and skills and capacity in organisations and individuals.

The NSSC project also had a predominantly organizational and policy innovation scope. Most of the objectives are related to the improvement of enabling conditions for SMEs with a particular focus on the development of clusters. The project was also seeking policy recommendations for 'unlocking' SME business potentials and market integration with the NSR.

Next to technological innovation the prime objective of BioChar was policy innovation. Insight into the economic and agronomic benefits of BioChar, derived from 'real world' examples and best practices should eventually lead to standards for the application of BioChar. During the lifetime of the project the latter would probably not take place but it would try to bring about a necessary condition: general acceptance of the benefits of the BioChar technology. An important step to get BioChar approaches accepted by, for instance, farmers would be to make credits related to BioChar applications tradable on the carbon market.

A prime goal of enerCoast as already mentioned in the preceding sub-section is organisational innovation: the development of business chains which bring producers and consumers of biomass together. A concrete policy tool would be developed: an evaluation matrix to assess the potential of bio-energy solution. This could form a building block for policy innovation.

The prime objective of E-harbours is to bring further the Virtual Power Plant concept. A necessary condition on the technological level as mentioned is the development of intelligent grids and ICT infrastructures. This should be paralleled by organisational networks bringing together producers and consumers of renewable energy.

The expected policy impacts of the case study projects are summarised in Table 22 below.

Table 22: Expected policy impact of the case study projects

Project	Expected policy impact
CaRe-North	Diffusion and uploading (to policy levels at higher scales) of successful approaches towards low-carbon accessibility and transport
North Sea - SEP	To 'inject' renewable energy strategies into overall regional energy strategies and other relevant strategies
BWC	Support policy strategies which aim for energy efficient building design and construction; support the removal of barriers in policies and regulative frameworks
IFP	Primarily organizational innovation and learning: project was seeking improved institutional structures, co-operation arrangements and skills and capacity in organizations and individuals.
NSSC	Predominantly organizational and policy innovation scope: improvement of enabling conditions for SMEs with a particular focus on the development of clusters; policy recommendations for 'unlocking' SME business potentials and market integration with the NSR.
BioChar	Predominantly to get political and societal support for BioChar applications and this should lead to the fulfillment of a necessary condition for widespread use: related to that: to make credits related to BioChar applications tradable on the carbon market
EnerCOAST	Organizational innovation: the development of business chains which bring producers and consumers of biomass together; an evaluation matrix assessing the potential of bio-energy could contribute towards policy innovation
e-Harbours	Organizational innovation: couplings between producers and consumers of renewable energy via (technological pre-condition) smart networks and grid.

There is no case study project not dealing with policy innovation, but some primarily focus on organization innovation: the development of (new or stronger) networks between 'actors and agents' which are deemed necessary to reach the objectives of the project. BioChar, EnerCOAST and e-Harbours are the most important examples of this approach. Organisational innovation would eventually trickle down into policy innovation: the development of measures to support the ambitions or the removal of regulatory barriers.

Some projects directly address policy making through the need for policy change and adaptation of regulatory frameworks. This counts especially for CaRe-North, North Sea-SEP and BWC. The latter specifically addresses (building) regulations as these could block or stimulate more energy efficient building techniques.

Realized impacts

In the previous section we have presented the foreseen impacts of the eight case study projects. In this section we try to estimate the realized impacts in the sense of territorial, technological and organizational and policy impacts. Quite a number of potential impacts are difficult to record due to the limited time horizon of projects. This has also been emphasized during the interviews and in the responses to the questionnaires.

If there are discernible territorial impacts of the project these are often the result of concrete tangible projects. North Sea-SEP, BWC and e-Harbours are clear examples. These 'flesh and blood' projects are not only meant to see whether the advocated approach works, but if successful serve as demonstration projects: projects which are worth replicating. BioChar went in the opposite direction. Because BioChar techniques are in a state of infancy demonstration projects can also have negative outcomes. This apparently was the case. 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.

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 here and again BioChar, but in an opposite direction. IFP and NSSC could have indirect technological effects thank to networking and clustering of enterprises. Bringing entrepreneurs together could lead to all sorts of innovation ranging from marketing to technological impacts, although the former are the main object of these projects.

Projects having an organisational impact means that these projects bring actors and stakeholders in new relationships with each other. Projects focusing on networking and cluster formation share this ambition: IFP and NSSC. e-Harbours 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 does 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 had a basic ambition to communicate project 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 will depend 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 project again, in a few years' time. Table 23 summarises the realised impacts of the case study projects.

Table 23: Realized impacts of the case study projects

Project	Territorial impact	Technological impact	Organisational and policy impact
CaRe-North	Realization of 'lighthouse projects': car sharing; dedicated bus services	Ex ante and ex post evaluations of novel approaches (fuel consumption, Co2 emissions)	Varies per case/sub-project: traceable input in number of policies and (procurement) guidelines; position papers and meetings/ conferences
North Sea-SEP	Small pilot projects	Direct via pilot projects and indirect via contributions towards local/regional strategies and policies	Input/contributions towards several local/regional energy strategies and policies
BWC	Mostly beyond project lifespan apart from demonstration projects	Valorisation projects: sharing technological knowledge	Policy recommendations and communication output, incl. conferences, exhibitions
IFP	Indirect via: harmonized compilation of statistical indicators on energy; stimulating development of clusters and business networks; suggestions for improvement of grids/networks	No main focus of project but probably indirect via involvement of 200 companies in project activities	Indirect via policy recommendations and varied communication output; application of triple helix approach in some cases
NSSC	No main focus of the project, but indirect via stimuli to create clusters	No impact, apart from indirect effects of cluster formation	Creation of business networks and clusters; indirect influence on policy via policy recommendations
BioChar	No main focus of the project; decrease of CO2 value in emission trading systems took away the territorial potential of BioChar approach	Large: uncertainties discovered in relation to toxicity of BioChar feedstock	No main focus of the project; due to technological uncertainties of BioChar possibly no indirect effects
EnerCOAST	Potential impact part of assessment methodology developed in the project	No main focus of project, but could result from partnerships stimulated via the project	Indirect via application of evaluation matrix to assess local/regional potential of bio-energy solutions
e-Harbours	Direct via Showcase cities and demonstration projects; indirect larger if approach will be applied widely	Direct innovation via the experience with demonstration projects most importantly within the context of the Virtual Power Plant concept	Impact via the Showcase activities; the new networks that have been created will contribute to impacts beyond project lifespan

7.2.3 Characteristics of transnational project cooperation

Above the realization of project results that were described in project application was assessed. Below we evaluate **transnational** cooperation in projects. As noted in Section 7.1.1 of this chapter, objectives of INTERREG programmes are not solely caught through the definition of distinct project results. The programme also aims at an improvement of transnational cooperation. Assessment criteria refer to the performance of cooperation investigated through the perception of strength and weaknesses (and the focus of projects) and levels of learning that were reached. Below we first distinguish characteristics of cooperation that influence, according to the framework of learning, cooperation. In Section 7.2.4 these characteristics are used to order notions on the quality of the partnership and learning effects.

General accounts: amount of organisations, legal status and geographical coverage

In the eight selected projects and two cluster projects a total of 119 partner organisations were involved. Seven of these organisations participated in cluster projects only. These were not considered in the analysis of which results are described below (they gain attention in Section 7.3). We note that the remaining total number of 112 organisations included doubles. Partner organisations who have participated in several projects were occurring several times in the count. These were few though. The province of Groningen was involved in three projects. The Dundee College, the Chamber of Commerce Northern Netherlands and the University of Edinburgh were involved in two projects.

In applications partner organisations were asked to describe themselves according to their legal status. The freedom to choose for labels has led to a broad range of description (in this sample of eight projects 44 different categories were used). Descriptions of status differed on nuances in terminology. A brief evaluation of descriptions showed that 88 public bodies were involved and ten organisations that fall under private law. Of 21 organisations the legal status could, based on the available documentation, not clearly be identified.

An analysis of the distribution of all partner organisations across countries showed that slightly less than half of them (45%) were located in either Germany (29) or the Netherlands (24). 19 organisations from Great Britain participated, 12 from Belgium, Denmark and Norway and 11 from Sweden. This distribution can partially be explained by the size of national territories that are part of the North Sea Region and the density of urbanisation (and organisations) within these territories.

An analysis of the distribution of all organisations across NUTS3 regions showed stronger differences. Of the 242 NUTS3 regions in the North Sea Region, 27 regions were represented with one organisation, ten with two, five with three, three with four and one with five. Regions that were represented with more than five organisations were the region of *Hamburg* (DE600) and *Aberdeen City, Aberdeenshire and North East Moray* (UKM50) with each 6 organisations, the region *Overig Groningen* in the Netherlands (NL113, 11 organisations), the region *Rogaland* in Norway (NO043, eight organisations) and the region *Osterholz* (DE936, eight organisations). This outcome might give rise to the idea that there were some ‘nodes’ in transnational cooperation under the NSR INTERREG VIB programme. We note that

concentrations of partner organisations in regions can be for several reasons. An over-representation of partner organisations from the *Osterholz* region in the project North Sea-SEP is, for example, caused by a group of smaller municipalities in this region which were each listed as partners in the application but were in fact sub-partners. Other regions showed a high amount of organisations that were key partners in projects. That these regions formed nodes is underpinned by the fact that lead beneficiaries frequently came from there.

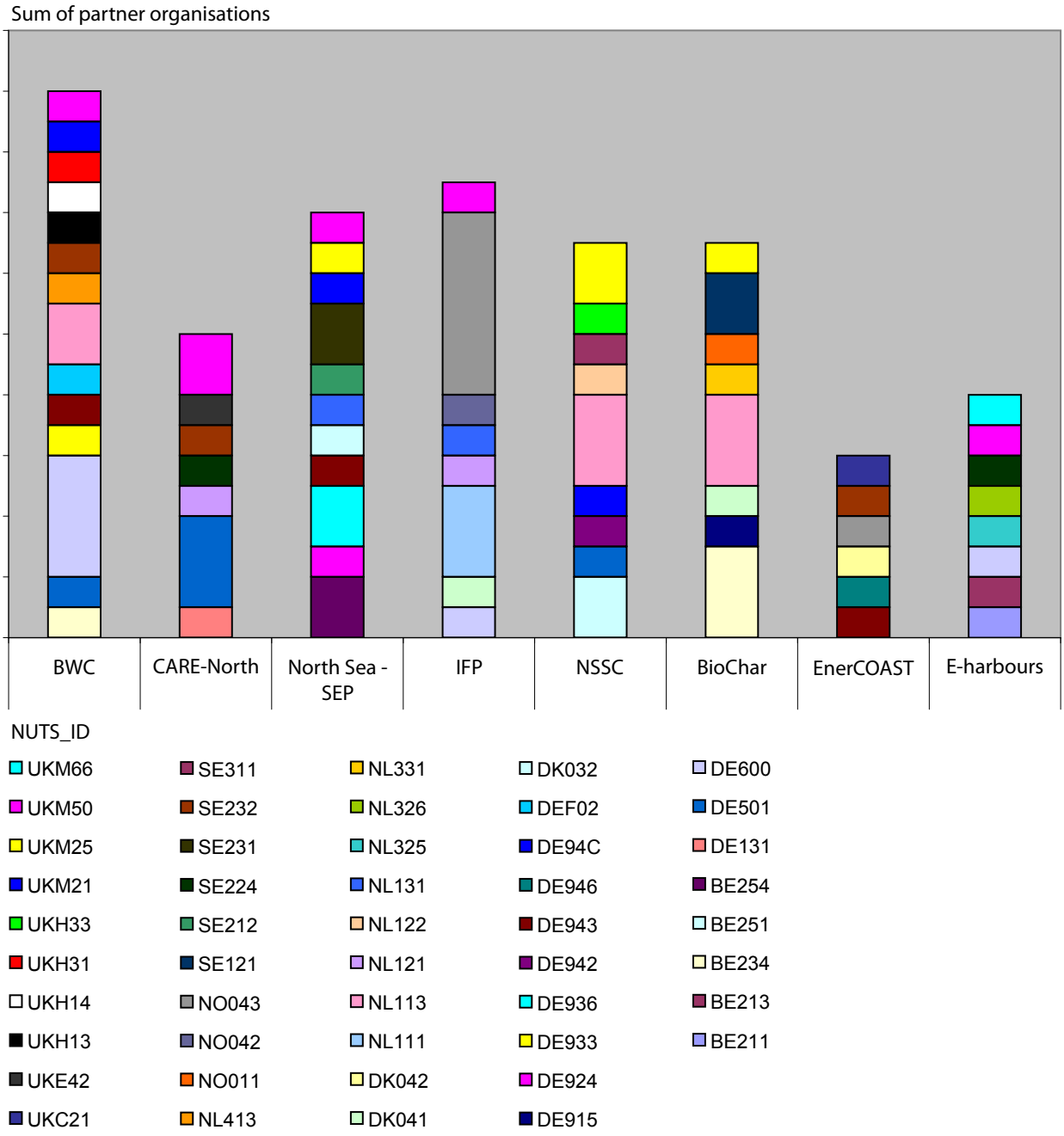
There were different numbers of organisations involved in projects. The largest amount of organisations was involved in the project North Sea Sustainable Energy Planning (North Sea-SEP). In this project 25 organisations were involved. As noted above this project had a specific way of listing partners though. The smallest number of organisations was involved in the project E-Logistics in NSR Harbour Cities (E-harbours). In this project 8 organisations were involved.

Looking at the geographical distribution of partner organisations by projects it was observed that the obligation for territorial coverage has been fulfilled in different ways by project partnerships. All projects have included organisations from at least four countries (Care-North). Most projects had partners from five countries (BWC, IFP, NSSC, EnerCOAST, e-harbours). One project had partners from 6 countries (North Sea-SEP) and one from seven (BioChar). In several projects partners from one country were overrepresented. Outstanding in this respect was the project North Sea-SEP (out of the 25 involved organisations ten came from Germany), the project BWC (out of the 18 organisation, eight came from Germany) and the project IFP (out of the 15 organisations, seven came from Norway).

When looking at the regional geographical coverage in projects, most had an equal distribution of partners across NUTS3 regions (one organisation per region) and few peaks. In the project BWC four partner organisations came from Hamburg (DE600) and two from Overig Groningen (NL113). In the project CaRe-North, three organisations came from Bremen (DE501) and two from Aberdeen City, Aberdeenshire and North East Moray (UKM50). In the project North Sea-SEP two partners came from respectively Kortrijk, Osterholz and Hallands län (BE254, DE936 and SE231) (next to the eight sub-partners from Osterholz and Sydjylland). In the project IFP six partners were located in Rogaland (NO043) and three in Oost-Groningen (NL111). The project NSSC knew a concentration of partners in Overig Groningen (NL113, three), Edinburgh (UKM25, two) and Brugge (BE251, two). In the project BioChar three partners came from Gent (BE234), three from Overig Groningen (NL113) and two from Uppsala County (SE121). In the project EnerCOAST there was a concentration of sub-partners only (three in Østjylland, DK042). Also in the project e-Harbours there was no concentration of key partners. Each region was represented by one partner organisation.

In general it can be concluded that all cooperation in projects under investigation have reached a high degree of regional geographical coverage and were transnational in nature. Differences naturally occurred through the size of the partnership (see Figure 7).

Figure 7: Geographical Coverage of NUTS3 Regions in Project Cooperation



Geography of partnerships

Above general accounts, mostly derived from data in project applications, were analyzed. Below notions about partnerships derived from case studies are added to these general observations. As described in the case study methodology the main aim of analysing the geography of partnerships was to detect the divergence of rationales and the complexity of compositions within transnational partnerships. These aspects are influencing levels of learning in several ways. In outline, shared and (geographically) balanced rationales and intra-organisational structures support high levels of learning and organisational change. Co-operation among partners with divergent and (geographically) unbalanced rationales and structures may also produce learning effects. However these are likely to be restricted to the exchange of experiences and remain within partner organisations.

Before presenting results we place a set of notions on the analysis itself below.

Rationales and intra-organisational structures were primarily distinguished in relation to single project partnerships. Domains of interest and the broadness/specificity of interests across the whole sample were assessed only in outline and through the extraction of key words associated with dominant interests. Distinctions among interests were often difficult to make. Organisations who focus on territorial interests and planning were mostly public authorities. These frequently express their interests, competences and working areas well and were easy to allocate (although we note that it was sometimes difficult to detect involved sector departments from authorities). Also organisations from the domain of knowledge interests express themselves most often clearly. Specifically knowledge institutes with a dominant interest in research define aims and working areas precisely. The interests of more complex organisations such as governance arrangements, business development networks and knowledge networks are often less specific in expressing their aims and cover several domains of interest simultaneously. Examples are chambers of commerce who frequently have a broad interest in economic development but are obliged to operate within distinct territories and deduct more refined interests from these. Below results per project are briefly presented.

The project **Built with Care** (BWC) was about the mainstreaming of energy efficient building design and construction to mitigate human impact on climate change. Among the 18 partners involved in this project were ten organisations with a dominant knowledge interest. Five of these ten organizations have a broad interest in research and education. The five other organizations focus on the development and dissemination of knowledge concerning energy efficient buildings. 8 partners have a territorial interest. They are single public authorities with well-defined planning competences. The scales about which these authorities are concerned differ, from city or municipality to provincial level. Seeing the interests of all partners in the BWC project in conjunction it can be concluded that knowledge interests were a main driver within the partnership but well balanced with territorial interests. The composition of the partnership showed a low degree of complexity since 13 of the 18 partners were single and clearly identifiable organisations.

The project **Carbon Responsible Transport Strategies for the North Sea Region** (CaRe-North) was concerned about the development of electric mobility, low carbon fuels, carbon budgeting and compensation and encouraging a low-carbon mobility culture. Within this project ten partner organisations were involved. With regards to partner interests, the majority of partners (six), being local or regional authorities with planning competences, have territorial interests. Among these were four authorities with a broad interest in planning and two with a more specific interest in transport development. The two partners with knowledge interests have a broad interest in developing and disseminating initiatives that support sustainable development. Two partners that participated in the project have a specific economic interest in sustainable, technological applications and waste management. Overall, territorial interests dominated the project partnership, with particular interests in the fields of low carbon transport, travel behaviour and alternative fuels. There was a relatively low degree of organisational complexity within the partnership, with only three partners representing consortia of organisations.

The project **North Sea Sustainable Energy Planning** (North Sea-North Sea-SEP) was concerned about the development of new tools for regional planning and development to increase the use of sustainable energy in the NSR. In this project 25 organisations were involved. Of these 25 organisations 11 organisations were sub-partners, representing regional stakeholder networks of key partners. All 11 sub-partners were local authorities (municipalities) with broad planning competences. Among the 14 key-partners there were six organisations with an interest in knowledge, among them four public, academic organisations with a broad interest in research and education and two knowledge networks concerned with the dissemination and application of knowledge on sustainable development in distinct regions. Six of the 14 participating key organisations have a territorial interest. Among these six were three public authorities with a general interest in planning and two governance arrangements with a broad interest in regional sustainable development. One organisation with a territorial interest is a partnership among several municipalities and specifically interested in waste management. Two of the key partners who participated in North Sea-SEP have a dominant interest in economic development. One organisation is a company consulting on renewable energy projects and the second one an association composed of regional councils, counties and municipalities and focused on economic development in a specific region. Considering the interests of all North Sea North Sea-SEP partners in conjunction it can be concluded that rationales within the partnership were diverse but balanced. With six of the 14 key partners the partnership was relatively complex.

The project Innovative **Foresight Planning for Business Development** (IFP) was concerned about innovative foresight planning to stimulate business development and innovation in four economic clusters: food, energy, technology and finance. Altogether 15 partners participated in this project. Of these 15 partners seven partners have a territorial interest and are commonly interested in regional planning. Two of the seven partner organisations are regional governance arrangements among local and supra-local governments. Among the 15 partners in the IFP project were two organisations with a dominant interest in knowledge, one public and one private organisation. The private organisation is focused on technological development in a distinct region. The public organisation is broadly concerned about research and education. Six partners who participated in the IFP project have a primary economic interest. Three of these organizations are single public organisations with a broad focus on the economic performance of a range of economic segments, the welfare of larger areas. One of the organizations with an economic interest is a composed private organisation with a broad focus on economic development in a specific region and two are single private organisations with a more specific focus on banking and consultancy. Seen the interests of all partners in conjunction it can be concluded that project partners in IFP had diverse and over-lapping interests. The organisational structure was with seven composed partners relatively complex.

The project **North Sea Supply Connect** (NSSC) was concerned with the economic performance and innovation potential of small and medium sized enterprises to increase involvement in transnational business networks in maritime, food and health, energy and public infrastructure industries. Among the 13 partners were five organisations with a dominant interest in knowledge. Two of these have a broad interest in research and education. Two of the organizations with a knowledge

interest are mainly concerned about knowledge dissemination. Both are public organisations and both focus on the dissemination of knowledge among small and medium sized businesses. One partner with a knowledge interest is a co-operation among several business partners and aims to stimulate growth and entrepreneurship within a specific region, mostly by means of education. Two partners in the NSSC project have a territorial interest. They are public authorities with well-defined planning competences. The scales about which these authorities are concerned differ. One is interested in regional and one in local development. The largest interest group within the project, consisting of six partners, was composed by an interest in economic development. All six partners resemble business development organisations (BDOs). Their activities in specific areas deliver a focus on specific economic segments, although segments are defined to a greater or lesser degree. Among the BDOs were two chambers of commerce. Also these express an interest in sectors that concentrate in the areas they are responsible for. Viewing the interests of all partners in the North Sea Supply Connect project in conjunction it can be concluded that interests were diverse but that there was a slight dominance of economic interests. The intra-organisational structure, with seven network organisations, was complex. The NSSC project was initially set up as a part of the Baltic Sea Supply project, under the 20% rule. At a later stage the two projects entered in a financial joint venture. This condition added to the organisational complexity.

The project **Climate Changing Soils** (BioChar) was concerned about biomass-to-energy processing systems, a technology to capture CO_2 from urban, industrial and agricultural biomass residues and a reuse of this in soil amendment. In the BioChar project 13 partners participated. When distinguishing project partners by their interests, it appears that most of them have an interest in knowledge. Among the ten organizations with knowledge interests there were nine partners that are interested in research only and are concerned about specific research fields, aligned around the keywords agriculture, energy and sustainability. One partner in the BioChar project is a private organisation which besides an interest in research, has an interest in profit. It is a consulting firm, specialising in soil quality and soil management. There were two public authorities with a broad territorial interest participating in the project. Both authorities hold an important mandate for planning on the regional scale. The 13th partner is a public body with an economic interest in agriculture. This partner is a board that is established by and closely related to employers and employees organisations of distinct industries (therefore categorized as a composed organization). It can therefore be concluded that knowledge interests in the BioChar project partnership clearly prevailed. The partnership also largely consisted of organisations with a low degree of complexity.

The project **BlueGreen Coastal Energy Community** (EnerCOAST) was concerned about strengthening the regional production of terrestrial and marine biomass as a source of bio energy through (sustainable) supply chain management. In this project six organisations participated as key partners. Four organisations were sub-partners, representing a regional stakeholder network of key partners. All four sub-partners were local authorities (municipalities) with broad planning competences. One key partner's main interest is territorial in nature as it engages in regional development. Two partners followed mainly knowledge exchange and knowledge transfer interests. Three partners can be seen as pursuing mainly economic interests. Two of

these are profit-oriented umbrella associations representing several sector (energy) or multi-sector enterprises. Another partner who participated is a chamber of agriculture that represents and supports the agricultural and fisheries sector in the state of Lower Saxony and thus pursues both, sector-economic as well as territorial interests. This organisation was allocated to the domain of economic interest. Overall, the partners' interests and rationales varied. An interest in planning was underrepresented in the project. Knowledge and economic interests were balanced. The composition knew a medium degree of complexity with three out of six key partners representing consortia of organisations.

The project **E-Logistics in NSR Harbour Cities** (e-Harbours) was concerned about the creation of a sustainable energy model in harbour regions on the basis of smart grids in order to reduce energy consumption and increase renewable energy production. Altogether eight partners participated in this project. The interests of the project partners tend to focus on territorial and research/knowledge dimensions. Four partners have territorial interests. For the three involved local authorities this is a broad territorial interest, covering different aspects of sustainability including eco-friendly transport, increasing use of renewable energy and combating the effects of climate change. One organisation has a territorial interest, which is more narrowly defined by its role in the management of port traffic and the provision and maintenance of dockside facilities. The second most common interest of project partners is the knowledge dimension. One university offers education in a range of subjects including engineering, architecture and the built environment. Two research centres within the university - one dedicated to management, governance and society and one to innovation, design and sustainability were involved in the e-Harbours project. Within another university, a competence centre for renewable energy and energy efficiency undertakes research and teaching activities in the fields of energy networks and renewable energy. The third knowledge institute that participated is an independent, publicly owned research institute working on technological innovations to support the transition to a low carbon society and sustainable industries in a specific region. Only one partner had an economic interest. The organisation provides and installs a range of renewable energy systems including photovoltaic and wind energy. It is also a leader in hydrogen fuel technology for the public and private sectors. The organisational structure of the partners in each case is relatively simple, with each partner being a single entity rather than representing further consortia or groups.

Characteristics of transnational project cooperation

Below conclusions from the analysis of the geography of partnerships are drawn. First results from the whole sample are described. Second, transnational cooperation in projects is distinguished.

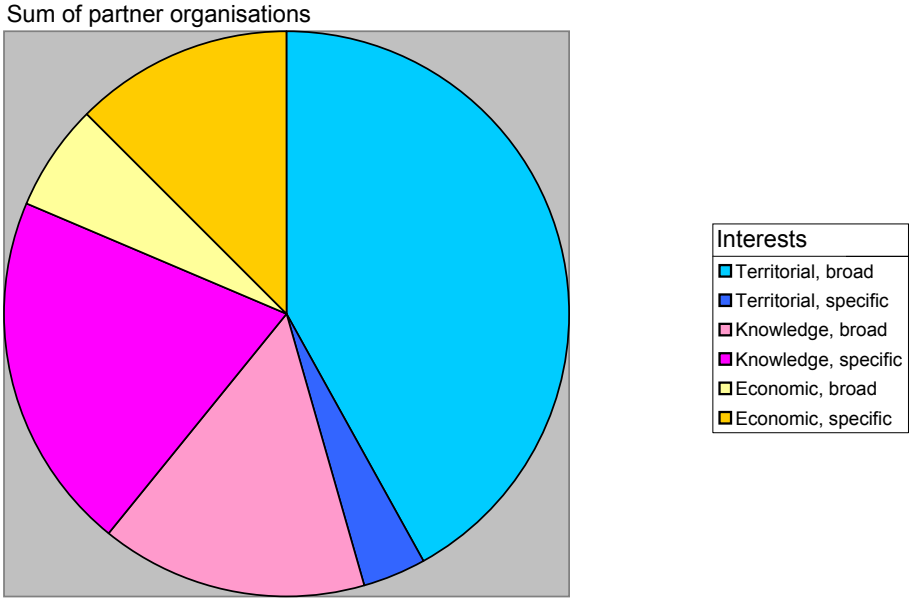
When reviewing the 112 partner organisations which were involved in projects by their **rationale**, a slightly dominant interest in territorial development can be detected. 51 organisations who participated have this interest. 40 organisations shared an interest in knowledge. 21 organisations that were involved in projects have an economic interest. Partner organisations had, given results from this analysis, overall broad interests. There were relatively few organisations to which a

specific interest could be allocated. This notion counts for all domains of interest that were considered in this analysis (territorial, knowledge and economic). Most common broad interests in territorial development were interests in local planning (27 organisations) and regional planning (19). Specific territorial interest were marginal (4) and related to port management, waste management and public transport (2).

In the domain of knowledge interests, broad interests were established by a concern about research and education and a general interest in knowledge dissemination. Organisations with such broad interest were 18. There were more organisations in the domain of knowledge interest that had specific interests (22 organisations). Most of these interests are taken by research institutes and deducted from distinct research fields under attention in projects. The most common keyword here was environmental sustainability. The theme of energy occurred less often and is approached from a broad range of directions, including technology, built environment, economy and planning. A relatively large group with specific knowledge interests was established by an interest in knowledge dissemination in distinct areas and among distinct groups (8).

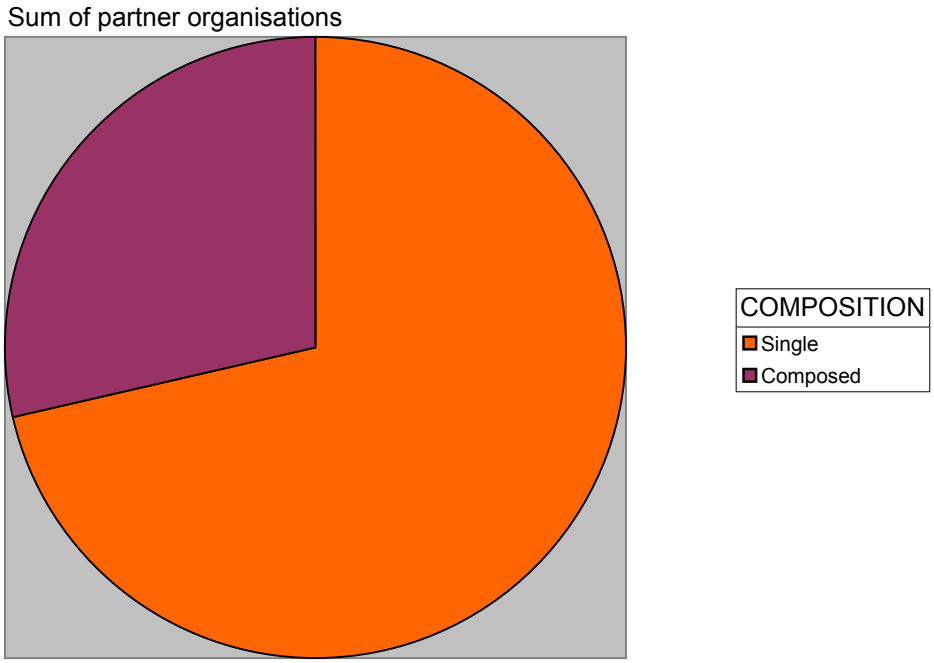
Also economic interests were more often specific than broad. Broad interests were established by a general interest in economic development. Specific interests were sometimes interests of single companies in specific products such as distinct technological applications or distinct fields of consultancy. Specific interests were also established by attention to distinct economic clusters in regions, frequently covering the energy sector. An overall distribution of interests is illustrated in Figure 8.

Figure 8: Domains of interests of partner organisations



When reviewing the composition of partnerships, most of the organisations were single and clearly identifiable organisations (83). Roughly a quarter of participating organisations were composed organisations (29). An overall distribution of organisations with complex and simple compositions is illustrated in Figure 9.

Figure 9: Composition of Partner Organisations



When considering the distribution of interests across domains of interest and inter-organisational structure of key partners in project partnerships, a set of more or less distinct characteristics of transnational cooperation came to the foreground. (We note that partners that were classified as sub-partners were excluded from this analysis).

There was one project in the sample of eight in which there was, seen that rationales of participating partners, a clearly dominant interest in knowledge. The **BioChar** project could be, when using the terminology developed by Colomb (2007), described as a 'virtual network', in this case a virtual knowledge network focused on the development and application of a specific technology (BioChar). The project is also outstanding in respect to the simplicity of its organisational structure and, even more, the high specificity of knowledge interests.

In two projects (**NSSC and EnerCOAST**) economic interests played an important role, but were balanced out by knowledge interests. Territorial interests played a subordinate role in these projects. In both projects economic interests were predominantly specific and focused on the development and performance of distinct economic sectors/clusters in regions. Both projects showed the highest degree of organisational complexity in the sample of eight projects. Roughly 50% of partner organisations were network organisations. We note that knowledge interests differed. In the case of the NSSC project, organisations representing this interest were mainly interested in the dissemination of knowledge among a specific group (small and medium sized businesses). In the case of EnerCOAST specific research interests prevailed.

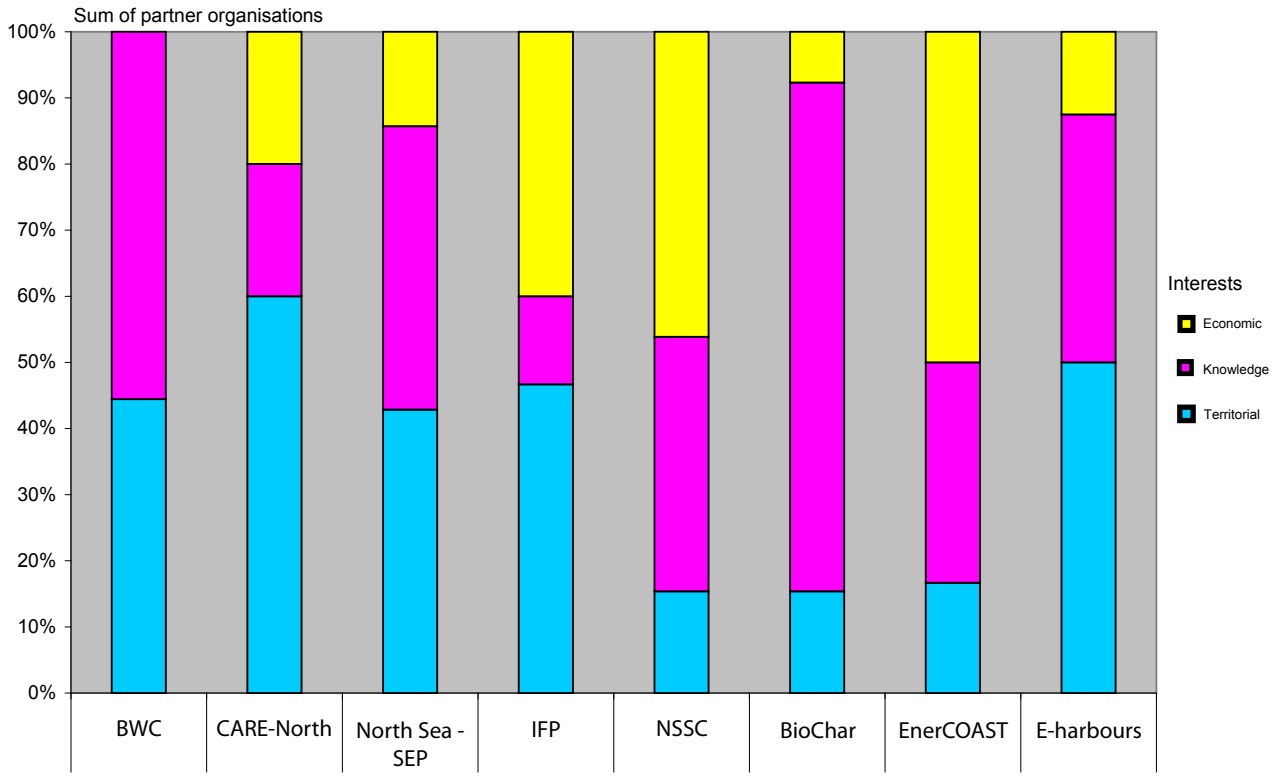
Another project in which economic interests were important was the project **IFP**. Here, however, knowledge interests (a broad interest in knowledge dissemination) played a subordinate role and the interest in economic development was balanced out by territorial interests mostly represented by single and clearly identifiable public

authorities. The territorial interest of organisations was very well aligned. All partners with a territorial interest shared a broad interest in regional planning.

There were three projects in which territorial and knowledge interests were the most dominant interests and there was a marginal or no interest in economic development. These were the projects **BWC, North Sea-SEP** and the project **E-harbours**. The three projects also resemble each other in their low degree of organisational complexity. In the projects BWC and North Sea-SEP roughly a quarter (25%) of all partners were composed organisations. Outstanding in this respect was the project E-harbours. None of the organisations was complex and also its geographic coverage was most equal in the sample of eight projects. Differences among these three projects came to the foreground when reviewing the specificity of interests. While in the projects North Sea-SEP and BWC few specific interests could be detected, however such interests were well and clearly expressed by partners in the E-harbour project. Distinct expertise was not only brought in by knowledge partners but also by partners from distinct planning sectors.

Figure 10 shows the dominant rationale of partner organisations in each project and Figure 11 their intra-organizational structure. Table 24 summarises the overall characteristics of transnational cooperation in each project.

Figure 10: Rationale of Partner Organizations



In the project **CaRe-North** territorial interests were most dominant. 60% of the partners shared this interest. Another characteristic of the project is that the remaining partners distributed their interests across the two remaining domains. In this way one largely shared interest came to stand opposite two marginal ones.

Overall the complexity of the partnership was low (as in most projects that have a large interest in planning which is mostly represented by public authorities).

Figure 11: Intra-Organizational Structure

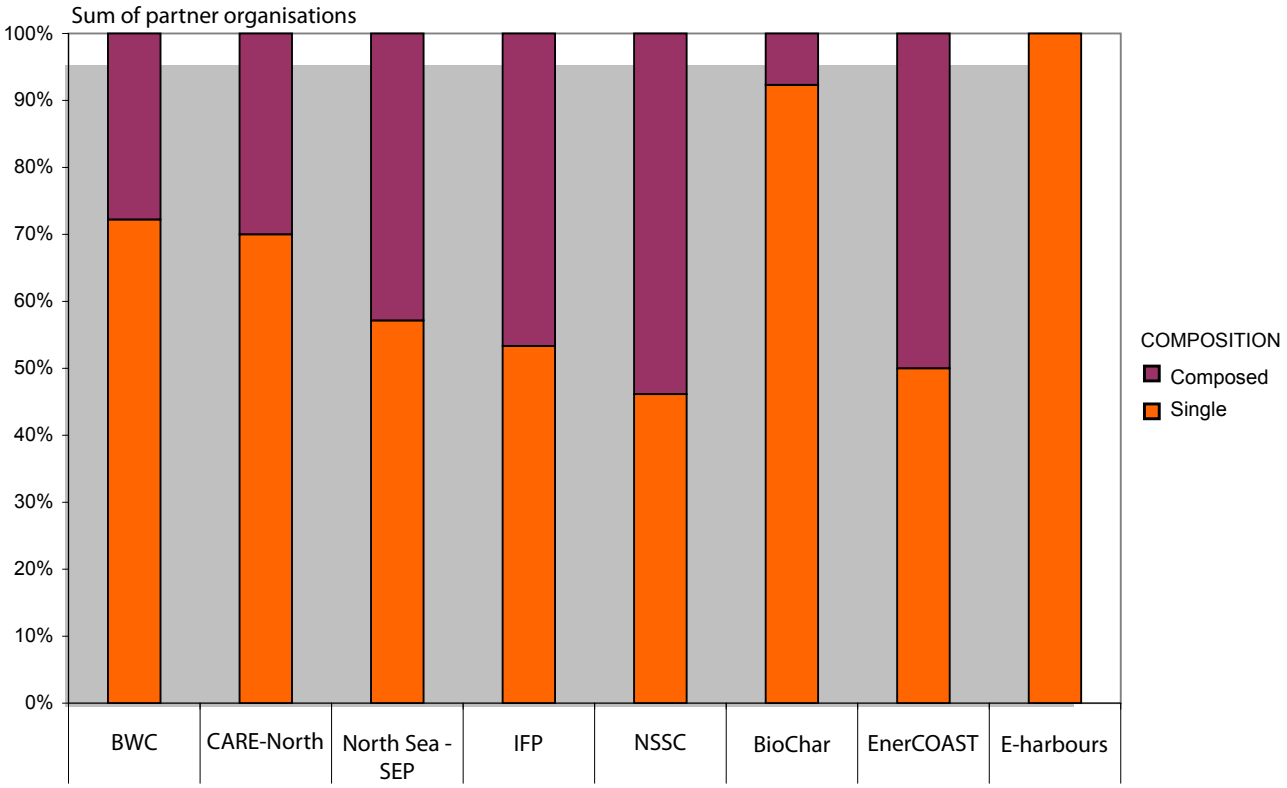


Table 24: Characteristics of Transnational Cooperation

Project	Geographical coverage	Diversity/balance of interests	Specificity of interests	Complexity of intra-organisational structure
BWC	18 partners; 5 countries; 14 NUTS3 regions.	Balance among territorial (8) and knowledge (10) interests.	Mainly broad; Broad (13), specific (5).	Simple; Complex (5), simple (13).
CaRe-North	10 partners; 4 countries; 7 NUTS3 Regions.	Dominance of territorial interests (6); fragmentation of other interests (knowledge 2, economic 2).	Broad/specific; Broad (5), specific (5)	Simple; Complex (3), simple (7).
North Sea-North Sea-SEP	14 partners (11 sub partners); 6 countries; 11 NUTS3 regions.	Balance among territorial (6) and knowledge interests (6); marginal economic interests (2)	Mainly broad; Broad (10), specific (4)	Complex/simple; Complex (6), simple (8).
IFP	15 partners; 5 countries; 8 NUTS3 regions.	Balance among territorial (7) and economic (6) interests, marginal knowledge interests (2)	Mainly broad; Broad (12), specific (3)	Complex/simple; Complex (7), simple (8).
NSSC	13 partners; 5 countries; 9 NUTS3 regions	Balance among economic (6) and knowledge (5) interests, marginal territorial interests (2)	Broad/specific; Broad (7), specific (6)	Complex/simple; Complex (7), simple (6).
BioChar	13 partners; 7 countries; 8 NUTS3 regions	Doninant knowledge interests (10), marginal territorial (2) and economic (1) interests.	Mainly specific; Broad (2), specific (11)	Simple; Complex (1), simple (12).
EnerCOAST	6 partners, (4 sub partners); 5 countries; 6 NUTS3 regions	Balance among economic (3) and knowledge (2) interests, marginal territorial interests (1)	Broad/specific; Broad (3), specific (3)	Complex (3)' simple (3).
E-harbours	8 partners; 5 countries; 8 NUTS3 regions	Balance among territorial (4) and knowledge interests (3), marginal economic interests (1)	Broad/specific; Broad (4), specific (4)	Simple; Complex (none), simple (8).

Learning in types of transnational project cooperation

In the previous section, characteristics of transnational cooperation in projects were analyzed. Accounts of geographic coverage, the diversity and balance of interests and the complexity of compositions of single partners were used to describe aspects of transnational cooperation that influence, according to the theoretical framework used in this case study, levels of learning. Below notions on the perceived strength and weaknesses of the eight partnerships from the perspective of involved partners are ordered by these aspects. Single insights were gained in interviews with key partners involved in the projects. We note that amounts of and approaches in interviews differed. We therefore classify the results below as observations. Notions on strength and weaknesses by project are listed in Table 25.

In general, the diversity of interests of project partners in projects was seen as an important asset of cooperation. Partners frequently mentioned that such diversity was a motivation to participate in project partnerships. Expectations were most frequently described in general terms. Alternative points of view as well as new knowledge were supposed to enrich the understanding of issues that partners had when setting out for cooperation. Also 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. These notions remained often general though and were in only few cases underpinned by evidence on the continued use of insights within partner organisations.

Partners from several projects reported a lack of alignment of interests in cooperation in retrospect. Disagreement occurred in partnerships with various combinations of interest: territorial/knowledge interests (BWC, North Sea-SEP), knowledge/economic interests (NSSC) and economic/territorial interests (IFP). This factor (the combination of distinct interests in projects) was not explanatory though since several project partnerships with similar varieties of interests did not suffer from a miss-alignment of interests. A characteristic that was shared by all projects from which disagreement was reported was a broad focus. 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 several projects diverse rationales were associated with communication barriers that occurred specifically in early project phases. Several partners said that these difficulties delayed projects to a larger extent than expected. Several partners noted that barriers were overcome in the course of cooperation.

From some cases it was reported that the diversity of interests had, in retrospect, strengthened the overall transnational partnership. Among these cases were the project EnerCOAST and, to a lesser degree, the project North Sea-SEP. In both projects it was mentioned that the integration of interests required additional efforts. In the case of North Sea-SEP these efforts were related to communication. In the project EnerCOAST the key to this achievement was seen to be the common

acceptance of a ‘methodological and strategic umbrella for diverse rationales’ which was actively established at an early stage of cooperation. The early effort to integrate interests was also portrayed as a good investment in 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.

Two out of eight projects held a dominant interest. In the project BioChar, in which knowledge interests were clearly prevailing, a shift of focus has taken place. Fundamental research questions came to stand at the centre of attention and other issues that related to policy innovation were dropped. Respondents in interviews reported that in the light of the new focus, the partnership has turned out to be ideal. Partners who have participated in the projects also reported from a high degree of consensus among partners in the project. The CaRe-North project partnership was characterized by a dominant interest in territorial development and a fragmentation of interests in other domains. From this project there were reports from a lack of analytical knowledge and difficulties of academic partners to persuade other partners of the value of their work.

When relating mentioned strength and weaknesses to specific domains of interests which were used to describe characteristics of partnerships, a set of observations could be made. A high involvement of partners with territorial interests was associated with several strength and weaknesses. In three out of five projects that knew a high involvement of 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 one case (EnerCOAST) this barrier let to the marginal commitment and drop-out of partners from two countries. From one case (E-harbours) there were reports on a missing understanding of legal and market perspectives (on energy). 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 potentials in different countries.

The involvement of partners with territorial interests gained also some other remarks. In one project in which territorial interests were underrepresented (NSSC) it was noted that project output was defined not well enough to comply with the responsibilities/objectives of a public authority. In two projects with an important territorial scope, the political and organisational instability of public authorities was mentioned as a threat. In one project it was mentioned that public authorities can reach a broad audience and thus accelerate local implementation processes.

The participation of partners with knowledge interests were mentioned in interviews mostly when these partners contributed with specific knowledge and expertise. It seemed that partnerships often ‘discovered’ the value of analytical knowledge in the course of projects. Such knowledge was frequently highly appreciated only in retrospect. When partners with specific knowledge interests were underrepresented, this found mentioning several times. In one case (NSSC) a lack of knowledge on existing tools and instruments (for building up company networks on the European level) has required additional work and a serious delay of the project. From one project (E-Harbours) it was reported that analytical knowledge provided by

knowledge institutes and expertise provided by sector departments of authorities have complimented each other well. Partners with an expertise in knowledge dissemination (such as schools, colleges or knowledge networks focused on the dissemination of knowledge among certain groups) although representing a large proportion of partners with knowledge interests, were not specifically mentioned in interviews.

There were three projects in which partners with an economic interest formed an important group. In two of these projects there was a perceived lack of focus and agreement. This weakness could have several reasons since the three projects differed in several aspects. From one of the projects (NSSC) there were reports of difficulties establishing a focus on economic clusters. This difficulty was caused by a variety of cluster definitions across regions, different degrees of institutionalisation of cluster approaches in regions and the broad range of economic sectors at the interest of different partners in the project. Statements of different partners in the project indicate that this problem could not be resolved. Another difficulty concerning the integration of partners with economic interests in this project partnership related to their organisational complexity. Being network organisations these partners were expected to act with ease across regional and national boundaries. This expectation was, in the case of the NSSC project not fulfilled. The main barrier seemed to be the (in the case of chambers of commerce, legal) obligation of business development organisations to focus on distinct economic activities within (often softly) defined territories. All partners that were interviewed on this project reported from difficulties to engage single companies (SMEs) in transnational cooperation.

A range of important strengths and weaknesses which were mentioned by project partners did refer to aspects which were not covered by the characteristics incorporated in the framework. These are described below. Several partners referred, when reflecting on the strength and weaknesses of partnerships, to the lead beneficiary. In one project (CaRe – North) the quality of the lead beneficiary was perceived to be a major asset of the overall partnership. The partner's experience and success in other European projects has increased first the attractiveness of the proposal and later the confidence in the overall partnership. In another project, in which a partner took the lead for practical (financial) reasons there were remarks on a lack of engagement of this partner. The engagement of single persons found mention more often, specifically in the context of partnership formations. Qualities of persons who took the initiative and lead in early stages of projects were their experience and embedding in transnational cooperation and their strong conviction of the importance of issues under investigation. In two cases 'founding fathers' dropped their lead for practical reasons in a later stage of projects.

In nearly all projects existing social ties that had emerged in earlier cooperation (largely under earlier INTERREG programmes or other European programmes) were mentioned as an important asset of partnerships. The familiarity within existing networks was seen to create trust, ease communication and speed up decision making processes. Frequently such ties defined a 'core group' in projects to which at later stages of formation processes additional 'new' partners were added. In one case it was mentioned that the search for new partners was guided by practical reasons: the obligation to reach geographical coverage or the ability of partners/ organisations to provide pre-financing. In one case it was mentioned that the search

for ‘new’ partners took a long time (one and a half years). Once it was also noted that existing strong social networks have made the expansion of partnerships and cooperation more difficult. From one project it was reported that the inclusion of new partners has delivered communication problems and has delayed the project.

Table 25: Strengths and weaknesses of transnational project cooperation

Acronym	Strength	Weakness
BWC territorial and knowledge interests broad interests	Ex-ante: Open-mindedness of partners; Familiarity among partners (based on earlier cooperation). Ex-post: Emerging understanding that there are different means and paths to the same goal	Ex-post: Amount of partners: There were too many partners; Diversity of interests (too divers); Lack of commitment.
CaRe-North Dominant territorial interest medium	Ex-ante: Capability of the lead partner (confidence through the partner’s experience and success in earlier transnational cooperation) Familiarity among partners (based on earlier cooperation) Ex-post: Emerging confidence in the partnership	Ex-post: Initial unfamiliarity among some partners, resulting in a lack of awareness of capabilities of partners. Lack of analytical capacity; Difficulties of academic partners to persuade other partners of the value of their work.
North Sea – North Sea-SEP territorial and knowledge interests broad	Ex-ante: Heterogeneity of partner interests (perceived to be crucial to meet project objectives) Ex-post: Heterogeneity of partner interests Multiple perspectives and competencies improved solution and project outcomes	Ex-post: Barriers to communication and decision-making, processes took long; Amount of partners (too high) Diversity of interests (lack of shared objectives) Lack of strict and coherent moderation in decision making processes
IFP economic and territorial interests broad	Ex-ante: Amount of partner Diversity of interests	Ex-post: General lack of agreement; Differences in national policies and different public administration (formed barriers to agreement and the development of tools); Personal changes in governmental organizations (caused delays).

Table 25 continued

Acronym	Strength	Weakness
NSSC economic and knowledge interests medium	Ex-ante: Familiarity among partners (based on earlier cooperation); Geographic coverage (cooperation with the Baltic Supply project); Access to companies to international markets through the involvement of BDOs; Ex-post: Geographic coverage (cooperation with the Baltic Supply project);	Ex-post: Lack of focus, agreement on sectors and activities could not be reached; Lack of partners with knowledge of the project context (existing data sets and tools) Lack of geographic coverage (some regions were underrepresented, partners were not sufficiently involved) Lack of involvement of companies, Lack of transnational cooperation (business networks turned out to have less access to international networks than expected, partially based on legal conditions) Lack of motivation (some partners participated for practical (funding) reasons only
BioChar Dominant knowledge interest specific	Ex-post: Well focused (focus was sharpened in the course of the project); Concentration of specific knowledge and expertise (turned out to be ideal in retrospect); High degree of consensus and agreement.	Ex-post: Lack of partners with link to policy makers and politicians
Enercoast Economic and knowledge interests specific	Ex-ante: Differentiated interests and expertise. Ex-post: Common strategic and methodical umbrella; Preparedness and commitment of the partners.	Ex-post: Administrative and operative policy frameworks (weakened the project's partnership structures and outcomes).
E-harbours Territorial and knowledge interests specific	Ex-post: Complementarities among scientific knowledge and technical expertise, Capability of public authorities to reach a large audience, Awareness of partners of issues in their own country	Ex-post: Missing knowledge on legal and market perspectives; Missing transnational perspective, lack of framework to integrate results.

7.2.4 Conclusions: Transnational Cooperation and Learning in Projects

Summarizing perceived ex-ante and ex-post strengths and weaknesses of partnerships a number of observations can be made. A diversity of interests has – ex-ante – been generally appreciated and has – ex-post – often enriched the repertoire of knowledge of single partners: learning within projects. Reaching high levels of learning has, however, required additional efforts in early project phases and in the form of common frameworks and communication. The specificity of interests was therefore an asset of transnational cooperation. This has helped to avoid disagreement among partners.

An important barrier to achieve high levels of learning in partnerships with a territorial scope was the diversity of planning and administration systems in countries. A barrier to cooperation among partners with economic interests was their (inherent) territorial interest that is often not made explicit.

The familiarity within partnerships was highly appreciated but has also been a barrier to an enlargement of cooperation which would entail an increase of territorial coverage. Projects with a clear dominant interest have sharpened their focus in respect to this interest.

7.3 Transnational and European Learning through a Cluster Approach

7.3.1 Introduction: the cluster approach

In previous INTERREG B programmes transnational projects have been carried out predominantly as stand-alone projects although contacts and cooperation between projects with similar aims and objectives have always been encouraged. Under the 2006-2013 NSR Programme this took the shape of the so called cluster approach. Briefly described, a project 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.[6]

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 any 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 NSR INTERREG programme in general.[7]

In October 2011 the NSR programme started with the implementation of the first cluster project. Altogether the programme has implemented five cluster projects lasting a relatively short time when compared with individual projects: 18 months. Two clusters focused on energy. Energy Vision North Sea Region (EVNSR) had renewable energy production as main theme. Low Carbon Regions in the North Sea (or LOWCAP) focused on energy efficiency and carbon reduction, so in general how to mitigate some of the general effects of the production and use of traditional (fossil) energy sources. The two clusters were seen as being complementary.

7.3.2 Transnational cluster arrangements

Cluster composition

EVNSR was the largest cluster of the two NSR energy clusters. It included 4 partner projects: BWC, IFP, North Sea-SEP and NSSC. Altogether 12 partners were included from all NSR countries except Norway. Most partners came from the Netherlands – 5 in total – which makes this cluster project somewhat territorially centralised.

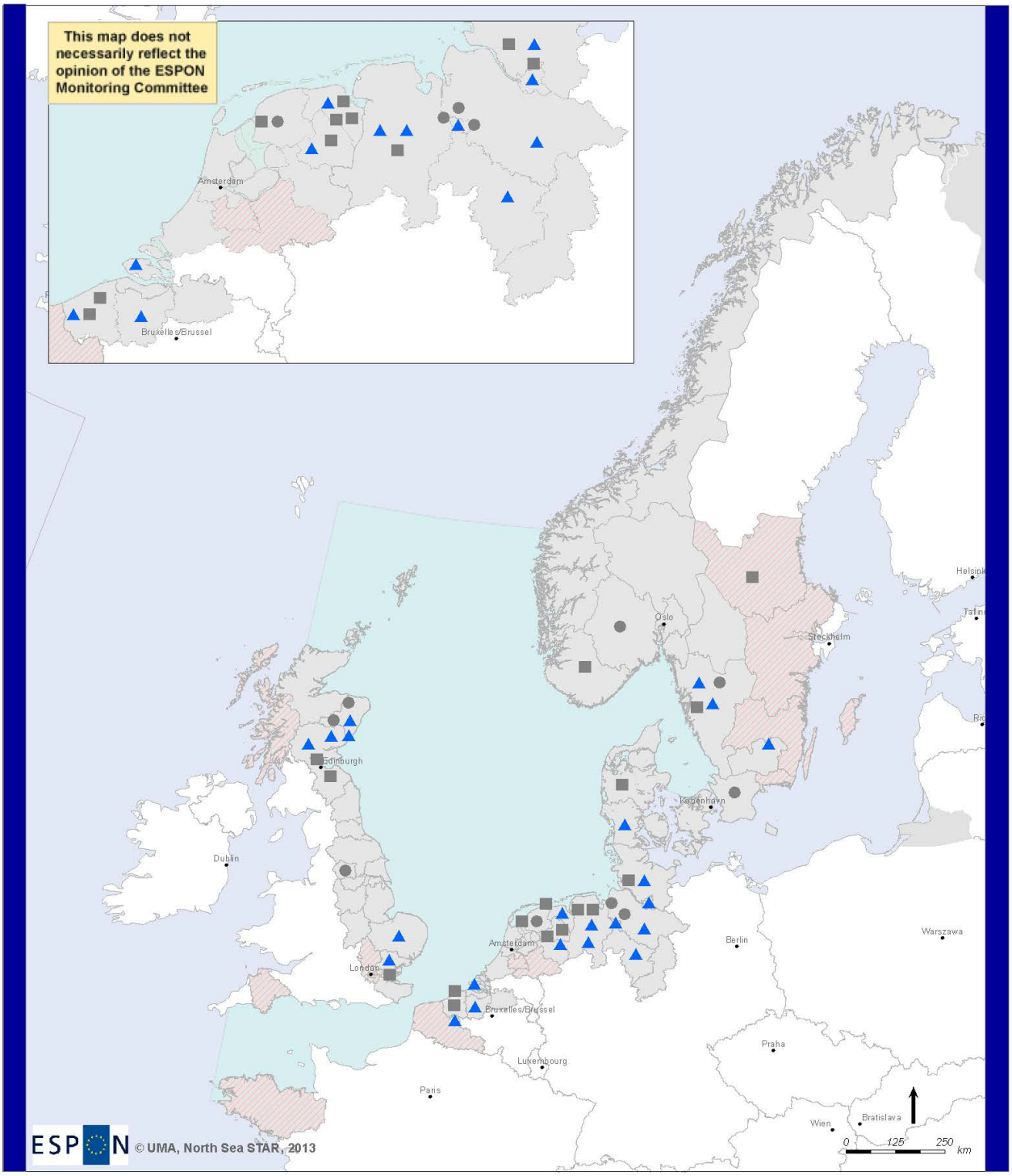
LOWCAP also included 4 clustered projects. Two of these were also included in EVNSR: BWC and North Sea-SEP. CaRe-North was the third partner project and the CCS project (Carbon Capture and Storage) the fourth one (not included in our case study analysis). Altogether 8 partners participated from four of the seven NSR countries: Belgium, Germany, Norway and the United Kingdom. So in terms of partnership LOWCAP was smaller than EVNSR.

[6] http://www.northsearegion.eu/ivb/events/show/&tid=61; accessed 10 October 2013

[7] http://www.northsearegion.eu/ivb/events/show/&tid=61; accessed 10 October 2013

Both clusters ran almost parallel to each other. EVNSR started mid-January 2012 and ended at the beginning of July 2013. LOWCAP started and ended half a month earlier. The beneficiaries of both clusters are mapped in three maps (18, 19 and 20, below). Note that when a project is becoming part of a cluster not all (former) members of this project become a beneficiary in the (new) cluster. Also clusters can have beneficiaries which have not participated in any of the (former) individual clustered projects. A good example is the Dutch Energy Valley foundation which was the lead beneficiary of the EVNSR cluster but did not participate in any of the clustered projects.

Distribution of Project Partners Represented in the EVNSR and LOWCAP Clusters



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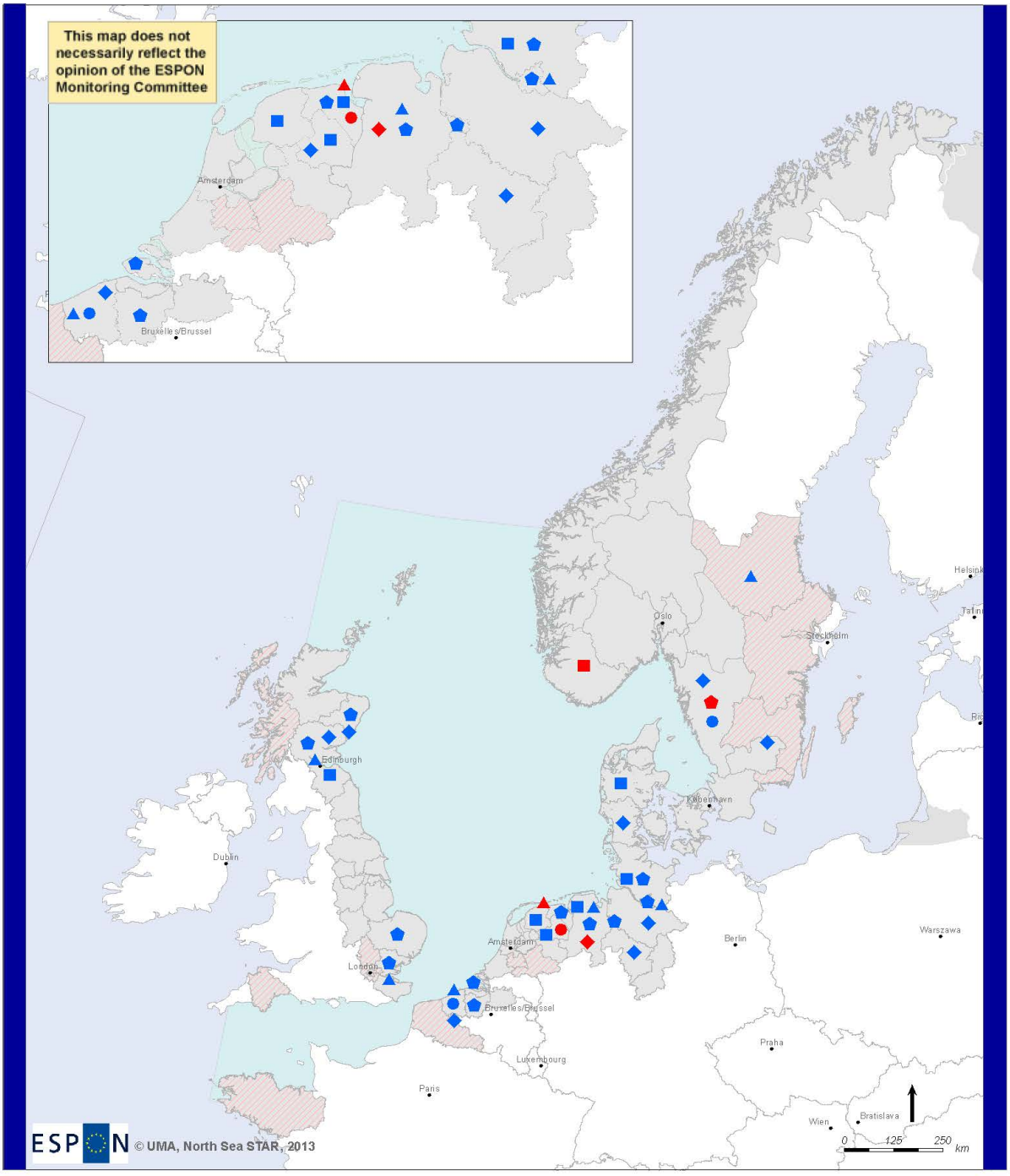
Thematic data: North Sea Region Programme energy projects by NUTS2 regions
Land boundaries: © EuroGeographics Association and ESRI. Regional level: NUTS2.
Sea boundaries: OSPAR Convention, EU Integrated Maritime Policy and EEZ.

North Sea Region Programme energy projects part of EVNSR and LOWCAP clusters

- Part of LOWCAP cluster
- Part of EVNSR cluster
- Part of LOWCAP and EVNSR clusters
- Regions covered by the North Sea Region Programme
- Regions outside the North Sea Region Programme

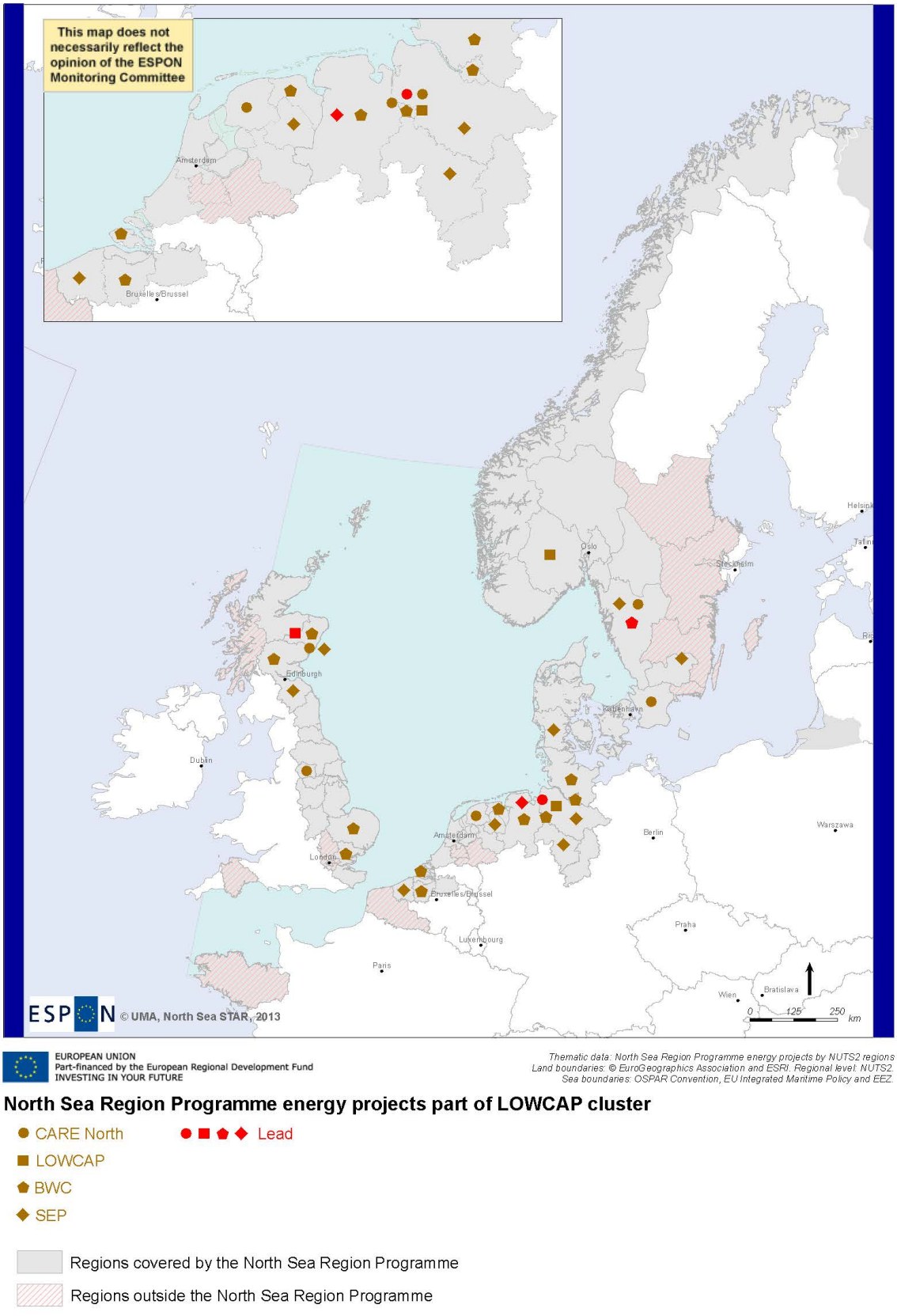
Map 18: North Sea Region Programme Beneficiaries in Energy Clusters EVNSR and LOWCAP

Distribution of Project Partners Represented in the EVNSR Cluster



Map 19: North Sea Region Programme Beneficiaries in Energy Projects Part of EVNSR Cluster

Distribution of Project Partners Represented in the LOWCAP Cluster



Map 20: North Sea Region Programme Beneficiaries in Energy Projects Part of LOWCAP Cluster

7.3.3 Reasons for participation and non-participation

When we take a closer look at the projects which participated in energy clusters the respondents in the case studies 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 specific reason to participate was mentioned in relation to the NSSC project: to make available a database of North Sea Region companies involved in renewable energy – an important achievement of NSSC – so they could become a target group for EVNSR. As we will see this did not materialise. A less frequently mentioned reason to participate was the expectation to increase the lifetime of a project. This is not considered as a very legitimate reason to set up or participate in a cluster, although apparently it can be an additional stimulus to do so.

Reasons for non-participation in cluster cooperation are highly 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. This is related to the focus of these projects. BioChar is seen by project beneficiaries as a project about technology and technological innovation and experimentation while the emphasis within a cluster is on raising the political profile of project approaches. In relation to BioChar this was apparently seen as premature. Also the limitation to the North Sea Region was seen as not very logical.

Also mentioned as a reason for non participation by beneficiaries – this time in the EnerCOAST project – was the expectation that a certain sense of conflict and competition could enter the partnership. This might have to do with the (intellectual) ownership of EnerCOAST solutions as only some of beneficiaries of the project partnership would be expected to participate in a cluster rather than all.

Besides these sensitivities also 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 in at least two of the non-participating projects was that contacts with other projects were a (good) alternative for cluster participation. Table 26 below summarises the main reasons given for (non) participation in clusters by representatives of each project.

Part of the interview questionnaire was the question whether with hindsight non-participation is now seen as a missed opportunity. While expectations and perceptions are connected to a decision about participation before the start of a cluster this question is ex post: is there any sort of regret that a project was not included in one of the clusters? Indeed this has been the case as mentioned by a small number of respondents related to e-Harbours. When this project was in an early phase they were not aware of the possibility to participate in a cluster. These respondents did not relate this to poor communication within the project partnership

or between the partnership and the North Sea Region Programme, but they might have proposed to participate in one of the energy clusters or, alternatively, the maritime transport cluster.

Table 26: Reasons for (non)participation in clusters

Cluster	Project	Reasons for (non)participation
EVNSR	IFP	Bringing together renewable energy projects: learning from other projects and raise the impact of the IFP project
EVNSR	NSSC	To make available a database of NSR companies involved in renewable energy so they could become a target group for EVNSR
LOWCAP	CaRe-North	1) Possibility to take Care-North issues to a higher political level: higher potential political impact; 2) possibility to upload political recommendations/messages.
Both clusters	North Sea-SEP	Main reason to participate in both clusters: possibility to bring carbon reduction/energy efficiency issues to a higher political level and contribute towards societal debate LOWCAP: additional learning possibilities resulting from participation of other carbon reduction/energy efficiency projects
Both clusters	BWC	1) Learn from other projects and higher potential impact on decision-makers and 'implementers' in the public sector; 2) possibility to extend life-time of existing projects
Stand alone	BioChar	Reasons for non-participation/perceptions about added value cluster: 1) BioChar as a project focused on technology/research less suitable while cluster is about sharing practices & learning; 2) doubts about restricting cluster approach to NSR area
Stand alone	EnerCOAST	Reasons for non-participation: 1) no perception of any added value; 2) fear that a cluster would claim some of the marketing rights of the achievements of the project; 3) fear that participation would lead to tensions within the partnership; 4) contacts and liaisons with other energy projects in cross-border areas and other transnational areas were a viable alternative
Stand alone	E-harbours	Reasons for non-participation:1) pragmatic: project just started while cluster were well under way; 2) project was part of an informal cluster of projects with similar aims; 3) differentiation between projects in cluster probably too high for fruitful exchange and learning

7.4 Assessment of cluster experiences and learning

7.4.1 The EVNSR cluster

The EVNSR cluster has a strong base in the Netherlands as mentioned above. A prime reason that the Dutch Energy Valley foundation became the lead beneficiary was that this foundation already had experience with formulating an energy vision.

Nevertheless as the cluster projects were not known by the Foundation one of the first tasks was to become familiar through analysing them. In general the cluster formed a twin approach: analysis and communication. The analysis was about possibilities to technically integrate renewable energy systems and infrastructures. The communication strategy was eventually connected to the making of the energy vision.

To find the right sort of balance between these two different approaches was quite a challenge, as the double focus of the project was difficult to deal with within the timeframe and the budget of the project. So clustering projects within one overarching cluster project is one thing, to find a joint feasible strategy and focus is another. Exemplary for this is that the anticipated use of a company database originating from the NSSC project eventually did not take place. Respondents also put some question marks behind the communication strategy: a second round of communication about the results of the projects participating in the EVNSR is not considered particularly useful as this duplicates dissemination activities undertaken in these projects.

Not all cluster partners participated to the same extent. EVNSR was dominated by the participating organisations from the northern part of the Netherlands. So there was a kind of inner and outer circle of cluster project and cluster participants. We have not come across any negative appraisal of this situation. However, most partners of the IFP and NSSC seemed to be only partially or even marginally involved. Quite a number of respondents in our case study research did not have a clear image of what EVNSR was about or was doing. Similar observations can be made about the LOWCAP cluster.

7.4.2 The LOWCAP cluster

The LOWCAP cluster was a project of a different scale when compared with EVNSR: less partners involved. Nevertheless there have been some issues when defining the focus of the project. Respondents record a kind of mismatch between the three low carbon and efficiency projects which try to stop or substantially reduce carbon emissions at the one hand and the Carbon Capture and Storage (CCS) project at the other hand. The inclusion of CCS proved to be somewhat contentious: CCS is an end of pipeline technology and not fully tested.

There also seemed to have been a shift in the general direction of the cluster. Originally it was the intention that LOWCAP like EVNSR would provide input for the next Operational Programme for the North Sea Region. This became less urgent. Instead the recommendations of LOWCAP became the object of general public consultation and did not have their foreseen targeted impact, i.e. on the next NSR Operational Programme.

Like EVNSR not all partners of the individual projects have been involved. As the emphasis on dissemination became more important it became less opportune to get research institutes involved. In some case it proved to be difficult to get the involvement of partners if their individual project was already finalised. The

organisations and institutions that were involved also did not participate to the same extent.

7.4.3 Two clusters or one?

We have seen that is was not easy arrive at a joint approach within the two energy clusters. Quite a number of respondents nevertheless express 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 situation. It is interesting to have a closer look at the two projects which participated in both clusters. Respondents from BwC did notice overlap between the clusters while separate foci for both clusters would have been much better. A response from North Sea-SEP puts the emphasis on the challenges of participating in two clusters: if it would be possible to do things all over again participation in only one cluster would have been better.

7.5 Conclusions

We have summarized the most important statements of case study respondents about cluster involvement and experiences in a summarizing Table (27).

Table 27: Experiences and learning within the two energy clusters

Cluster	Project	
EVNSR	IFP	No great role for project partners in cluster, apart from IFP lead partner
EVNSR	NSSC	1) database not needed; 2) most NSSC partners not involved in cluster, partly because tangible cluster outcomes insufficient to justify expenditures; 3) cluster sometimes used to extend lifetime of project
LOWCAP	Care-North	1) Care-North acquired sufficient political backing on project level (cluster not really needed from this perspective); 2) cluster provided an additional dissemination channel
Both clusters	North Sea-SEP	One energy cluster probably would have been enough If to start all over: only participation in one cluster
Both clusters	BWC	crossover/overlap between both clusters, so one cluster might have been sufficient; in case of two clusters: each one should have a clear/separate focus, which would have made added value for participants more clear. perception of cluster concept is to feed up ideas, instead clusters have been used to disseminate project results while individual project already had sufficient dissemination extensions

It looks like there have been a shift in the rationale of the cluster approach: originally – at least partially intended – to provide building blocks or inspiration for the new 2014 North Sea Region programme the clusters seemed to have become projects in their own right. As the diversity of projects brought together under the umbrella of clusters in both cases proved to be quite high only certain parts of these projects seemed to have been used. Finding a non-contentious joint approach 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 to combine approaches which although not fully opposing each other, on the other hand do not seem to combine easily in their logic. Looking at participation we see – formulated in straight terms – leaders, followers and a considerable amount of (limited) participation.

7.6 Recommendations Emerging from the Case Studies

In light of the evidence presented through the case study analysis, the following recommendations can be made:

Stimulate project initiators to invest in sound methodological approaches early on in projects.
When comparing expected and realized project results, it turned out that projects with a more sound methodological approach toward the integration of interests from several domains have been generally more successful. Specifically successful were projects in which such an approach was developed at a very early stage of the project. Barriers to the construction of common frameworks and methodologies are often rooted in territorial conceptions that have not been made explicit at early stages in the project cooperation. Increased attention toward approaches that are methodologically sensitive should be given in applications already.

Social networks: acknowledge the value of social ties in forming project partnerships.
Most project cooperation has been built up on earlier cooperation among partners. Pre-existing social ties have frequently been seen as an asset, also in ex-post evaluations of partnerships. They have made communication faster and easier and action more effective. Sometime existing social ties have formed barriers especially in cases where the geographical coverage has expanded. Partners that were added to already familiar partnerships were often chosen for pragmatic reasons: they were 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. To recognize the added value of existing social ties in partnerships allows for assistance to increased geographical coverage.

Cluster formation: encourage emerging transnational cooperation across the boundaries of the existing transnational regions.
Project results have been disseminated not only through the cluster projects but also frequently (in effect more often) through the engagement of partners/partnerships in other forms of transnational cooperation. Some partners 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. Other partners have chosen to sustain successful cooperation through engaging in other projects within the North Sea Region. To systematically take

account of such engagement can help to identify clusters of projects, less focused on thematic scopes, more focused on the quality of transnational cooperation. A flexible approach to the North Sea Region boundaries is a necessity to such an approach. This flexibility has been frequently described as a desirable feature of future cluster projects.

Cluster approach: Balance expected results with funding and time provided.
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 cases based on regional specialization) indicate refined and promising strategies.

Cluster partnership: Prepare partners for cooperation and start clusters early.
Many partners stated that they neither knew other partners, nor the scope of their work when engaging in the cluster project partnership. This condition has favoured the formation of 'partner clusters' within clusters, partners that already knew each other and that were perceived by others as dominant. The unfamiliarity in cluster partnerships has also led to fast drop-outs. Partners that saw their interests disregarded did not claim them but retreated. 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. It might be worthwhile if a cluster approach is continued to start clusters earlier: it seems that defining the focus of a cluster can take quite a while. For the sake of a clear focus it would be desirable to avoid combining projects with diverging objectives.

Energy transition: Strengthen the economic perspective on energy transitions.
Attempting to incorporate an economic perspective on energy transition has been at the core of some projects. The analysis of these projects has identified barriers in bringing such interests to the forefront. Institutions with economic interests in energy transitions are diverse, frequently complex and often still in a state of formation. To incorporate such institutions has in several projects led to misunderstanding, disagreement among partners and long lasting searches for a project focus. To encourage such institutions to express their (territorial) interests, the problems they meet and the capabilities they have at an early moment in partnership formation can help to avoid conflict and delay at later stages of projects and inform a better understanding of the performance of such institutions in projects.

Evaluation of project and project applications: Improve descriptions of project partners.
The performance of transnational cooperation has been a central issue in this case study research. To assess the qualities of transnational partnerships and consequently learning has been challenging. The challenge has been increased by some practical circumstances, including uncertainty about participating partners. Project applications and other initial documentation have focused on thematic

priorities and the relation that project results have to those. It was frequently difficult to investigate which concrete partners were involved, what their specific interests and expectations in projects were and which knowledge they were intending to contribute. In the analysis, specifically the interviews, it turned out that these aspects were often explanatory for the achievements and within projects. To incorporate aspects that potentially influence the performance of transnational cooperation in project applications is there for crucial: does the profile of the partners in the partnership match with the ambitions?

8. North Sea and European Transnational Policy 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 programme and we are pleased to see that energy perspectives are strongly represented in the three axes that have been put forward and in the associated discussion of investment priorities. It is hoped that the North Sea STAR project has provided a useful input to these efforts. Now that the broad priorities of the Programme have been outlined, it seems appropriate to focus the project's final recommendations on matters related to future project development and evaluation, programme management, and 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 the European Union and national governments. The recommendations are justified with evidence drawn from the various work packages including: the baseline mapping and updating of the current energy situation; transnational energy policy and project mapping; the scenario building work; case study review of energy projects and clusters; and the stakeholder sparring activities.

Project Development and Evaluation

1. **Energy projects in the new Operational Programme should be directed towards delivering a 'Zero Carbon Society'.**
   Target audience: North Sea Region 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 approved the methodology behind the scenarios and 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 2050*. By adopting this as the goal for the 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 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. However, in line with the 'zero carbon society' ambition it is suggested that the programme should look beyond conventional solutions to achieving energy efficiency and be careful to direct its limited resources to developing innovative new approaches. Direct interventions in energy pricing mechanisms are not envisaged as these are national matters beyond the scope of programme intervention.

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 Region Programme Secretariat, Programme Beneficiaries

It is important to note that in the stakeholder sparring sessions it was also 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 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 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. Outputs from the ESPON funded ReRisk project could provide useful inspiration for partners in this context.

3. **The new North Sea Region 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 efforts should be made to encourage such institutions to express their interests, the problems they meet, and the capabilities they have at an early moment in partnership formation to inform a better understanding of the performance of such institutions in projects and to help avoid conflict and delay at later stages. 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 North Sea STAR Scenario 2 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 could address these in order to break out of 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 to the more radical zero carbon society energy transition 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 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 toward the integration of interests from several domains were generally more successful. Particularly successful were projects in which 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. It is therefore recommended that increased attention toward project methodology should be given in project development and evaluation.

A key aspect here should include a clear description of the role of individual project partners. This point has emerged from consideration of the strength of transnational cooperation in the case study research and assessment of this has been challenging. The challenge has been increased by some practical circumstances, including uncertainty about the role of participating partners. Project applications and other initial documentation tend to focus on thematic priorities and the relationship that project results have to those. It was frequently difficult to investigate which concrete partners were involved, what their specific interests and expectations in projects were and which knowledge they were intending to contribute. In the case study interviews it turned out that these aspects were often explanatory for the project achievements. To incorporate aspects that potentially influence the performance of transnational cooperation in project applications therefore seems crucial: does the profile of the partners in the partnership match with the ambitions? Equally are all partners clear about their role within the wider picture and the role of others?

In developing or evaluating project methodologies another factor to consider 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. 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 could be included in the new 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. For example, it was recommended that project activities should help to 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 by building thoughtful stakeholder engagement and dissemination strategies into the project design. 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 varied

greatly and that approaches need to be tailored appropriately recognising for example that a proliferation on ongoing networks was not necessarily desirable.

Programme Management

7. The concept of project clustering and cooperation should be maintained and enhanced as part of the next North Sea Region 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 felt that clustering can add value by helping projects talk to each other, learn from others' experience, develop wider synergies and a more holistic perspective; and provide greater collective weight and influence for project results. As a consequence it is suggested that the approach should be retained as a feature in the new programme. This recommendation also supports the interim conclusions made by the North Sea Region Programme's On-going Evaluation which also recommends the continuation of clusters in the next Operational Programme.

8. Consideration could be given to developing different models of clustering/cooperation in the new 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 partners under the current 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 also felt that there could be benefit in combining top-down cluster formation with bottom up approaches where project partners can extend or build clusters themselves as there was some experience that this produces good results. Flexibility was frequently described as a desirable feature of future cluster arrangements. The outputs of the ESPON funded TERCO project could be informative in responding to this recommendation.

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. Partners that saw their interests disregarded did not claim them but retreated. 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. It might be worthwhile if a cluster approach is continued to start clusters earlier: it seems that defining the focus of a cluster can take quite a while.

This latter theme was a particular feature of discussions at the final stakeholder sparring workshop in Delft where it was felt that greater clarity in establishing the purpose of clusters from the outset or at an early stage in cluster formation would be beneficial. In addition it was suggested that that this could usefully be connected to greater clarity in the specification of their outputs in order to provide a clear focus and direction to cluster activities.

10. Balance expected 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 could be given to more consistent approaches to central dissemination of project results in the new 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 when projects have finished would be to encourage a more systematic approach to dissemination of project results. As noted

above at present project websites can disappear after projects close and collation of information on the North Sea Operational Programme website is variable. This means that wider and on-going learning from project results can be compromised. To improve this situation consideration could be given to requiring all projects to produce a synthesis report which can be made available on the programme web portal. Stakeholders described this as the creation of a central infrastructure for dissemination like an E-library of project results. Experience from ESPON in specifying project outputs and the use of synthesis publications could be drawn upon here in thinking through possible approaches.

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 because it is collected in slightly different ways in different national jurisdictions it is impossible to consolidate into a picture of what is happening across the region as a whole. Particular issues concerns inconsistencies in the units of assessment used and varying interpretations of terminology. For the project this has meant that it has been impractical to develop energy scenarios that were quantitatively informed. Progress on this and other fronts will require more consistent data inputs. In addressing this area, findings from the ESPON funded TranSMEC project could be useful as well as those from the project Territorial Trends of Energy Services and Networks and Territorial Impact of EU Energy Policies.

9. Areas for 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 and three areas seem to merit particular attention.

First, 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.

Second, 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.

Third recommendations related to greater harmonisation and standardisation of approaches to energy data could potentially benefit from an input from the research community. Varying use of terminology and units of assessment across the North Sea region reflect different contextual factors in member states and well informed harmonisation proposals that understand the reasons for the current situation and scope for practical change are needed to make real progress. The research community seems well placed to make a valuable independent contribution here.

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