



System Plan 2011

ENERGINET/DK



Summary



Energy is a cross-border product, and as a European transmission system operator, Energinet.dk is forming more and more collaborations of an international nature. The transition of Danish electricity and gas systems from isolated Danish grids to being a part of the larger regional energy systems is already well under way. This development is leading in the direction of more integrated European markets, more binding agreements on a common energy and environmental policy and greater regulation and coordination. All with a common understanding of the necessity of integrating and utilising renewable energy as the sustainable energy source of the future.

The Danish energy systems in their present guise are the results of effective development over the past decades based on the principles of providing energy centrally and distributing it to the individual consumers for local utilisation. The future is going to be quite different. The ongoing development is set to continue over the next 10-15 years and fundamentally change the power system. A new decentralised infrastructure in which far more energy is generated from renewable sources such as wind, sun and biomass is on the way. At the same time,

there will be more local power generation from, for instance, photovoltaic cells on the roofs of individual consumers.

Electricity will become the main energy carrier and will also be utilised in the other energy sectors in future, initially for heat and transport purposes and probably also for the production of RE gas in the longer term. A closer market coupling to other countries and fluctuating power generation increase the energy flows in the system. Moreover, the development towards decentralised, local generators requires management of both consumption and generation at the same point of settlement. All in all, changes that place additional demands on intelligent control, expansion and operation of the entire power grid. Up to 2020, the transmission grid should continue to be expanded and converted substantially with new interconnections, widespread integration of RE generation and undergrounding of numerous new and long sections.

The transition to an energy supply that is independent of fossil fuels and the interaction with electricity, heat and transport systems will significantly influence

natural gas over the next ten years. The Danish natural gas network has the potential to integrate renewable energy (RE) gases and function as an energy storage facility for other forms of energy. Consequently, gas can become an important part of the RE-based energy system.

The tasks of integrating mainly solar and wind energy require international and regional initiatives as well as strong, well-functioning electricity markets for the allocation of generation and demand. This is reflected amongst others in the EU regulations that focus on strengthening market forces through greater transparency in the markets and less friction between them. Moreover, European collaborations between the TSOs in the areas of both electricity and gas become more binding by virtue of the development of common operating standards and market principles; Energinet.dk is a driving force behind this work. This is why international relations and initiatives are a coherent theme throughout System Plan 2011.

European cooperation

At EU level, the third liberalisation package is being implemented in the member



states. In November 2010, it was followed by the European Commission's infrastructure package, *Energy infrastructure priorities for 2020 and beyond - A Blueprint for an integrated European energy network*, which is the Commission's proposal for implementing the necessary investments in European energy infrastructure. The infrastructure package has been followed by several legislative initiatives, which are scheduled for negotiation during the Danish presidency of the EU in the first half of 2012.

The organisational framework for working with the infrastructure package is the European TSO organisations within the areas of electricity and gas, ENTSO-E and ENTSOG, which were established as a result of the liberalisation package.

Within the area of electricity, the initial phase of establishing and organising ENTSO-E is over, and it is now a matter of implementing the obligations from the third liberalisation package. In particular, the preparation of the European market rules has begun in earnest in 2011. Teams of technical experts have been established in ENTSO-E to define the task and technical content of the market rules and

prepare the first drafts. The first market rules to be prepared are *Network Codes* for intraday, day-ahead (spot) and capacity calculations, followed by the market rules for the balancing market in 2012. The work with market rules should be completed and approved by the European Commission by the end of 2014.

Concurrent with the preparation of the rules, the coupling of the European markets is progressing at regional level. Since November 2010, the spot markets in the Nordic countries and the CWE region (Germany, Holland, Belgium, Luxemburg and France) have been coupled together in a temporary market coupling arrangement. This solution has been developed by TSOs, exchanges and EMCC (*European Market Coupling Company*) in a regional pilot project under ENTSO-E. Energinet.dk had the chairmanship in the first year and continues to play a significant role in the work. The next step in the project is to implement a permanent solution, whereby market integration in the entire north-western European region is based on a price coupling that calculates exchanges and prices in a single calculation. The aim is to have the solution in place at the end of 2012.

Overall, Energinet.dk is working on the regional planning to ensure holistic and analysis-based regional planning that clarifies the socio-economic infrastructure needs. Accordingly, Energinet.dk is seeking to improve the preconditions for future European investment decisions so they can be taken on a clear socio-economic basis and to establish the framework for the future expansion of energy infrastructure throughout the EU.

Similarly, within the area of gas, Energinet.dk is actively participating in the European cooperation, ENTSOG, where focus is on developing common EU rules for cross-border trading of gas as well as strengthening coordination of the gas infrastructure in the EU. Energinet.dk has chosen to focus the Danish efforts in ENTSOG on those areas where Denmark has exceptional competencies as a role model, such as the development of market and exchange functions and the integration of renewable energy into the gas system.

Energinet.dk is collaborating with other TSOs on the preparation of regional investment plans for the gas infrastructure



in the Baltic Sea area and the north-western region of the EU. This should be seen in context of the overall ten-year plan (*Ten Year Network Development Plan*), which ENTSG issued in February 2011. The plan concludes that even though the projects that are already decided improve the overall supply situation over the ten year period, there are three regions which will have insufficient security of supply. The three regions are Denmark and Sweden, the Baltic countries as well as Poland and Lithuania. The solution to the Danish-Swedish challenges is the decided expansion of capacity between Denmark and Germany, which should in the long term be supplemented by further expansion of the German system and/or another expansion of the Danish or Swedish system.

Climate change legislation and new energy-policy agreement

As a follow up to the recommendations of the Danish Commission on Climate Change Policy, the previous government introduced in February 2011 "Energy strategy 2050", which is essentially based on the commission's recommendations concerning focus on national resources,

considerable wind power expansion and efficient utilisation of biomass.

The new government has expressed general agreement with "Energy strategy 2050" and continued many of the ideas in the strategy, which can now be seen as the previous government's proposal for the negotiations for a new energy agreement.

The new government platform shortens the time frame for realising the energy-policy objective of fossil fuel independence. The government platform determines a number of specific targets, for example concerning the emission of greenhouse gases, which should be reduced by 40 per cent by 2020, and wind power, whereby half of Denmark's conventional electricity consumption in 2020 should come from wind. Internationally, the government will work towards an ambitious, binding climate change agreement and an increase in the EU's target for the reduction of CO₂ from 20 per cent to 30 per cent by 2020, followed by binding targets beyond 2020.

The specific targets in the government platform should be included in future climate change legislation, which the

government will propose in 2012. Until then the energy sector targets in the government platform are expected to be included again in the proposal for the coming energy agreement. This agreement is expected to strongly emphasise a financed transformation of the energy sector that should create jobs and green growth in Denmark. Similarly, we are probably looking at a future of significantly more biomass in the power stations and more biogas and gasification gas, which should in time replace natural gas.

The power system

In future, the largest energy source in the power system will be wind power. Efficient utilisation of electricity in other sectors is essential for the achievement of climate change and energy-policy objectives. The wind power expansion requires a strong European infrastructure and international markets. This places great demands on the transmission grids. Moreover, the long-term grid structure has also been established until 2030 on the basis of requirements for security of supply, market functioning, wind power utilisation and considerations with regard to preparedness. In



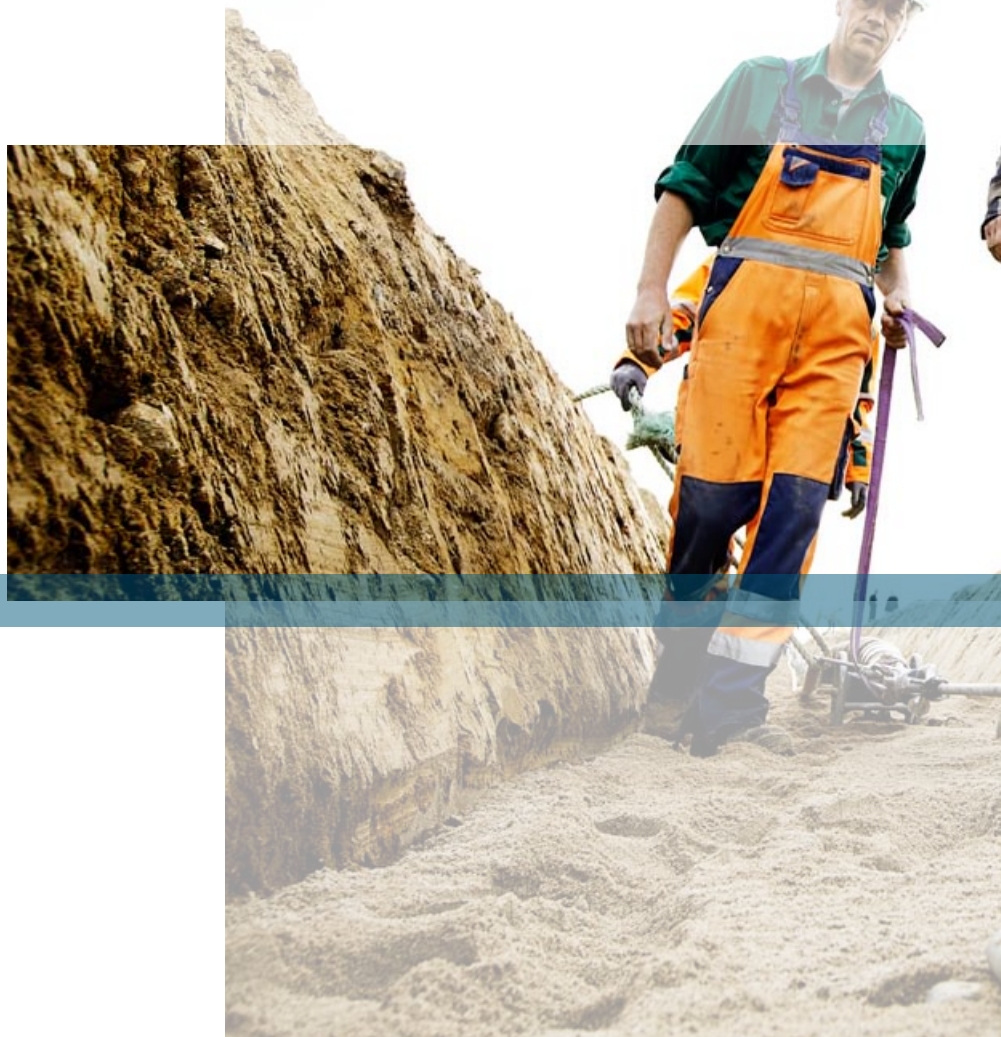
addition, consideration for the visual environment is of great significance.

In connection with the establishment of the long-term grid structure, Energinet.dk is continuously assessing a number of potential construction projects, which if realised would influence the development of

the main transmission grid. These mainly concern the COBRACable to Holland, connection of the offshore grid at Kriegers Flak, a connection between Jutland and Zealand, connection of a new 400 kV link which the German TSO, *TenneT TSO GmbH*, is planning on the west coast of Germany, and a 400 kV connection to

Sweden across the Øresund, to replace the North Zealand 132 kV connection.

To ensure a transparent electricity market in which market players and other stakeholders can take informed decisions, Energinet.dk has in dialogue with the market players prepared a new strategy



for ancillary services. The main element in the strategy is to achieve access to the necessary regulation resources via larger markets, in which there is efficient and fair competition, while ensuring numerous commercial outlets for Danish suppliers. Increased internationalisation is an important means to achieve this.

In general, the development of the electricity market is characterised by increased internationalisation and the implementation of common European market models. Ensuring a socioeconomically optimal utilisation of transmission connections is essential for the development of the markets.

A well-functioning retail market with price-sensitive demand depends to a large extent on informed, active consumers who react to differences in the market prices. To reinforce the consumers' incentives to become demand responsive, a variety of new initiatives are being developed in the electricity market, including flexible settlement systems, DataHub, single invoicing and "*the third settlement group*". The latter is a form of settlement, in which the demands for validation and

deadlines are adjusted so that the additional costs of hourly-based settlement can be reduced. This enables the introduction of demand response incentives to a wider range of customers and contributes to a gradual transition towards genuine hourly settlement.

In the future, increased volumes of renewable energy will create a growing need for balancing services at European level and as a consequence increasing pressure on Energinet.dk's costs of balancing the power system. Energinet.dk is therefore working towards a further development of markets for balancing services at European level.

The power system of the future requires changes to its design as well as the establishment of an updated communications and management system that could commercially and technically utilise the numerous distributed resources. Energinet.dk operates with a concept that describes such management of the power system. The concept is a model for how updated data communication between players in the power system, both commercial and grid companies, can contribute to the management of the power system of the future. The model is based on market mechanisms and outlines the possibilities of the distribution network and electricity customers to contribute via supply of services to the



interconnected power system, otherwise known as Smart Grid. The concept identifies the potential needs for ancillary services in a power system, in which half of the energy is derived from wind. Moreover, it suggests how the ancillary services can be provided in a socioeconomically efficient manner and with robust technical solutions.

In the coming years, the development of Smart Grid solutions in Denmark will focus on cooperation for the implementation of future communications and control concepts in the power system. This should support the integration of electric vehicles and heat pumps as well

as efforts to make conventional power demand responsive. Much of the Smart Grid expansion should occur in the regional power grids. Close cooperation between key players in the industry should ensure harmonised and standardised solutions.

The natural gas system

The transition to a Danish fossil-fuel independent energy system is in itself a significant challenge for the natural gas network. Consequently, Energinet.dk is analysing the role of the gas system in the transformation of the energy system. In the analysis into the future role of gas and the possibilities of creating flexibility in an energy system based on renewable

energy, Energinet.dk is also working on the potential of biogas and other RE gases to provide flexibility.

According to the Danish Energy Agency, natural gas production in the Danish North Sea fields will decrease significantly in the coming years and may be virtually phased out by 2040. However, these projections are by no means certain. Energinet.dk has a constant focus on alternative supply options for gas to Denmark and continuously monitors the need for greater capacity in the supply of gas.

The regulation of the European Parliament and of the Council of Ministers



on security of natural gas supply came into force in December 2010. It reflects Europe's increased focus on security of supply at a time when the member states' own overall gas production is falling and gas imports from third countries are increasing. The regulation imposes a minimum EU standard for handling the security of supply task while still allowing the individual member states to establish more extensive requirements. The existing set of rules and procedures should be reviewed in the course of 2012 with a view to ensuring that Denmark complies with the framework of the regulation.

A number of indicators point to an increased need for gas storage, such as the EU security of supply regulation, expansion of infrastructure (the North Sea, Germany, Norway), the development of the Danish and Swedish gas markets as well as the need for gas-fired peak-load units for managing wind power fluctuations.

The import of natural gas from other sources than the Danish North Sea fields requires a decision on how to deal with natural gas that does not meet the Danish Gas Regulation's gas quality

standards. Energinet.dk has conducted a technical and socioeconomic analysis which shows that adjusting the Gas Regulation and ensuring the adjustment of sensitive equipment instead of treating the natural gas is acceptable with regard to safety and is the economically most advantageous solution.

Interaction between energy systems

Energinet.dk has carried out a number of analyses on the interaction between gas, electricity and heat aimed at providing extensive knowledge, particularly about the dependency of heat supply on electricity and gas. The objective of the analyses has been to qualify Energinet.dk's annual projections of natural gas consumption and highlight the possibilities for higher efficiency through interaction between energy sectors.

In the coming years, research and development will focus more intensively on finding solutions for the intelligent integration of renewable energy into the power system and the integrated planning of several energy systems such as the power system, the gas system, the heat systems and the transport sector.

One of the major challenges for the Danish objectives within the field of energy is the conversion of the transport sector, in which an interaction with the power system is obvious. Work is under way to integrate electric vehicles into the power system both nationally and internationally



to maximise the value of the renewable energy and even out fluctuations in power generation, it is vital that the energy system is responsive both in relation to energy sources and demand. Overall efficiency can be ensured by integrating the electricity, gas, heat and transport sectors as well as developing systems for energy storage. This holistic view of the energy system will continue to be even more decisive, right from research, development and demonstration to the actual energy planning and operation of the systems.

and there is broad political consensus on the feasibility of doing this.

The utilisation of gas in transport also holds a potential which is about to be analysed. However, the size of this potential and the budget for developing suitable

infrastructure have not been identified to the same extent as for electric vehicles.

The energy system of the future is based on renewable energy, of which the largest energy source is fluctuating and enters through the power system. In order



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