



# System Plan 2009

ENERGINET/DK



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# System Plan 2009

Summary



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# Preface

The reduction of greenhouse gases globally and increased security of supply through fossil fuel independence have been focal points in the energy sector in recent years and numerous analyses have pointed to a number of solutions.

The next step is to focus on the development of the necessary solutions and the initiatives that should ensure the implementation of the solutions. Energy systems must be developed in which fossil fuels are no longer the principal elements. Energinet.dk is actively participating in this development and is working to utilise wind power in other sectors via the power system. In the long term, we therefore view the power system as the backbone of the energy system.

In both the short and medium term, natural gas will remain an important element in Danish energy supply. In future, the gas we use in Denmark will be increasingly based on biogas, and Energinet.dk will continue working to ensure access for biogas to the gas grid.

Denmark has demonstrated that economic growth and the reduction of CO<sub>2</sub> emissions are possible. We must incorporate these experiences into developing solutions that should integrate electricity into the heat and transport sectors and biogas into the gas grid. Business orientation is the key phrase. It is a matter of creating solutions that are competitive on the global market as there will be huge export potentials for new 'green' energy technologies in the future. Denmark has therefore a unique opportunity to join in the development of new energy technologies while participating in the facilitation of a global market for these technologies. In other words, we should create Danish solutions to global problems.

This requires widespread cooperation across organisations in the whole energy sector and other sectors; producers, consumers, authorities, research institutes and many other players should cooperate on the task. One of Energinet.dk's main responsibilities is to ensure holistic market-based solutions in the energy sector. This central position is reflected by our involvement in a wide range of activities that generally support the EU targets for reducing greenhouse gas emissions, the increased utilisation of renewable energy and energy efficiency in 2020 – popularly known as the 20-20-20 targets.

In the long term, these activities will also form the building blocks of the work to ensure long-term security of supply through fossil fuel independence. The 20-20-20 targets and security of supply together form the keystone for System Plan 2009.



Peder Ø. Andreasen  
President and CEO

# 1. Summary

**Security of supply, energy and climate** have been high on global, European and national political agendas in 2009 due to, amongst others, the UN Climate Change Conference, which will be held in Copenhagen in December. The EU's Climate and Energy Package has been finally adopted, including the so-called 20-20-20 targets<sup>1</sup> and the renewable energy directive. The package means that Denmark shall increase its share of renewable energy significantly, reduce greenhouse gas emissions in sectors not covered by the EU emissions trading system (EU ETS) and carry out significant energy efficiency improvements in the future.

Apart from the climate and energy package, security of supply has also been high on the energy-political agenda. Focus has primarily been in three main areas:

- Long-term security of supply
- Infrastructure expansions (electricity)
- Access to natural gas

Energinet.dk's activities largely reflect the political focus areas, and Energinet.dk is contributing a wide range of solutions which are necessary to realise the climate and energy-political objectives. The objectives associated with the climate and energy package and the security of supply work are interrelated. Energinet.dk will focus its activities so as to contribute to the promotion of an effective realisation of the overall political objectives.

In relation to Energinet.dk's core areas, the decisive factors for Denmark's fulfil-

ment of the climate and energy package targets are increased integration of wind power into the power system, the intelligent application of electricity-based solutions in the heat and transport sectors as well as significantly greater utilisation of the potential for producing biogas.

System Plan 2009 provides an overview of Energinet.dk's most significant activities. The following section summarises these activities with a focus on how Energinet.dk is contributing to the fulfilment of the political objectives in relation to security of supply and the Danish 2020 targets.

## Integrating wind power into the power system

Wind power is currently Denmark's most important source of renewable energy for power generation. Energinet.dk expects that wind power together with biomass will bear the largest share of the renewable energy expansion in the electricity sector. This expansion is a precondition for enabling Denmark to fulfil the target of 30 per cent<sup>2</sup> renewable energy in 2020.

The Danish energy system is facing a paradigm shift. The energy system requires re-alignment and innovative thinking so that large volumes of renewable energy can be integrated effectively. Energinet.dk expects the power system to become the focal point for this change based on the significant role which wind power is expected to play in our endeavours to reach the climate and energy-political objectives.



The future energy system must be efficient and flexible so that renewable energy can be utilised where it is most valuable. Consequently, Energinet.dk operates with a number of means for the integration of wind power into the power system, some of which also contribute to the use of electricity in other sectors.

A core task for Energinet.dk is to ensure that renewable energy is effectively integrated into the power system, primarily on market-based principles and with a continually high degree of security of supply. This re-alignment of the power system is based on three main elements:

- A robust transmission grid and strong interconnections
- Flexible consumption and generation, for instance through the integrated planning of energy systems.
- Advanced measurement and control of the power system on both the generation and the consumption sides (SmartGrids).

In other words, the future energy system must be energy efficient, flexible and intelligent so that renewable energy can be utilised where it is most valuable.

<sup>1</sup> The targets mean that the EU Member States as an entity shall reduce their CO<sub>2</sub> emissions by 20 per cent in 2020 compared with the 1990 level, achieve 20 per cent renewable energy in energy consumption and improve energy efficiency by 20 per cent.

<sup>2</sup> The EU target of 20 per cent renewable energy is divided among the Member States, depending on the individual country's economic capacity and national potentials. The national target for Denmark is 30 per cent renewable energy in 2020.

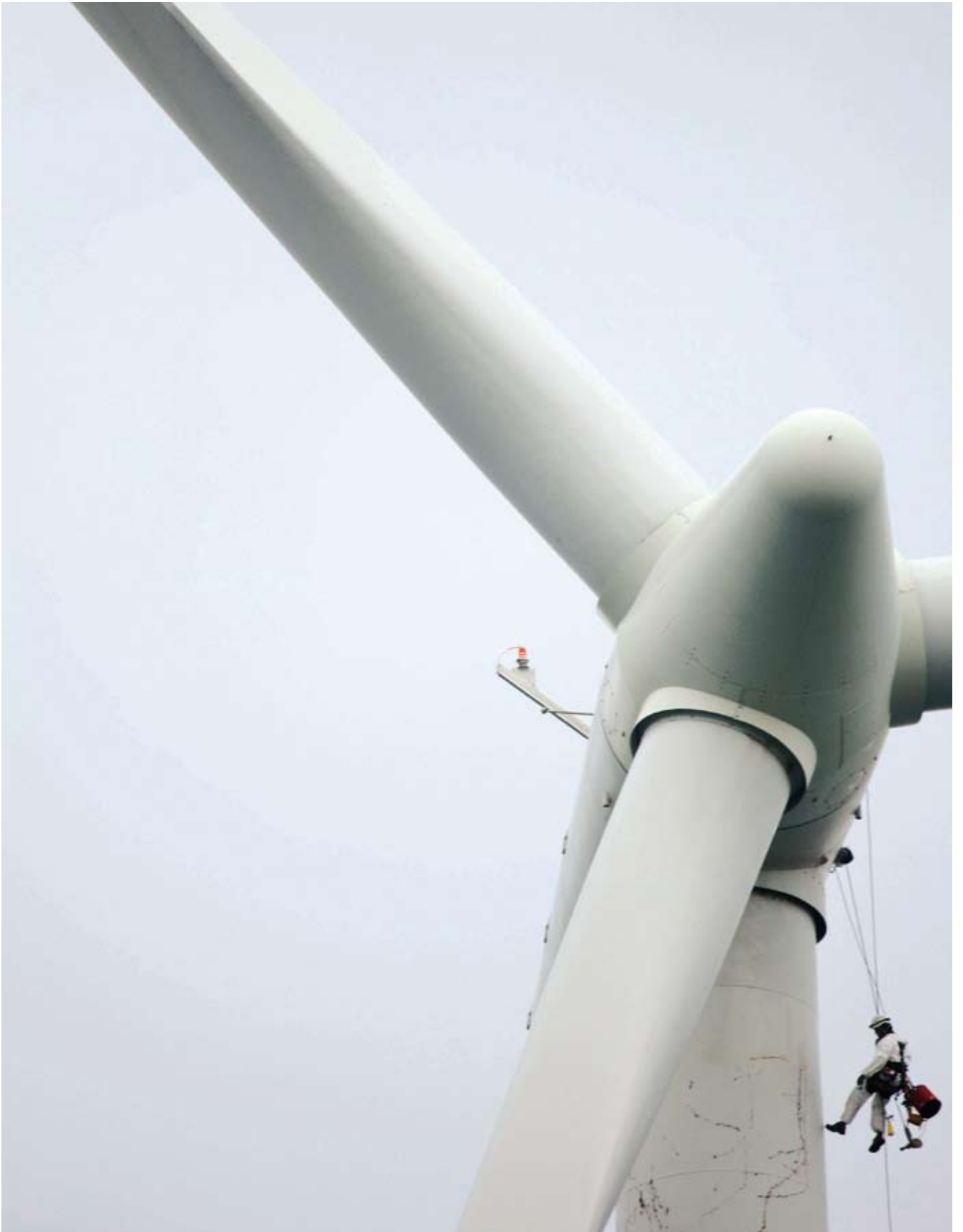
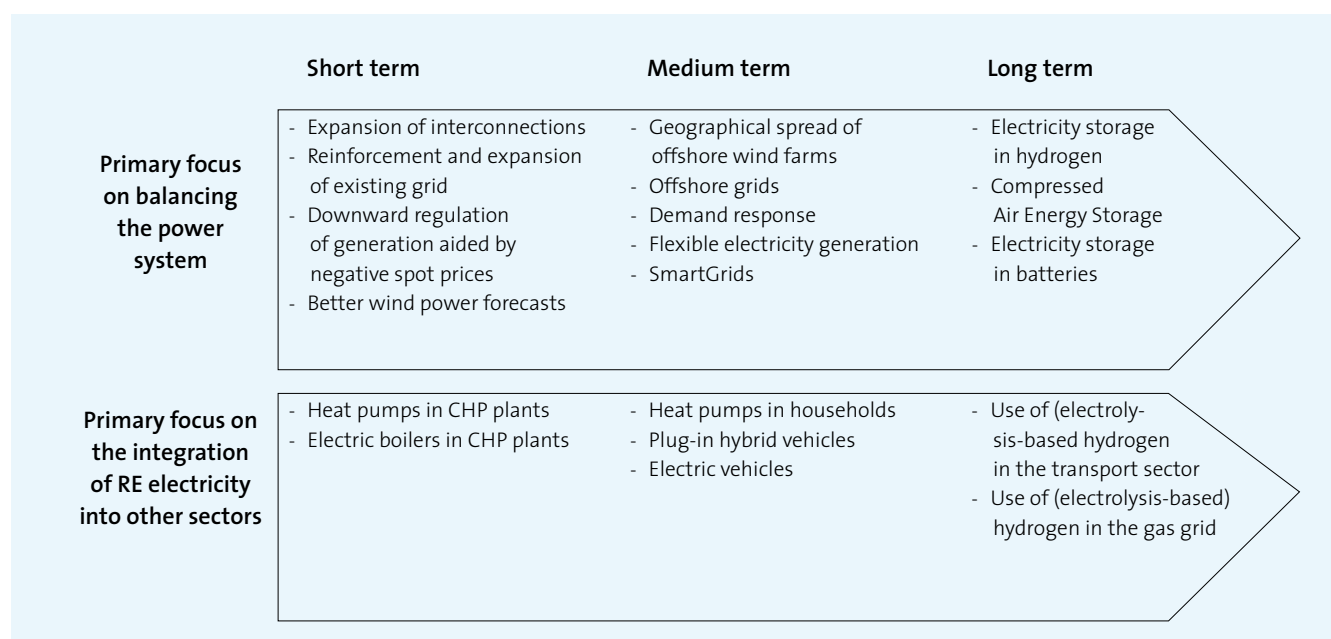


Figure 1: Means for balancing the power system and integrating electricity into other sectors.



A number of Energinet.dk's specific activities pertaining to these elements are described in the following sections.

## Robust transmission grid

On 4 November 2008, the political parties behind the energy agreement of 21 February 2008 entered into an agreement on new guidelines for the future expansion of the main electricity transmission grid in Denmark. In concrete terms, this means that Energinet.dk has received backing to launch a number of specific projects. The specific projects concerned are:

- **The Kassø-Tjele line** will be upgraded with towers in a new design to hold 400 kV double circuit lines along the approx. 170 km long section
- **The Revsing-Endrup line** An additional 400 kV system will be installed on the existing towers along the approx. 30 km long section
- **Kassø-German border** The existing 220 kV overhead line will be converted to a new 400 kV overhead line on towers in a new design. The length of this section is approx. 30 km.

Apart from the decision about the specific projects, the agreement includes a decision that, in step with developments in security of supply as well as technological and socio-economic developments, all 400 kV lines will be placed underground.

## Strong interconnections

Interconnections make an important contribution to the effective integration of wind power into the power system. Energinet.dk is working on four ongoing projects aimed at increasing interconnection capacity:

### Skagerrak 4

Skagerrak 4 is one of the five so-called 'priority cross-sections' which the Nordic TSOs decided to develop in 2004. The Skagerrak 4 interconnection between Norway and Denmark will have a capacity of approx. 700 MW and increase the possibilities for synergies between generation based on hydro-power, wind power and thermal power stations. In addition, this will improve the possibilities of benefiting from the demand in a larger geographical area.

At the same time, the interconnection will contribute to higher security of supply in both Norway and Denmark. Energinet.dk has submitted an application for establishing the connection to the Danish Minister for Climate and Energy, and in Norway the public authority approval procedure for the connection is being prepared.

### COBRA Cable

The COBRA Cable project examines the potential for establishing a 600-700 MW interconnection between Denmark and Holland. It is estimated that the COBRA Cable will contribute positively to the possibility for effective integration of large volumes of wind power into the Danish and Dutch power systems. Similarly, the connection between Holland and Denmark will create better coupling between the Nordic and Northern European electricity markets (the Day ahead and the regulating power markets) independent of congestion in the transmission grid in Northern Germany. Finally, the connection will lead to improved security of supply in both Holland and the Nordic region.

**Increased capacity on Germany-Jutland interconnection**

From 2012, the trading capacity between Jutland and Germany will be increased from the current 950/1,500 MW to 1,500/2,000 MW in the north and southbound directions, respectively. The connection is expected to be further upgraded to a minimum of 2,500 MW in both directions in 2017. The increase in trading capacity ensures better integration of the Nordic and Northern European electricity markets, thereby securing better utilisation of the installed wind turbine capacity in both Denmark and Germany. Moreover, this connection is expected to contribute positively to security of supply in Denmark and Northern Germany.

**Krieger's Flak**

The area of Krieger's Flak in the Baltic Sea is a potential candidate for future offshore wind farms in Denmark and presents a promising opportunity for the integrated planning of landing facilities for offshore wind turbines and interconnections. The relatively shallow area of Krieger's Flak is divided into Danish, Swedish and German areas, and offshore wind farms are being considered in all three areas. The establishment of offshore wind turbines in the Danish part of Krieger's Flak will ensure a geographic spread of offshore wind turbine capacity in Denmark. In this way, the fluctuating generation contribution from wind power in Western and Eastern Denmark can to a certain extent be counterbalanced. Moreover, the risk and consequences of concurrent outages of a large number of wind turbines are also reduced when strong wind fronts pass over Denmark.

However, for the time being only Germany has taken the decision to establish offshore wind turbine farms at Krieger's Flak. If it is also decided to construct offshore wind farms on the Danish and Swedish parts of Krieger's Flak, it will be possible to integrate the landing facilities of the three countries' offshore wind farms in one combined, in-

ternational solution that would also increase the exchange capacity between the Nordic region and the Continent.

In collaboration with Svenska Kraftnät and the German company Vattenfall Europe Transmission, Energinet.dk has conducted a study into the possibilities of creating a combined, international grid solution at Krieger's Flak. An international solution appears to be better than separate national solutions.

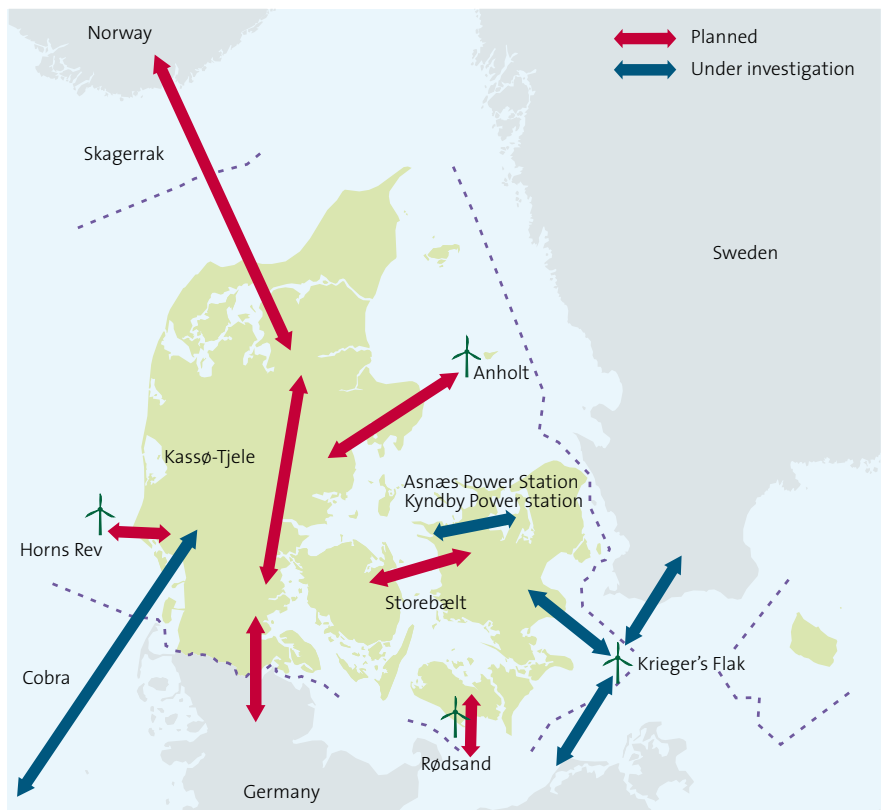
If the cables to the offshore wind farms were only used for wind turbine power, they would be used under half the time on average. However, if a combined grid solution were established, this surplus capacity could be used to exchange energy between the countries, thereby utilising the interaction between wind, hydro and other sources of energy. Compared to a purely national landing facility, the combined solution is expected to

make a much more positive contribution to security of supply in Denmark.

**Offshore grid**

The development of a common offshore grid at Krieger's Flak as described above presents an opportunity to achieve greater utilisation of wind power resources, which for individual countries would be relatively expensive to utilise. Moreover, in addition to making it possible to counterbalance the contribution of fluctuating wind power generation in a wider area, the offshore grid also makes it possible to further integrate the European electricity markets. Apart from the aforementioned opportunity at Krieger's Flak in the Baltic Sea, there are also possibilities for the development of a large-scale North Sea grid. The EU Commission has placed great focus on this possibility, which is also discussed in the 'Second Strategic Energy Review' issued by the Commission in November 2008.

**Figure 2** Overview of the planned and contemplated new interconnections and the connection of offshore wind farms.





## Flexibility in power consumption – the use of electricity in the heat and transport sectors

The targets for reducing greenhouse gas emissions in sectors not covered by the emissions trading system mean, among other things, that fossil fuel based technologies in the heat and transport sectors need to be replaced by new, efficient technologies that do not use fossil fuels. There is an extensive array of technological possibilities for integrating more renewable energy into the energy system such as increased use of biogas, biomass, liquid biofuels and further optimisation of the interaction between electricity and district heating systems.

Electricity-based technologies are characterised by high efficiency, and through electricity-based solutions renewable energy from wind power can be used in sectors other than the electricity sector. As the electricity sector is subject to the EU ETS Directive, an increase in electricity consumption in Denmark will thus not lead to increased CO<sub>2</sub> emissions for sectors covered by the emissions trading system in the EU as a whole.

Energinet.dk's report 'Efficient use of wind-based electricity in Denmark' from March 2009 analyses the effect of a significant increase in the use of electric vehicles and heat pumps in conjunction with a considerable increase in the expansion of wind power. The analyses show that Denmark can reach a large share of its EU 2020 targets through increased use of heat pumps and electric vehicles, provided that wind power capacity is also increased significantly. Table 1 summarises the key figures of the report in connection with the EU's Climate and Energy Package.

The key figures show that the interaction between wind power, heat pumps and electric vehicles yields substantial socio-economic benefits. The optimal interaction between wind power, electric

Table 1 Key figures related to the EU 2020 targets.

	RE share of total energy consumption	CO <sub>2</sub> emissions in sectors not subject to the EU ETS Directive Million tonnes/year	RE share of transport	Improved energy efficiency
Target for Denmark, see the EU 2020 targets	+13 percentage points	-7.5	10 percentage points	20 per cent
Heat pumps and electric vehicles 2020	+5 percentage points	-3	4 per cent points	7 per cent

vehicles and heat pumps makes it possible to:

- increase the share of renewable energy by 5 percentage points, corresponding to approx. 40 per cent of the necessary increase to reach the target
- reduce CO<sub>2</sub> emissions in sectors not subject to the EU ETS Directive by 3 million tonnes per year, corresponding to approx. 40 per cent of the necessary reduction
- increase the share of renewable energy in the transport sector by 4 percentage points, corresponding to approx. 40 per cent of the target
- improve overall energy efficiency by approx. 7 per cent, corresponding to approx. 35 per cent of the target in this area.

However, the socio-economic benefits greatly depend on the implementation of the intelligent interaction between the means and the power system, for instance, so that consumption does not take place at those times when the system is under pressure. Otherwise, the new, substantial electricity consumption from heat pumps and electric vehicles, for example, could become a considerable load on the power system, especially in the distribution network. Therefore, the activities which Energinet.dk has initiated on the background of the report also have a strong focus on developing demand-response methods and systems.

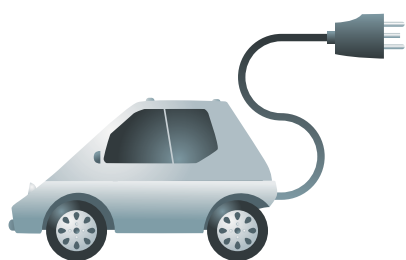
In the case of the transport sector, the results also show that the increased use of electricity alone cannot be expected to fulfil the demand for 10 per cent renewable energy in the transport sector in 2020. Consequently, it is important to continue focusing on the development of efficient biofuels for the transport sector and to analyse which technologies contribute most effectively to the fulfilment of the target.



Heat pumps and electric vehicles utilise energy efficiently and thus contribute to an improvement of the overall energy efficiency. Energy savings and efficiencies will be central parameters for the fulfilment of targets in 2020, and are also important focus areas in Energinet.dk's work towards an effective integration of significantly larger shares of renewable energy into the energy systems.

Energinet.dk supports and participates in a wide range of projects within the analysis, development and demonstra-

tion of means for the effective integration of renewable energy through the integrated planning of energy systems. A selection of these projects is described in the section below.



### Electricity to heat

Energinet.dk supports, via the ForskEL-programme, the project 'Analysis of the combination of wind power and heat pumps for Heat Plan Århus'. The project will analyse the value of various wind/heat pump solutions in the city of Århus based on how a 50 MW<sub>electricity</sub>/150 MW<sub>thermal</sub> heat pump can be utilised efficiently in an intelligent interaction with the power system.

Moreover, Energinet.dk expects to launch a project in 2010 together with the Danish Energy Agency and the Danish Electricity Saving Trust on individual heat pumps. The project will analyse the efficiency of various electricity market solutions vis-à-vis the operation of individual heat pumps and the interaction of the heat pumps with the power system.

### Electric vehicles

Energinet.dk is participating in a collaboration project with NRGi and the Danish Energy Association with a view to assessing the consequences for the distribution network when electric vehicles become more widespread. The project, which is expected to be completed at the end of 2009, analyses conditions regarding the capacity available for supplying electric vehicles taking into consideration the load on cables and the maintenance of a satisfactory voltage quality.

Through intelligent integration of electric vehicles into a future SmartGrid, the risk of overloading the power grid can be significantly reduced. Knowledge gained from the project represents an important contribution to future SmartGrid solutions and the rolling out of an intelligent infrastructure for electric vehicles.

The Danish Energy Agency's pilot project for electric vehicles has in the second tender round amongst other things focused on projects that shed light on the interaction between the power system and electric vehicles. Energinet.dk cooperates with the Danish Energy Agency to ensure the right focus in the projects funded.

Moreover, Energinet.dk supports, through ForskEL funding, the EDISON<sup>3</sup> electric vehicle project, which will develop and test the infrastructures required for widespread, intelligent integration of electric vehicles into the power system.

## SmartGrids

Future power generation will be decentralised and fluctuating to a far greater extent than today. Consequently, there is a much greater need for flexibility in the power system in the future. Such flexibility can only be achieved through increased activation of both generation and consumption units so that they contribute to the counterbalancing of the power system. This places great demands on the measurement and control of the power grid on both the generation and the consumption sides via digital communication. A SmartGrid, or intelligent power grid, is therefore an important element in a future power system. Energinet.dk is working on a range of projects which should ensure the implementation of intelligence in the power system in the future.

Energinet.dk is developing a 'Concept for controlling the power system', which sets

<sup>3</sup> Electric vehicles in a Distributed and Integrated market using Sustainable energy and Open Networks.

out an overall Danish plan for how the Danish power system should be controlled up to the year 2025. The concept will be developed in a broad, inter-disciplinary cooperation between Energinet.dk and the industry.

Specifically, Energinet.dk is involved in two major projects which test and demonstrate various SmartGrid elements. The first of these projects is the so-called 'Cell project', which is being conducted in close cooperation with SYD ENERGI Net. The project develops, tests and conducts full-scale pilot testing on a new intelligent control, regulation and monitoring concept for the Danish power system in a specific grid area.

The second project is called 'EcoGrid Europe' and is a future full-scale demonstration project on the island of Bornholm, which will develop and test the optimal utilisation of local, renewable energy sources, for example through the utilisation of electricity consumers' flexibility. The aim is to demonstrate the extent to which SmartGrid solutions can help to integrate up to 50 per cent renewable energy into the power grid while still ensuring that this takes place on market terms. The project is seeking support via the EU's 7th Framework Programme for Research.

## The electricity market

A competitive and reliable energy supply requires open energy markets. One of Energinet.dk's primary fields of work is to ensure that the electricity market functions and supports security of supply. Not least because of the increasing volumes of renewable energy in the power system, well-integrated regional markets are crucial for security of supply and economically efficient generation of energy.

Energinet.dk is leading a new joint TSO project aimed at developing a model which would enable a market coupling in Northwest Europe (the Nordic Region, Germany, France and the Benelux countries) so that electricity prices would re-

flect regional demand and ensure a high degree of regional security of supply.

For many years Energinet.dk has worked determinedly to establish a market coupling between Denmark and Germany. The market coupling was introduced in the autumn of 2008, but had to be suspended due to technical problems. The market coupling was reintroduced on 9 November 2009 and is expected to ensure an effective exchange of electricity between the Nordic and the German electricity markets.

### Negative spot prices

From 30 November 2009, negative spot prices will be introduced on the Nordic electricity exchange, Nord Pool Spot. The negative spot prices are expected to occur in the relatively few hours when electricity generation exceeds consumption and the capacity of the interconnections. In an electricity system with an increasing wind power share, the number of hours with surplus electricity will, all things being equal, rise in relation to the current level. The introduction of negative electricity prices is to encourage producers to adapt generation to the actual possibilities of selling the electricity.

### Security of supply

As initially stated, there has been considerable political focus on security of supply in 2009. In particular, long-term security of supply, which should be ensured, for example, through independence from fossil fuels from politically unstable areas, has received much attention nationally.

Moreover, there is continued political focus on infrastructural expansions which should ensure that the reliability of the power system remains intact and improve competition in the electricity market.

Finally, there is a still growing focus on the access to fuels, especially on expanding the European gas infrastructure to en-



sure diversification of supply routes and the integration of biogas into the gas grid.

It is the Government's ambition that Denmark eventually becomes independent of fossil fuels. In continuation thereof, when and how Denmark can achieve this independence and which technologies can play a role along the way to reaching this goal are under discussion.

The long-term Danish security of supply strategy should build on, amongst others, the recommendations presented by the Climate Commission when it reports on its work in the second half of 2010.

Energinet.dk is contributing to this and has initiated analysis that should identify the consequences for the electricity and gas systems from the various ways of realising the political vision of fossil fuel independence.

#### Security of supply in the power system

A long-term focus on fossil fuel independence means that the role of the power system in energy supply becomes even more central than is the case today. An adequate and robust electricity

transmission grid is thus a precondition for realising the energy-political objectives for the climate, security of supply and market development in the energy sector. The electricity transmission grid must therefore be continuously expanded and adapted concurrently with the integration of large volumes of renewable energy and the increase of trading capacities to neighbouring areas.

#### The power balance

It is important for the security of supply in the future that there is adequate generation capacity to meet the demand. The power balance set by Nordel for 2012/2013 shows that the Nordic system, even on a cold winter day, will have a surplus of power.

#### Calculating security of supply

A central task for Energinet.dk is to maintain the existing high degree of security of supply also when the generating plant switches to renewable energy. Therefore, Energinet.dk is working on strengthening its ability to analyse how changes to the power system impact security of supply.

The work is based on a combined analysis of power system adequacy, which should be understood as the ability of the power system to satisfy demand at any given time, and power system reliability, which should be understood as the ability of the power system to manage sudden system disturbances.

## Security of supply in the gas system

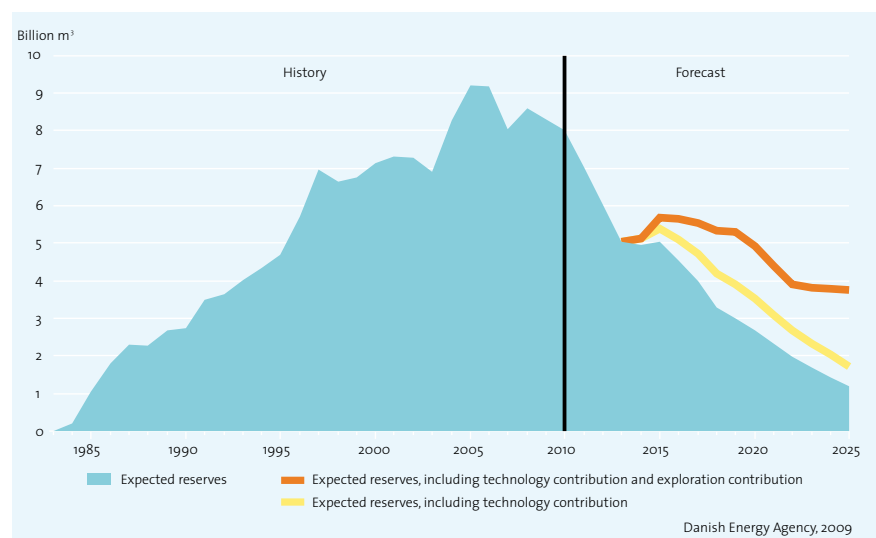
For many years, a well-functioning natural gas system has contributed a substantial share of Denmark's energy supply. Energinet.dk is tasked with ensuring that the necessary gas transmission system with the necessary capacity is made available, making it possible for the commercial players to supply Danish gas consumers.

The Danish Energy Agency estimates that natural gas production in the Danish North Sea fields will fall sharply in the coming years and possibly be virtually phased out in 2030. There is considerable uncertainty in the forecasts, see Figure 3.

Today, the North Sea constitutes the only physical possibility to pipe gas into Denmark and Sweden. Therefore, if Energinet.dk does not invest in new infrastructure that would facilitate supply to Denmark and Sweden from sources other than the Danish North Sea gas fields, there is a risk that supply issues will arise in a relatively few years. Consequently, on the background of an Open Season process, Energinet.dk has decided to work for the expansion of the existing gas infrastructure to Germany from 2013, so that the flow of gas after 25 years of constant export can be turned from export into import.

At the same time, Energinet.dk continues to explore the possibilities for establishing a pipeline which could secure access to Norwegian natural gas resources. Such pipeline would significantly support the political wishes for increased diversification of natural gas supply routes to Europe.

**Figure 3** Production forecast for natural gas in the North Sea, Danish Energy Agency 2009.



Access to natural gas has also received much attention in the EU, as the majority of European countries are net importers of gas. Domestic gas production throughout Europe is falling, while consumption is increasing. This increase is expected to continue in the coming years. By 2030, the European Commission expects that 80 per cent of the EU's gas consumption will be covered by imports. Today, imports account for approx. 50 per cent of consumption, with 25 per cent of gas imports coming from Russia.

A number of major infrastructure projects are currently being planned which are aimed at bringing more gas to Europe and contributing to greater diversification of gas supplies to the EU. New pipelines are thus being planned, for example, between Northern Europe and Russia (Nord Stream), and between Southern Europe on the one hand and Russia/Caucasus (South Stream), Northern Africa and the Middle East (Nabucco) on the other. Moreover, a number of LNG port facilities are being planned and projected in both Southern and Northern Europe.

## The gas market in Europe and Denmark

The market situation in Europe is still characterised by national markets with national spot trading, however with considerable cross-border trading. There is no established coherent spot market for natural gas in Europe. One reason for the lack of cross-border spot trading is general capacity shortages, especially at the border points, a lack of interoperability between the different national systems and as yet highly limited spot trading in several countries, including Denmark.

At European level, work is ongoing to strengthen compatibility between the systems in the individual countries. The aim of this work is to increase the scope for exchanging gas between regional hubs and to solve the problems of cross-border interoperability. This work is supported by Energinet.dk both through Gas Infrastructure Europe (GIE) and through bilateral cooperation with neighbouring TSOs.

The establishment of the Danish gas exchange Nord Pool Gas in 2008 (which is jointly owned by Energinet.dk and Nord Pool Spot) paved the way for increased

competition in the wholesale market. The establishment was a natural consequence of the liberalisation of the Danish gas market in 2004 which made it possible for all consumers to freely choose their own natural gas supplier.

Energinet.dk's role is to ensure an efficient and flexible gas market. This means, among other things, that Energinet.dk develops products and facilities that commercial players can utilise in gas trading.

### Biogas in the natural gas grid

Together with the heat and transport sectors, agriculture constitutes a key focus area for Denmark in connection with the fulfilment of requirements for the reduction of greenhouse gases in sectors not subject to the EU ETS Directive.

Most agricultural greenhouse gas emissions stem from methane and nitrous oxide emissions associated with the treatment of manure. These emissions can be significantly reduced if the manure is

used for the production of biogas over the conventional treatment of manure.

The 'Grøn Vækst' (Green Growth) agreement, entered into by the Danish Government and the Danish People's Party in the early part of summer 2009, places a strong focus on the increased utilisation of manure for biogas. The agreement aims to utilise 50 per cent of the manure for energy purposes in 2020. Today, approx. 5 per cent of manure is utilised for energy purposes. In addition, a subsidy-based parity of the sale of biogas to CHP plants and the natural gas grid, respectively, was agreed. This would open up to a future, in which biogas is transported and managed via the natural gas system, which would enable in the future the efficient integration of significantly greater volumes of biogas into the energy system than today.

If 50 per cent of the manure from animal husbandry in Denmark is utilised for the production of biogas, it would result in an overall reduction of greenhouse

gas emissions of 0.5-1 million tonnes of CO<sub>2</sub> equivalents per year<sup>4</sup>. The Danish target for reducing CO<sub>2</sub> emissions from sectors not subject to the EU ETS Directive is 7.5 million tonnes in 2020.

The majority of Danish biogas production is based on manure, and the production of biogas is therefore highest where animal husbandry is most intensive, ie in the western part of Denmark. However, energy consumption is concentrated in population centres in the eastern part of the country, which means that there is a need to send the energy eastwards. Today, this is done exclusively by utilising the biogas in local electricity generation and using the electricity infrastructure.

However, in the future, an increased need for the upgrading of and transport through the natural gas grid could arise in line with increased biogas production.

<sup>4</sup> Calculations based on data from 'Agriculture and Climate' (Danish Ministry of Food, Agriculture and Fisheries, December 2008).





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