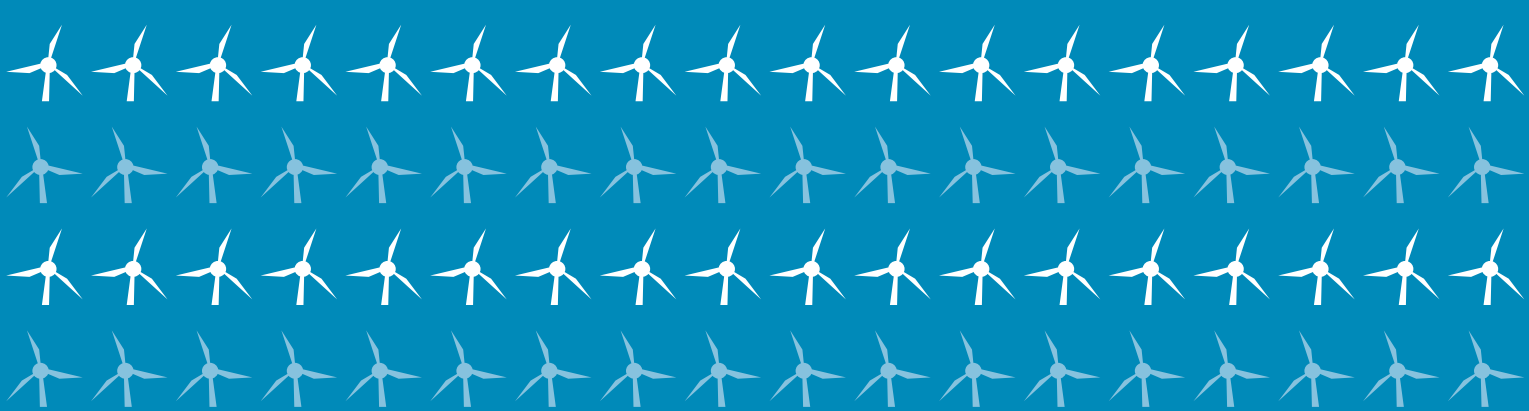
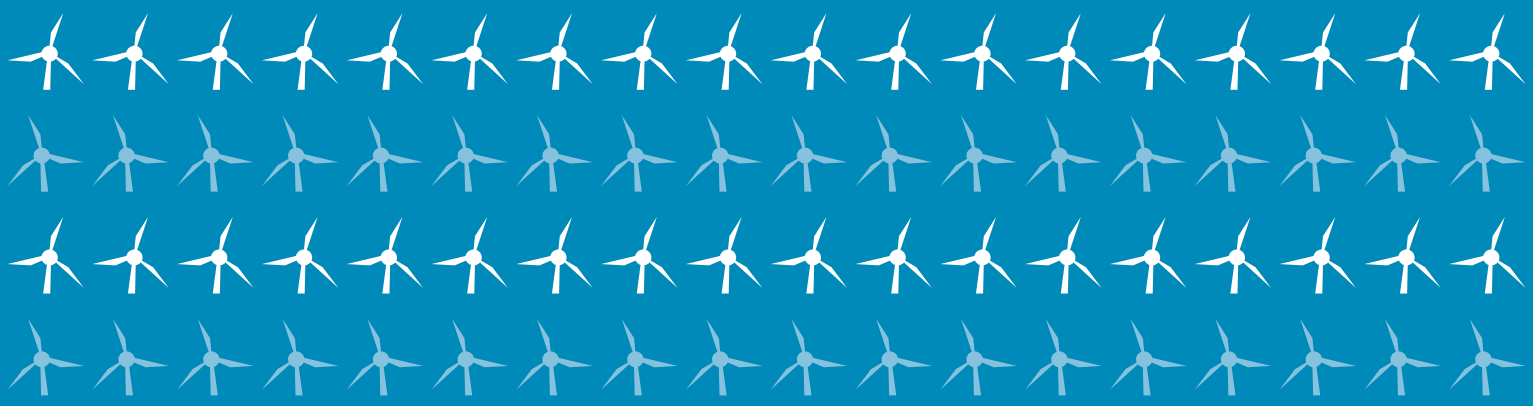
NORTH SEA
SUSTAINABLE ENERGY PLANNING

THE FINAL COMPENDIUM

CHAPTER II – BASELINE PAPERS





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1 THE NORTH SEA – SEP COMPENDIUM

All of the following influence the degree to which different interventions for sustainable energy may be relevant and successful: the diversity in existing energy systems, local energy resource potentials, the organisation of energy provision, the built environment and the context of regional and national government powers, relationships and policies. Because of that, as a basis for the North Sea – SEP project, all participating regions have carried out baseline studies and produced baseline papers with fundamental facts on the national and regional energy situation. The aim of the baseline studies is to gather information from the regions as a starting point for further eloborations of studies and comparisons between the regions. To make it easier to compare the facts, the most important parts of the Papers are compiled in a synopsis.

After a short excurs on the general approach of baseline studies and papers the project regions will be introduced, giving an idea on the general background of the partners and their geographic, social and economic preconditions. This is followed by a comprehensive description of the general energy status quo, stating facts on the energy infrastructure of the partner countries and regions. Chapter 5 gives an outlook on the organisation of energy production and supply and important market characteristics. This includes potentials in the production of renewable energies as well as appropriate economic potentials.

The information from the baseline studies were taken to develop the regional energy strategies (see part III Energy Strategies), develop and/or support energy networks (see part IV Regional Networks), to identify the need for and develop methods and means for raising awareness and knowledge regarding sustainable energy planning (see part V Teaching) and to develop concrete business cases in this context (see part VI Business creation).

2 BASELINE STUDIES – THEORETICAL APPROACH

2.1 What is a baseline study?

Baseline studies can be either used as starting points for evaluation and monitoring processes or as the basis for further research and development/planning activities within a project. For North Sea – SEP the baseline studies were conducted to collect basic information on the regions involved in the project and on their general and energy related preconditions. The baseline studies were the first step that had to be taken for the development of energy strategies, regional networks and other activities within the project. A baseline study involves providing a snapshot of the status quo concerning a certain topic in a region at a given point of time. This includes the identificiation of available information or data, needed for further activities.

2.2 How to conduct a baseline study?

The baseline studies in the North Sea – SEP project were conducted respecting a certain scheme, a set of questions that was used as a guideline by the single regions. Thus it was possible to compare the regions, to compile different facts and make them available in a comparing manner in a synopsis report. The baseline studies were conducted by the partners, using their sources of information, existing reports, documents, studies, strategies etc. on energy development in regional and national context. Including expert input was also a vital source of information and data. However, it was not the aim to gather as much numbers and exact calculated indicators as possible, but rather to give a good and reliable overview on the status quo regarding predefined categories that were chosen and considered interesting and important for this project. An important step was for each partner to provide an exhaustive list and documentation of sources used for conducting the studies and creating the report. This is important in order to be able to make comprehensible statements.

2.3 Content of the baseline studies

The questions for these baseline studies were categorised in eight main topics:

1. Energy infrastructure
   This includes questions on the sources, generation technologies and delivered forms of energy, the approximate shares held by each in the supply mix and in the major market segments, the amount of heat and electricity produced from renewable sources (and of which sources), how much the region relies on energy imports and if there are any major/unusual energy consuments in the region.

2. Organisations and markets
   In this section questions concerned the general organisation and owner structure of the energy infrastructure and how the responsibilities are distributed among relavant actors. This also includes information on market structures, the provision of decentralised energy equipment, energy-related materials, building services, the import of energy, typical business models, the involvement of national (and international) energy supply companies and intermediaries (industry and professional associations, energy advisers and auditors, architects and designers, specifiers, wholesalers and distributors, energy services companies, social housing agencies, community groups and charities, landlords, etc.), the involvement of different groups in community-led energy initiatives, and key factors affecting consumer confidence in new energy technologies and services.

3. Built environment
   Typical pattern of settlement, proportions of urban, suburban and rural settlement, 6 housing types and ownership, organisation of construction of buildings, share of new buildings and renovation and actors for energy counselling are important aspects in this category, providing an idea of energy demand and supply preconditions for the built environment.

4. Government

Which aspects of energy provision are controlled by which levels of government? What agencies are involved in energy provision? (regulators, general and specific energy agencies, etc.) and to what extent is the implementation of energy initiatives left to charities, community groups and other non-government organisations (NGOs)? – These are the questions in section 4 of the baseline study.

5. Governance instruments

Here, information on relevant national and regional policies, their aims and influences, their achievements, actors involved, fields of action, their implementation and translation into concrete strategies, actions plans or measures, the address of special technologies, means and instruments for influencing energy provision, the overall integration of these into governance structures, regulation mechansims, attempts to influence energy user's behaviour and the potential of strategies to facilitate development of energy initivitiative are requested.

6. Economic, financial and fiscal conditions

What aspects of the taxation system affect energy provision? What specific financial support schemes are used in energy provision? What incentives are provided explicitly for micro- or decentralised electricity and heat generation? How are these funded and how well do they work? – These are the main question for the 6th category in the baseline study.

7. Industry capacity, innovation, skills

This section includes questions on:

- The organisation of energy related supply chains,
- The extent of addressing the development of energy-related industries by national and regional strategies,
- On research and innovation capacity in energy and the built environment present in the country and region,
- The sort of support for new industry creation and growth,
- Innovation,
- Employment generation in energy and the built environment and
- Knowledge and know-how related to sustainable energies in the region.

8. Energy issues and debates

The level of awareness, the most prominent issues and discussions, key actors for training and teaching processes, the consideration of different technologies, the level, consistency and effects of consultation on national and regional level, and the knowledge transfer from other countries and regoins are in the focus of this last section. These eight categories are concluded by remarks on categories of governance instruments and means for promoting and enhancing the overall situation and structure of sustainable energy production and provision on a regional and national base. Knowledge on this is important for the development of further and the enhancement of existing instruments.

3 THE PARTNER REGIONS

General facts and knowledge about the regions facilitate understanding different approaches and ideas concerning sustainable energy planning. Each region has its own preconditions that influence the different processes, stakeholders, interests and actor groups and that deliver different backgrounds and needs for further development. This is e.g. true for basic facts such as the population size, population density and the settlement structures, topographic and economic factors etc. These factors have a significant impact on energy demand and production and the potentials for the production of renewable energy. The North Sea – SEP partner regions that have provided baseline papers are:

- Kortrijk Region (Belgium)
- Sydjylland (Denmark)
- Lower Saxony (Germany)
- City of Oldenburg (Germany)
- Osterholz Region (Germany)
- Northern Drenthe (The Netherlands)
- Aberdeen Region (United Kingdom)
- Dundee Region (United Kingdom)
- Kronoberg Region (Sweden)
- Varberg Region (Sweden)

3.1 Kortrijk Region (Belgium)

The Kortrijk Region is situated in the South Western part of Belgium. It is a part of the Flemish speaking area. In particular, the region covers the Arrondissement Kortrijk and counts 282,130 inhabitants. The largest cities in terms of the population are Kortrijk (74,868), Harelbeke (26,761) and Waregem (36,593). In 1960, the 'Intercommunale Leiedal' was established as an association of communes located in the region. The people are mostly settled around the city of Kortrijk. The region shares both a boarder with France as well as with the French speaking part of Belgium.

The topography of the Kortrijk region is characterised by low lands and a tree less environment. Less than 1 % of the region is woodland. Furthermore, important highways cross the region and connect it directly to the Netherlands, especially to the harbour of Antwerp and Lille (France).

3.2 Sydjylland (Denmark)

The region Sydjylland (Southern Jutland) is a region in the Southern part of the Danish peninsula. It has a size of 855,154 ha with a population of 717,563. The biggest cities are Esbjerg (71,579), Kolding (57,540) and Vejle (51,804). The degree of urbanisation is relatively low; the region is signified by rural settlements. On the other hand, important highways cross the region and connect it with Germany, the Danish Islands Fyn and Sjælland and with Sweden. The topographical structure consists of low land and a treeless landscape. Around 11 % of the surface is woodland. On the other hand, Sydjylland has a high amount of waterbodies in its landscape. Many small rivers and ship canals can be seen while crossing the country.

3.3 Lower Saxony (Germany)

Lower Saxony is a Federal State in the North of Germany and covers an area of about 48.000 km². Lower Saxony has a population of around eight million inhabitans and consists of 37 counties and 427 local authorities. The city of Hanover ist the capital of the state, has 525.875 inhabitans and is by far the largest city in Lower Saxony. Other larger cities are Osnabrück Oldenburg and Braunschweig. The degree of urbanisation is below the German average. Besides the aglomerations in the vicinity of the bigger cities there is still a sigificant number of people living in the countryside or in small villages. There are many different succesful economic branches located in Lower Saxony. The best known is the Volkswagen factory in Wolfsburg. Other important economic sectors are the harbours in the costal areas, energy economy and tourism. Also the production of agricultural goods contributes significantly to the added value chain of the State. Furthermore, the region is well-known as one of the busiest transportation hubs in central Europe. Important highways crossing the regions are the A2 (East- West) and the A7 (North-South). The topography of Lower Saxony is very diverse. In the coatsal regions large areas of grassland can be found whereas in the Southeast (Harz) wide woodlands and submountainous areas are common.

3.4 City of Oldenburg (Germany)

The city of Oldenburg is located in Lower Saxony in the Northern part of Germany. The municipality has a surface of 10,297 ha and 162,481 inhabitans. It is one of the biggest cities in the Federal State of Lower Saxony and had a significant growth in the last decades. Furthermore, a remarkable number of mediumsized enterprises is settled in Oldenburg. The topography of the municipality is characterised by a high amount of low land. The gross of the city is covered with buildings and infrastructure leading to a low amount of arable land and forests. Only around 3 % is woodland.

3.5 Osterholz Region (Germany)

The County of Osterholz is located in Northern Germany in the Federal State of Lower Saxony next to the hanseatic city of Bremen. It has a size of 65.070 ha and 111.718 inhabitans. Therefore, the County has a relativly low population density. In total, it consists out of seven municipalities. The biggest city in the region and administrational centre is Osterholz-Scharmbeck (29.978). This municipalitiy is the first project partner in the county. Other nameable towns are Schwanenwede (19.943) and Lilienthal (18.430). The topography of this region is characterised by low land and a relatively low amount of woodland. Only around 8 % of the country is covered with forests. The river Weser is located at the Western boarder of the region.

3.6 Northern Drenthe (The Netherlands)

The region Drenthe with its capital Assen is located in the Northern part of the Netherlands. The North Sea – SEP focuses mainly on the Northern part of the province, so that the general description of this project partner is mainly reduced to this specific area. The Northern part of Drenthe has a size of 104.657 ha and 189,643 inhabitans. The biggest city of this region is the capital of the province Assen with a population of 67.267. Other significant municipalities are the project partner cities Tynaarlo (32.359) and Noordenveld (30,878). The region Northern Drenthe has a low degree of urbanisation. In most cases Municipalities are formed by a number of villages and small towns, which were merged to bigger entities due to administrative reasons.

The Nothern part of the province of Drenthe is completely covered by low lands. The highest point of the province is 32 meters above sea level. The amount of woodlands is relatively low. Only around 11 % of the Northern Drenthe region are covered with woodlands. The arable land is intensivly used through farming, which is an important economic factor for the province. The province is involved, both at home and abroad, in various different partnerships with governmental organisations, which focus on stimulating economic activities. The House of the Dutch Provinces represents the interests of Drenthe in Brussels.

3.7 Aberdeen region (United Kingdom – Scotland)

The Aberdeen region is located in the Northeast of Scotland and has a size of 649,900 ha. It covers the Aberdeenshire local government council area and includes also the City of Aberdeen. In total, the region has a population of 462,900. The city of Aberdeen is by far the most populous municipality in the region with its 220,420 inhabitants. Other municipalities are Peterhead (17.873), Inverurie (12.447) and Fraserburgh (12.446). The topography of the region is characterised by mountains in the Western part and hilly landscape as well as low lands in the area around Aberdeen and in the North. Around 14 % of the country is covered by forests, which are predominantly located in the centre and the Southern part of the Aberdeen region. Furthermore, arable land is spread all over the region with a special emphasis on »The Garioch« located close to Aberdeen. Formerly, it used to be called the breadbasket of Aberdeenshire. Furthermore, the Don and the Dee are two nameable rivers.

3.8 Dundee Region (United Kingdom – Scotland)

The Dundee Region is located in the Western part of Scotland and has a size of 224.200 ha with a population of 254.860. It is formed out of the City of Dundee and the Angus local government council area. As well as the other Scottish partner Aberdeen, the concentration of the settlements is focused on the capital city and its surrounding areas. The gross of the population is concentrated on the city Dundee and the surrounding areas. Therefore, the largest cities in terms of the population in the region are Dundee (152.320), Arbroath (22.140) and Forfar (13.500).

The landscape in the Dundee region is significant, because of high and low lands. The land surrounding Dundee, particularly in the lower lying areas to the West and East of the city, bears soil of a high quality, which is particularly suitable for arable farming. On the other hand, mountains can be found in the Northern and Western parts of the Dundee region, which have a low population density. Only 7.5 % of the region is covered with woodland.

3.9 Kronoberg region (Sweden)

The Kronoberg County is located in the South of Sweden and represents the heartland of the province of Småland. It has a size of 943.000 ha with a population of 184.564. The population density is relatively low. The biggest cities are Växjö with 82.180 inhabitants and Ljungby (27.365). In general, the region has only a low number of settlements and many parts of the region are thus in their natural state. The Kronoberg County is characterised by a high amount of woodland. Around 64 % of the surface is covered by forests. Furthermore, the region is very watery. Many smaller and bigger lakes are visible in the landscape.

3.10 Varberg region (Sweden)

The Varberg region which is congruent with the Halland County is located in the South Western part of Sweden. It has a size of 571.900 ha and a population of 30.307. The biggest cities are Halmstad (58.577), Varberg (27.602) and Falkenberg (20.035). The settlements in the Halland County are predominately located at the coastal areas. The region around Varberg is characterised by a hilly landscape and a high percentage of woodland. Forests cover the gross of the Eastern part. In total, around 51 % of the County's surface is covered by forests.

4 ENERGY INFRASTRUCTURE IN THE REGIONS

Providing knowledge about the general energy infrastructure is also an important step towards planning processes for sustainable regional energy. This chapter provides a synopsis of the reports on energy infrastructures in the partner regions, thus giving an overview on the regional contexts and the various ways in which they differ in respect to factors influencing the local and regional energy supply and infrastructure. This paper necessarily provides a good view of the partners' contexts. The reader is referred to the individual baseline papers provided by each North Sea – SEP partner for more details. They are available via the North Sea – SEP project website: http://northseasep.eu/. Information concerning energy infrastructure is divided into five main categories: heat infrastructure and sources, electricity generation, energy imports and exports, renewable energy and information on ongoing developments and potential estimates. The partners' countries' energy mixes, infrastructures and dependency on imports are the result of different regional resources and historical decision pathways. Differences between countries have consequences for approaches to sustainable energy planning as new energy sources and practices face different competitors, and can make use of different existing infrastructures. In all regions, fossil energy sources account for the majority of primary energy sources, though proportions vary considerably, particularly for non-transport energy sources. Kronoberg reports the highest penetration of renewable sources: heat and electricity supply is based on 45 % Renewable Energy Sources (RES), with significant hydroelectric resources and use of biomass in district heating (DH) networks.

4.1 Heat infrastructure and sources

Natural gas is an important energy source in some regions. Both the UK and the Netherlands have large regional gas supplies (though the UK became a net-importer of gas in 2004; Domestic gas usage = 19,620 kWh/consumer; Non-domestic gas usage = 642 Mwh/consumer), and extensive gas networks in these countries meet the majority of the heating demand. Belgium and Germany are both significantly dependent on imports of natural gas to supply considerable proportions of heat demand. In Osterholz 75 % of urban and 40 % of rural heat demand is met by natural gas. Belgian gas network companies have been given targets of connecting 99 % of domestic buildings in urban areas to their central heating nets by 2020. Sweden has only a limited gas network, which doesn't reach Kronoberg. While natural gas networks may open up opportunities for injection of biomethane (where waste resources are suitable for production), DH networks offer opportunities for a range of heat and Combined Heat and Power (CHP) systems. Regions vary in the level of DH penetration. Sweden and Denmark have very high levels, and have correspondingly high levels of renewable heat and CHP. The UK and Netherlands in contrast, have currently only limited levels. CHP use in the Netherlands is relatively high, though most heat is used in industrial processes. Where gas or district heating networks do not serve space and hot water demands, those are met by different combinations of electric heating, oil, coal and micro-renewables (heat pumps, biomass boilers and solar thermal). In Sweden, for example, electric heating is the second common form (around 25%), and this accounts for around a third of the electricity consumption. District heating increased significantly during the last two decades. Today more than 90 % of approximately 1 TWh, used for district heating in Kronoberg, are produced from Biofuels.

4.2 Electricity generation

In most regions, electricity generation is dominated by centralised nuclear and fossil stations, though Denmark is an exception with a high penetration of small scale distributed generators. The following can be stated regarding the status quo of electricity production in the partner countries:

- Dutch electricity generation is predominantly based on gas and coal in an equal proportion.
- The electricity production in the UK has also high levels of gas and coal (around 45 % and 30 %) plus nuclear and a growing proportion of renewables (largely hydroelectricity in the North of Scotland, but with growing levels of onshore and, more recently, offshore wind).
- Danish electricity production shifted in the wake of the 1970s' oil crises from heavy dependence on imported oil to current high levels of coal-fired co-generation, however, meanwhile there is a considerable share of wind energy used for electricity production.
- The German electricity mix shows the greatest level of diversity, with nuclear and brown coal making up around a quarter each, black coal one fifth, renewables 15 %, gas 13 % and oil around 6 %
- Sweden's electricity generation is predominantly large scale, low carbon plant (hydro and nuclear) with a small renewable contribution. The electricity in Kronoberg region is up to almost 60 % generated from renewables inside and outside the region. In Kronoberg more than 20 % of the electricity demand is generated locally at wind power stations, hydro power stations, CHP plants as well as in industrial back pressure power plants.
- At a local scale, electricity production in Kortrijk is dominated by a large oil-fired power station, generally run on fossil-oil, though with around one fifteenth of input being palm oil. Electricity generation in Belgium is generally based on conventional thermal and nuclear sources.

The following table shows the share according to a Eurostat Survey from 2013.

	BE	DK	DE	NL	SE	UK
Conventional thermal	40,48	64,57	66,46	91,09	9,59	73,11
Nuclear	51,30	0,00	16,18	3,79	37,88	18,58
Hydro	2,22	0,06	4,63	0,10	48,11	2,37
Wind	3,82	35,37	7,91	5,02	4,41	5,94
Solar	0	0	4,81	0	0	0
Geothermal	0	0	0	0	0	0
Other	2,17	0	0	0	0	0

Table 1: Sources for electricity generation in the partners' countries, share of total in %
Source: Eurostat 2013 (http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Electricity_production_and_supply_statistics)

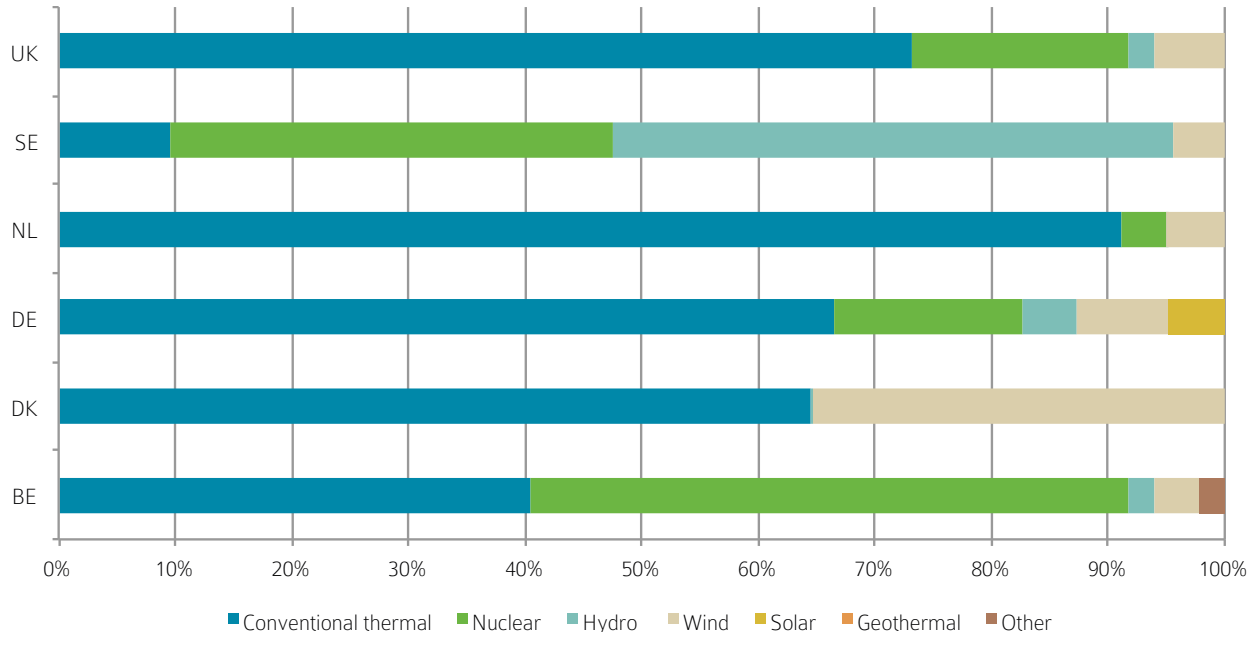

Figure 1: Sources for electricity generation in the partners' countries
Data source: Eurostat 2013 (http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Electricity_production_and_supply_statistics)

4.3 Energy imports and exports

Sweden and Denmark, along with Norway, Finland and Estonia, participate in the multinational »NordPool power exchange market«, a financial energy market for these countries. As the North Sea – SEP report from Sweden shows, annual net power flowing into NordPool countries can vary significantly around the average. In Sweden, imports and exports, taken over several years, roughly balance though annual fluctuations can be large. Participation in NordPool is identified as a factor supporting the high level of penetration of wind power in Denmark, as the power exchange allows Danish intermittent generation to be balanced by the flexibility of Swedish and Norwegian hydropower. Belgium is heavily dependent on external energy sources, imports accounting for around 95 % of primary energy consumption. Electricity imports are considerable at around one quarter of the demand. The Netherlands also import large amounts of energy, with imports accounting for three quarters of primary energy. However, a significant proportion of this accounted to Dutch oil refining, and 65 % of primary energy is ultimately exported. So while parts of the economy in the Netherlands are heavily dependent on energy imports, energy supply in the country is less so.
The UK became a net energy importer in 2004 and now imports around a third of primary energy supply. Since the construction of an interconnector with France in 1986, the UK has been a net importer of electricity, though this accounts for a relatively small proportion of UK electricity supply (less than 1 % in 2010). Power generally »flows« from Scotland to England (through another interconnector). Regional imports of energy create outward spending flows. The German county of Osterholz, together with a number of other North Sea – SEP partners, identifies this as a significant driver for undertaking regional energy planning, as greater exploitation of local resources can increase the proportion of energy payments, which stay within the regional economy. At present, up to € 150 million go out of the North Sea region in energy payments. Around 90 % of electricity consumed in the region is imported. In addition to cross border energy flows, energy technologies are important to a country's import/export balance sheets. This is particularly so in the case of Denmark, which is an international frontrunner in sustainable energy technology manufacturing. Danish exports total around DKK 65 billion (€ 8.5 billion), and account for 11 % of Danish exports.

4.4 Renewable energy

Penetration of RES varies across the countries, reflecting differences in regional renewable resources, regional industries, competing energy forms, infrastructure capacities (for example, district heating accommodates renewable heat sources at relatively large scales), and decisions taken within the energy industries and government (e.g. structuring energy taxes to favour certain aspects of energy systems over others). However, in all partners countries the primary production of energy from renewable sources increased from 2000 to 2010 (see Figure 2).

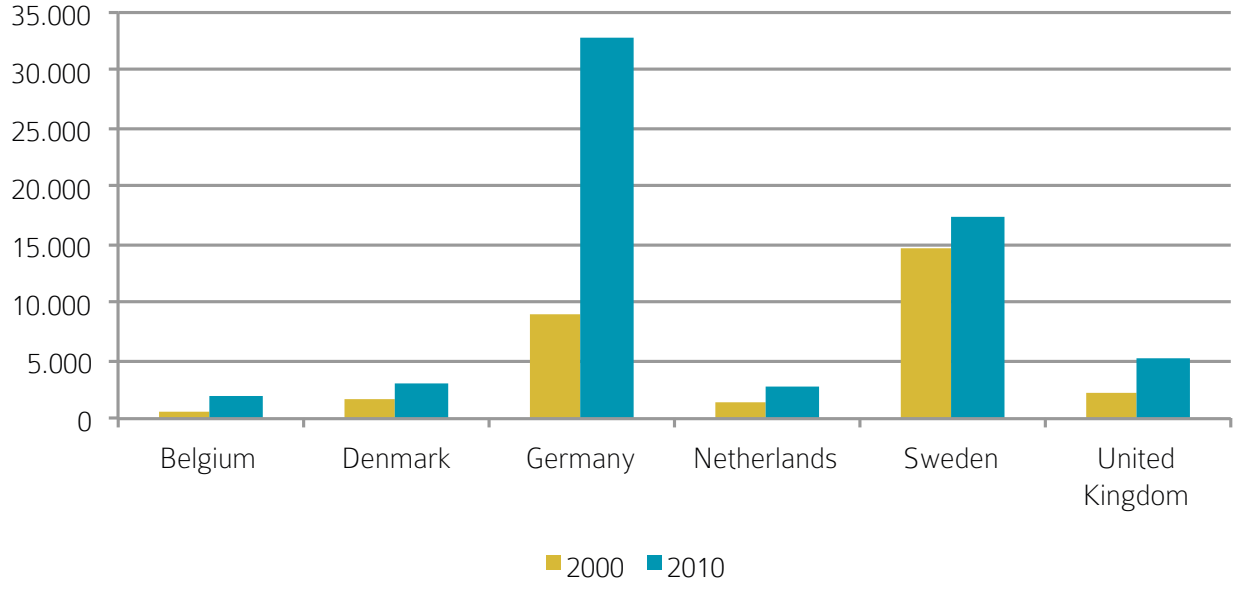

Figure 2: Primary energy production from renewable sources (in 1.000 toe) – 2000 and 2010
Source: http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Electricity_production_and_supply_statistics

In Denmark, 19 % of the energy consumption is served by RES. This is predominantly (around 70 %) biomass, used in cogeneration to supply electricity and district heating and in some heat-only-applications. (Biomass here is taken to include the renewable proportion of waste incineration.) Danish electricity production is around 30 % renewable – around two thirds of it is wind.

Sweden similarly has high levels of RES exploitation, using biomass in electricity generation and district heating, high levels of hydropower, but relatively limited penetration of wind power. Almost 60 % of electricity production in Kronoberg is derived from RES. RES similarly accounts for a high (45 %) proportion of overall energy supply, mostly biomass (two thirds). In Halland, around 69 % of the produced electricity is generated from RES: 9 % are based on wind energy whereas 60 % on hydro power. Electricity production in Osterholz is predominantly renewable (around three quarters), though regional production is small in comparison to electricity imports (90 %). 39 wind turbines with an aggregated capacity of 45 MW produce 70 GWh per year or around 6 % of the electricity demand. In addition, biogas is burned in three electricity generating plants. Two of those also feed DH networks, though the majority of DH input is non-RES. The proportion of renewable energy in the German electricity mix was around 15 % in 2008.

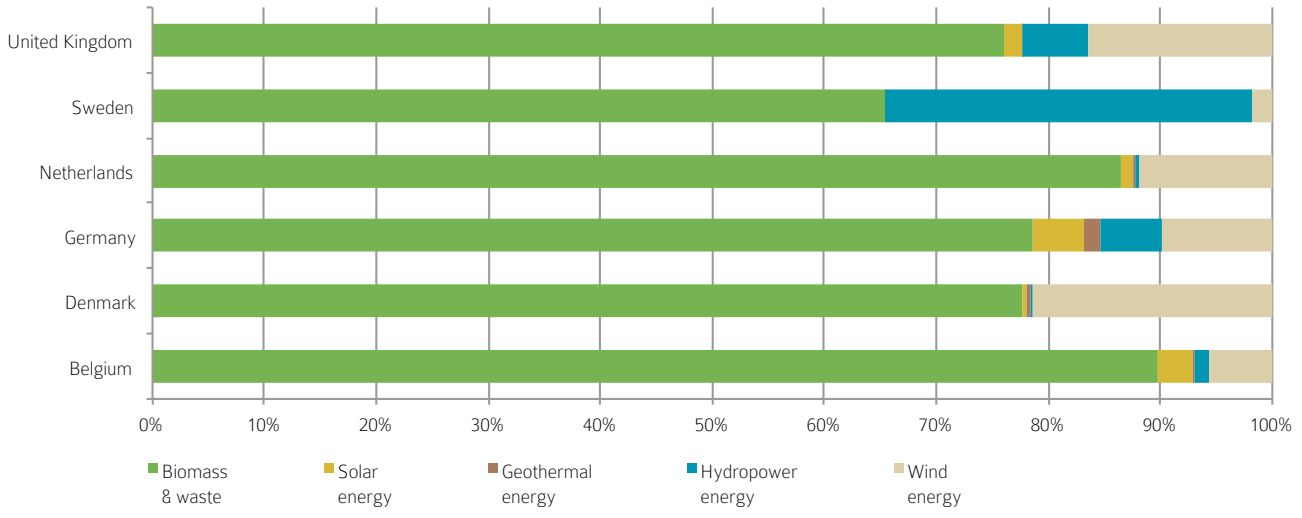

Figure 3: Share of renewable energy sources for electricity production of total renewable energy production in the partner countries (2010)
Source: http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Electricity_production_and_supply_statistics

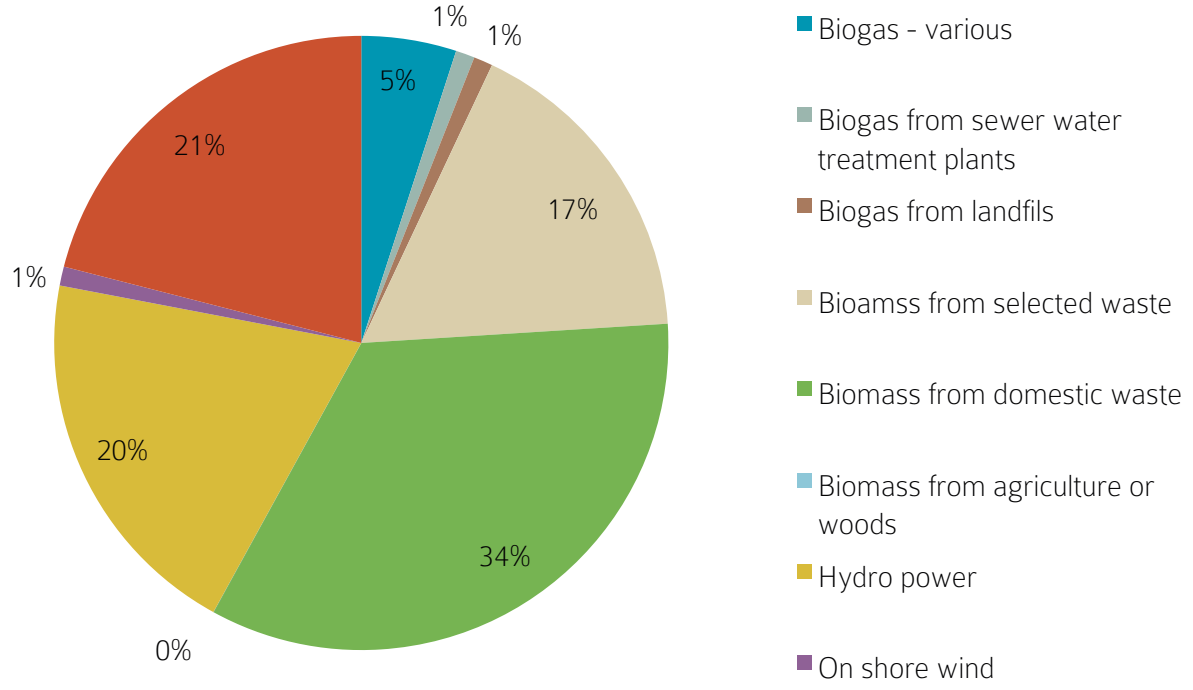

Figure 4: Production of renewable electricity in the Kortrijk region

Kortrijk punches above its weight in terms of RES exploitation in Flanders, contributing 8.4 % of Flanders' renewable electricity production though Kortrijk's population and land areas both represent smaller fractions. Four wind turbines account for 20 % of Kortrijk's RES production. Two large power plants together generate around half of Kortrijk's RES electricity, one waste incinerator, and one oil fired power station which uses a small fraction of palm oil. Decentralised renewable sources are also significant in the region, particularly solar photovoltaic above 10kW. However, renewable electricity represents a small minority of power production (around 5 % in Flanders).

RES in the UK is predominantly electricity production, though there is some biofuel mixing in transport fuels and small scale renewable heat (including heat pumps, small biomass DH systems, and rural wind-to-heat systems). Around 7 % of UK electricity generation is from RES: 3 % from waste incineration and biomass co-firing, 1 % from hydropower, and 3 % from others (predominantly onshore wind). Scotland has a higher RES electricity capacity than the rest of the UK, in both proportional and absolute terms, with most of the island's hydropower resources and a relatively higher penetration of onshore wind. The Netherlands' energy supply contains 3.4 % RES. The majority (two thirds) of this is biomass (both direct combustion and co-firing, with some small biomass boilers and a small biogas contribution). The other one third of RES production is wind. RES accounts for 9 % of Netherlands electricity production.

Several reports note the use of biofuels in transport fuels (in compliance with the EU Directive on the Promotion and Use of Biofuels and Other Renewable Fuels for Transport) as contributing to a country- or region-wide use of RES - though places vary in the degree to which this can be met from regional resources or relies on imports. In contrast, while some biogas and electric vehicles represent RES in transport, these are generally niche applications and make a small contribution.

4.5 On-going developments and potential estimates

Some partners reported on particular growth areas or the results of surveys of local sustainable energy potential. In the Netherlands, the contributions of heat pumps and biofuels to overall RES supply are both growth areas. Heat pumps are also a growing sector in Sweden. Kronoberg is not an exception to this, though a strategy to increase the use of biomass in the area is also pursued. Kortrijk has a regional plan to increase wind capacity five-fold, from 8 MW to 40 MW, and has identified large potential for harnessing solar power using roof space and land with certain restrictions (e.g. old landfill sites). Countries with significant hydropower potential (like Sweden and Scotland in particular cases) have generally already saturated the use of this source.

The report from Osterholz details a number of in-depth analyses of regional RES potential, and possible ways this full potential could be exploited, balancing electricity, heat and transport demand in different ways. In particular, the report suggests, that the technical potential for wind power is between 36 % and 58 % of the current electricity demand. The two figures correspond to different hub heights. The higher hub (which would increase potential output by around 60 %) would add around 5 % to the cost. In addition, solar collection could cover around 20 % of current electricity demand and 55 % of heat demand. Some of the North Sea – SEP partners made some additional observations concerning the potential of renewable energy sources. Even though the list is not yet complete, it illustrates tendencies and regional characteristics for six different RES. These are namely: wind energy, solar energy (solar heat), photovoltaic (PV), solid biomass, biogas and geothermal energy.

5 ORGANISATIONS AND MARKETS

The structures of energy markets and the types of organisations involved have important consequences for sub-national energy initiatives (SNEIs), conditioning the opportunities available for the use of existing infrastructures, access to markets (including different market segments) and on the value that a SNEI can capture from its energy production. The following is a short introduction to sometimes complex and dynamic structures of energy markets in the partner's countries and regions.

5.1 Electricty

Under EU directives, all countries have set out on a path of liberalisation of the electricity sector, though there are differences in the starting period of the countries and how the process has developed. E.g. in the UK, the earliest country to liberalise, privatisation was an integral part of the process, while other countries such as Sweden retain a degree of public sector ownership, for example through municipal ownership of generating assets. In all North Sea – SEP partner countries, which reported on electricity network operation, network operation has been »unbundled« from generation and supply activities to ensure, the natural monopoly of network operation is not used to prevent access of generators to the network or of customers to different suppliers. The form of separation and how it is regulated varies across countries.

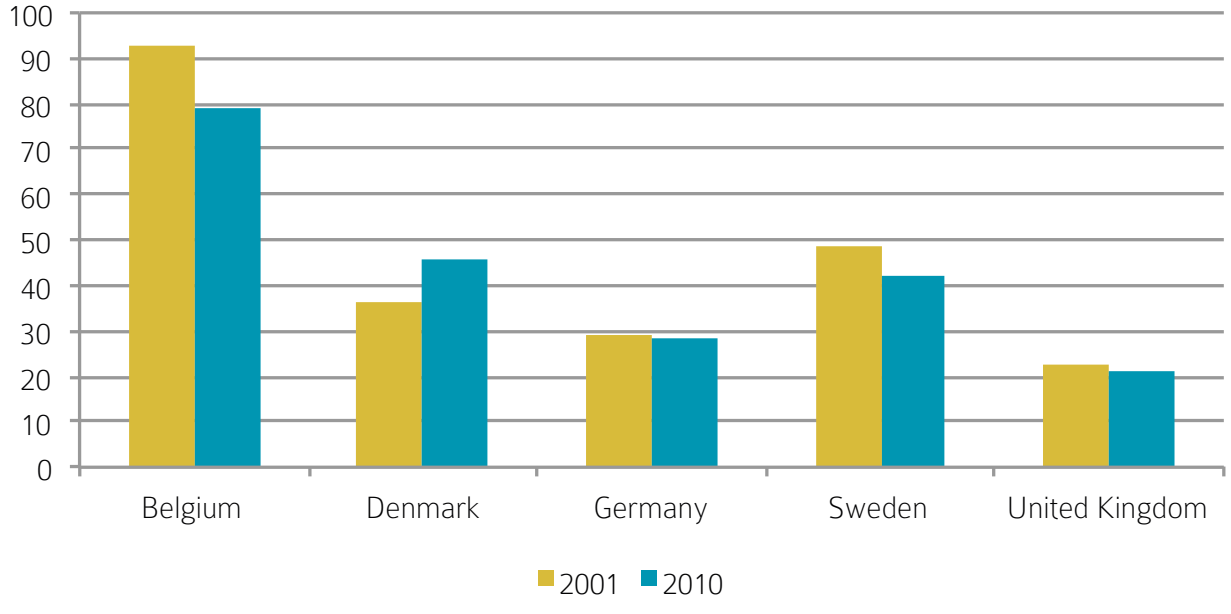

Figure 5: Market share of the largest generator in the electricity market (2001 and 2010) in %
Source: http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_ind_331a&lang=en

In the UK, for example, electricity distribution may be undertaken by private companies: these are required to be separated from companies which generate or supply electricity, but may be part of a group which includes generation/supply activities. Distribution network operators (DNOs) in the UK have, for several years, been encouraged to facilitate distributed generation (e.g. through regulatory incentives), though securing acceptable terms (including costs) of connection is still a significant barrier to distributed generation. This is due to a number of reasons, including inconsistency across different DNOs and slow administrative procedures. Swedish distribution networks, in contrast, are often owned by municipal energy companies, though there has been some transfer of ownership of these companies to private interests. Different countries use different models to regulate network activities. In the Netherlands, for example, prices are regulated, while in the UK regulation focuses on the return network operators make on their investments. Belgian DNOs are the old (pre-liberalisation) municipal energy companies. Electricity transmission (above 30 kV) is undertaken by the Belgian company Elia. In the UK, electricity transmission is undertaken by two privatised companies (one in Scotland, the other serving the rest of the UK). In contrast, Swedish electricity transport is undertaken by a state owned company, principally bringing hydro and nuclear power to distribution networks. In countries participating in »Nord Pool« (Norway, Denmark, Sweden, Finland, and Estonia) the majority of electricity supplied is traded through the »Nord Pool« Spot market, giving a high degree of liquidity which facilitates access for new entrants (retailers or generators). Only around a quarter of the Nordic electricity is traded through bilateral contracts between retailers and generators. In the UK, in contrast, confidential bilateral contracts are the dominant form of electricity trade between generators and retailers. Both generation and retail in the UK are dominated by six large, vertically integrated companies, with very little incentive to trade with competitors rather than selfsupply. Liquidity in the UK is therefore low and represents another barrier to new entrants. The UK's six largest energy companies are all privately owned (four by non-UK companies and two traded on the London Stock Exchange). And while there are around 50 companies undertaking electricity generation, the »Big Six« dominate. Sweden's electricity generation market is dominated by just four large companies (the next two having just 2 % market share each). The largest company (by power produced) is Vattenfall, a state owned utility. Belgian electricity generation is perhaps most concentrated, with one company (Electrabel, a subsidiary of the French company GDF-Suez) accounting for around 90 % of the power being generated. Retail contestability is common across partner countries, having been phased in on different schedules and in different countries. UK and Dutch partners both comment on the fierce competition in electricity retail. In common with other European countries, suppliers are increasingly bundling energy with other domestic services (such as telephone and internet connections). In Osterholz, electricity supply is dominated by EWE AG, though in three municipalities a significant proportion is supplied by three old municipal energy companies (so called Stadtwerke) which have now merged.

5.2 Gas

Gas networks are less ubiquitous across North Sea – SEP partner regions than electricity networks. While access to gas markets is likely less of a priority for regional sustainable energy planning (the main opportunity is injection of biomethane), the organisation of gas supply systems nonetheless has implications for planning the development of alternative heating systems. Input to the UK's extensive gas network is from a number of companies, predominantly extracting gas from the North Sea, but increasingly (since the UK became a net natural gas importer in 2004) through imports. The Belgian gas network relies exclusively on imported gas, the majority brought in by Distrigas with GDF and WINGAS (a partnership between BASF and Gazprom) contributing more modest shares (though WINGAS has increased its import volumes recently by supplying some large consumers directly). Input, transmission, distribution and retailing of gas are commonly separate activities. For example, in Belgium gas transmission is undertaken by Fluxys (a listed company formed from removal of transmission activities from Distrigas).

Belgian gas distribution is undertaken by the old municipal energy companies (as is electricity), and as stated above, they have been given targets for the number of domestic customers connected. In the Netherlands, in contrast, gas network operators are not under obligations to connect or serve any customer (though electricity network operators are under such obligations). Gas retail is generally competitive. In the Netherlands, for example, there are 22 gas supply companies. The UK also has a large number of gas retailers, though the »Big Six« dominate the market.

5.3 District heating

District heating (DH) networks are inherently local, and were commonly developed under municipal ownership, though there are currently different ownership patterns and business models across North Sea – SEP partner regions. In the Netherlands there are 56 DH networks delivering heat to around 4 % of dwellings. A Heat Law has recently been passed allowing the regulation of heat prices. It is likely that these will reflect a reasonable return on investment in a network business, but be capped to be below gas prices. In the Netherlands DH companies generally do not own the heat generating assets that supply the networks, but purchase heat, distribute it and retail it to consumers. Therefore, in the Netherlands it may be easier for third parties to establish heat generating projects to feed into heat networks than in countries where activities are integrated. Swedish DH networks often integrate heat generation, distribution and retail activities. These may be municipally owned (by the same companies operating local distribution networks), though changes in DH regulation have allowed for private ownership. Some municipalities have sold their DH companies (or share in them). In the past, heat tariffs were required by regulation to be cost reflective, resulting in relatively low heat costs. Deregulation of DH, however, has allowed heat tariffs to reflect market conditions (i.e. the cost of competing technologies), leading to some price rises. Heat supply in Denmark is perhaps the most regulated market of the North Sea – SEP partner countries. Local authorities have the power and duty to designate certain areas as DH zones in which buildings may be obliged to connect. DH therefore dominates heat supply in cities, where systems are municipally owned. Smaller systems in rural areas are usually owned by local cooperatives. The protection of consumers from mandatory use of a monopoly service is achieved through public or cooperative ownership, through the requirement that heat networks are operated on non-profit bases and through the competition of the prices in the »heat input«.

5.4 Built environment

The built environment is an important location for sustainable energy planning, through development of local energy systems, improvements in the efficiency of individual buildings and conditioning of daily travel. Opportunities for change are conditioned by a range of factors including the built form and patterns of ownership. The Netherlands is the most densely populated country in Europe, and as a low-lying country, it is particularly vulnerable to climate-changeinduced rises of the sea level. Drenthe region shows lower density than the average for the country, though the cities of Groningen and Assen are naturally sites of high density. In Osterholz, Germany, the population density is lower than the German average, and settlement is characterised by the county's proximity to the city-state of Bremen: southern municipalities blend »almost seamlessly« into Bremen, and most workers in the county commute into Bremen for work (contributing to the lowerthan-German-average per capita energy consumption in the county). The Kortrijk region in Belgium is part of a larger urban sprawl, reaching from Northern France, through Flanders and Wallonia, and on to the Randstad (the Netherlands) and Ruhr (Germany). Typically the development shows a low density with an inefficient use of space and encroachment of urban development into previously agricultural land. This pattern of development can be attributed to various issues including poor public transport, weak planning regulations, policies prioritising economic growth, and lack of coordination between government levels and agencies. While historical policy focus on economic development has resulted in low levels of unemployment, environmental quality is poor and transport pollution particularly significant.

In relation to the rest of the UK, the overall population density in Scotland is low: Scotland is around one third of the land area of the UK, but hosts less than one tenth of the population. Most of the Scottish population is concentrated in urban areas – the cities of Edinburgh, Glasgow, Dundee, Aberdeen and Inverness and the central belt region – and rural settlements represent around 15 % of dwellings. Around a third of Scottish dwellings are flats (a higher proportion than the rest of the UK), opening (relatively unexploited) opportunities for communal heating systems, but creating barriers to improve the energy efficiency of the housing stock as multiple households need to coordinate with each other to install upgrades. The latter complexity is exacerbated by mixed patterns of tenure within multi-dwelling buildings, in part a consequence of the »right-tobuy« policy whereby tenants of social housing providers are able to purchase the homes they live in. Overall, around 60 % of dwellings are occupied by their owners, 10 % are privately rented and 30 % are rented from »social landlords« and local authorities.

The Netherlands have similar patterns of ownership to the UK, with 56 % owneroccupied, 10 % privately rented and 34 % rented from public bodies. Of Denmark's 2.7m homes, 60 % are owner-occupied and 35 % rented[1]. In Sweden, flats have traditionally been provided by municipal housing companies and cooperatives, and only recently (2009) private ownership of these dwellings became possible. Countries vary (and have varied historically) in the energy efficiency required by building regulations. Countries often have agencies offering energy efficiency advice to households, though this is organised in different ways. For example, all Swedish municipalities have dedicated an energy efficiency adviser whose work is coordinated by regional offices and who draws on information provided by the national Energy Agency. Funding for energy efficiency advice is a mixture of municipal, regional and state contributions. In contrast, in the UK, energy efficiency advice is organised on a national (rather than local) scale: the Energy Saving Trust (EST) is a non-profit company cofunded by central government, devolved administrations and private sector companies (including the »Big Six« utilities and some network companies).

5.5 Government and governance instruments

5.5.1 GENERAL ORGANISATION

North Sea – SEP partner countries have various arrangements of organisations involved in the governance of energy provision. Several countries (including Sweden, Denmark and Germany) have national Energy Agencies acting as intermediaries between legislation and policy set by central government, and the day-to-day activities in energy systems. These agencies play a variety of roles. For example, in Denmark, companies can receive subsidies to cover their CO_2 tax payments, if they enter into energy efficiency agreements with the energy agency. In contrast, in the UK (which only reestablished a government department for energy in 2008) similar energy efficiency agreements are made directly between companies and the government.

The Dutch national government enters into Climate Agreements with municipalities, who are subsidised to develop a menu of relevant indicators. This subsidy has been responsible for a significant growth in the number of municipal climate officers. Municipalities are free to set their own levels of ambition for greenhouse gas (GHG) emissions reduction, and are of the opinion, that regional coordination is required. A consequence of the freedom of municipalities is that building regulations vary, leading to complaints from developers. Generally, strategies at national and local levels aim to remain technologically neutral.

Local government in the UK is organised differently across England and Scotland. A consistent aspect up to now was the use of local indicators of GHG emissions (including calculation of GHG emissions per capita) as part of the agreements between local and national/devolved governments on which central grant funding was conditional. However, the UK government abandoned this approach in 2010, requiring the report of GHG emissions but not using agreements to achieve reductions. In Scotland, a distinctive feature of local government is that it is (along with other public bodies) under an obligation to act in a way, which is calculated to contribute in a best manner to the delivery of

1 The remaining 5% are »unknown«.

emissions reduction targets. Danish municipalities have been obliged to undertake energy planning for several decades.

Various policy approaches towards sustainability in general and sustainable energy systems in particular are common across the regions, though the details of their implementation vary. For example, GHG emission abatement targets are highlevel approaches used in North Sea – SEP partner regions, but with different target levels.

5.5.2 TARGETS

The Netherlands have adopted the same target as the EU (20 % reduction by 2020 on a 1990 baseline). Denmark's »20 %« target is more ambitious as it is set against a 2005 baseline – the target agreed under the Kyoto protocol was a 21 % reduction on a 1990 baseline by the earlier date of 2008. The UK has sought to use its GHG targets to negotiate higher targets at an EU level: the statutory target is a 34 % reduction (on 1990 levels) by 2020, but an »intended« target of 42 % would be adopted in the case of the EU increasing its ambition. Scotland has a single 2020 target of 42 % reduction, irrespective of EU targets. In additaion, Scotland has the target to reduce GHG emissions by 80 % until 2050, which is in line with the overall UK target in this context. Targets are used more specific, though still relatively high-level ways in North Sea – SEP regions, in part through certain EU directives (such as the Biofuels Directive[2] which stimulated the development of biofuels targets reported by North Sea – SEP partners). Targets are variously set for GHG emissions from particular sectors, use of renewable energy in particular sectors (such as heat or electricity, usually expressed as a fraction of total energy consumption), and reduction in energy consumption (which may imply a target level of energy consumption, or a target energy intensity such as energy consumed per unit GDP). Targets in North Sea – SEP regions are established at different scales (national, regional and municipal). The Energy Performance of Buildings Directive[3] requires Member States to establish a common system for calculating the energy performance of buildings and to require new and existing buildings to have a certificate indicating the energy performance. A number of North Sea – SEP partners include these energy certificates to their reports, though the impact they have on the housing market (and hence on the value of energy efficiency retrofits and high efficiency new buildings) is likely to vary from country to country. For example, the Drenthe and Tynaarlo (Netherlands) report states that the householder awareness of energy issues is high (around 70 %) though the willingness to pay extra for measures is low (around 30 %) – financial performance of measures is seen as more important by householders than their environmental impact.

5.5.3 FEED-IN-TARIFFS

A specific instrument promoting renewable energy production are the so called Feed-in-Tariffs. Point of origin is the German Renewable Energy Act (»Erneuerbare-Energien-Gesetz – EEG«)[4]. The Act came into force in 2000 and was a boost for many renewable energy projects. The tariffs guarantee a fixed price for electricity which is feed into the grid. The German Renewable Energy Act is supposed to be an archetype for legislation in other countries. Hereafter, we give an overview about Feed-In-Tariffs in the North Sea – SEP partner countries.

[2] Directive 2003/30/EC of the European Parliament and of the Council of May 8th 2003 on the Promotion of the Use of Biofuels or Other Renewable Fuels for Transport, http://eurlex. europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:3200 3L0030:EN:HTML
[3] Directive 2002/91/EC of the European Parliament and of the Council of December 16th 2002 on the Energy Performance of Buildings, http://eurlex.europa.eu/LexUriServ LexUriServ.do?uri=CELEX:3200 2L0091:EN:HTML
[4] http://www.bmu.de/english/renewable_energy/downloads/doc/47883.php

COUNTRY	FEED-IN-TARIFFS	ADDITIONAL INFORMATION
Germany	yes	Various tariffs for renewable energies depend on technology, input material, and size
United Kingdom	yes	Feed-In-Tariff & Renewable Heat Incentive introduced
The Netherlands	no	
Belgium	no	No system of feed-inn tariff, but green power certificates. Guarantee on minimum value, but depending on the type of technology (e.g. on shore wind: 80, off shore 90/MWh). Average market value of green energy certificates: 110/MWh
Sweden	yes	
Denmark	yes	

Table 2: Feed-In-Tariffs

5.5.4 TAXES

Taxes on energy products in different countries have different environmental characteristics, though all regions participate in the EU Emissions Trading Scheme. Sweden has several relevant taxes: an energy tax (based on the energy content of fuels), a CO_2 tax, and a sulphur tax; and moreover large boilers, turbines and heat plants pay a NOx tax. Energy tax exemptions for energy intensive industries which enter agreements to reduce energy consumption are common across Europe, as the EU directive[5] requiring member states to tax energy products and electricity allows for such exemption schemes. Taxes can make sustainable energy options more financially viable by increasing the costs of energy options which have been identified as unsustainable. Conversely, policies such as »green certificates« (used, for example in the UK[6]), technology investment subsidies (e.g. Sweden) and targeted tax breaks (e.g. Belgium) improve the financial attractiveness of particular technologies, which have been identified as desirable to promote. One has to mention, that in 2007/08, UK renewable energy green certificates were worth around € 70/MWh, while equivalent certificates in Flanders were worth around € 110/MWh.

[5] Council Directive 2003/96/EC of October 27th 2003 Restructuring the Community Framework for the Taxation of Energy products and Electricity, http://eurlex. europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32003L0096:EN:HTML

[6] Examples in this paragraph do not exhaustively list those North Sea – SEP partner countries in which these instruments are used.

6 CONCLUSION

The baseline reports about the North Sea – SEP partner describe regional approaches to sustainable energy planning in different ways like exploring local resource potential, or focusing on local policy measures. These evaluations show that the project partners have significant differences in their potentials concerning the production of RES. The diversity in existing energy systems, the local energy resource potentials, the organisation of energy provision, the built environment and the context of regional and national governmental powers, relationships and policies – all of them are going to influence the degree to which different interventions for sustainable energy may be relevant and successful.

The Osterholz (Germany) and Kortrijk (Belgium) reports were both very detailed referring to the sustainable energy potential of their areas, identifying reduced dependence on imported energy sources as important drivers. Both reports emphasised the potential to increase exploitation of wind and solar energy, both having technical capacities to meet significant proportions of demand in those two regions. Similarly, as both regions are relatively flat, hydropower does not represent a considerable additional resource.

While neither Osterholz nor Kortrijk have significant regional biomass supplies, the sustainable energy strategy for Kronoberg (Sweden) focuses on the use of forest products, aiming to increase the already relatively high use of bioenergy in the region. This will draw the attention to the use of biomass in district heating, and towards the use of biogas in transport. Osterholz also identifies biogas for transport as having significant potential, though the potential in Kortrijk is limited in this regard. The Osterholz report emphasises that potential energy resources leave questions open as to the specific use of these resources, and presents calculations associated with different scenarios (e.g. maximising production of electricity versus maximising production of heat).

The Kronoberg document used a different approach, outlining the regional strategy for establishing actions linked to renewable technologies, roll-out of energy efficiency and bio-based vehicles, development of regional energy/climate industries and businesses, and networking in energy and climate sectors. For example, stakeholders in climate networks sign up to climate agreements, with companies and public authorities signing voluntary letters of intent to improve the sustainability of their energy use. The Drenthe and Tynaarlo (Netherlands) report similarly describes a number of sustainable energy projects and promotional activities such as awareness raising, community initiatives and a resident-led sustainable housing area which emphasises passive solar gain.

All in all, a number of common themes across regions should be possible to identify. For example, energy markets have been liberalised and unbundled, reducing the scope for »command-and-control« over the energy systems and therefore opening up possibilities for new entrants to re-think and to question established practices and technologies. The prominence of environmental and efficiency issues in energy policy has grown all across the partner countries, though there are differences in the question, for how long these issues had dominated major policy strings or even do so yet. This, along with the trend towards liberalisation and the development of Europewide policies, underpins similarities across partners in the national policy instruments deployed (which regional sustainable energy planning approaches may exploit).

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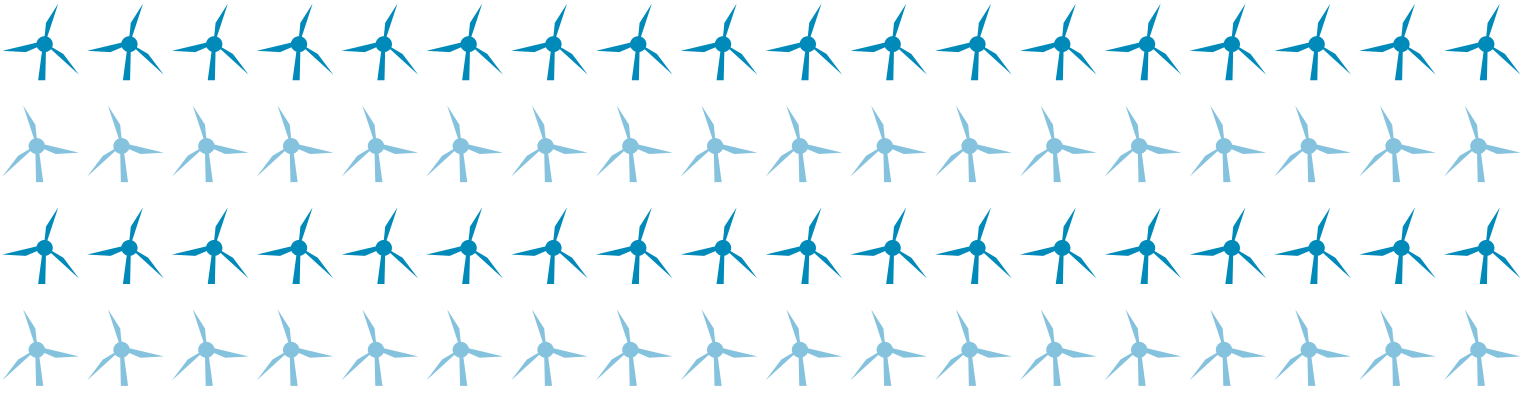

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