ENERGINET

SECURE SUPPLIES ARE SHARED SUPPLIES

ANNUAL REPORT 2018

SHORT VERSION

ENERGINET, TONNE KJÆRSVEJ 65, DK-7000 FREDERICIA, CVR NO. 28980671

FOCUS ARTICLES

In 2018, all parties in the Danish Parliament (Folketinget) undertook binding political commitments regarding a new energy agreement. The three focus articles in the annual report provide a picture of the energy agreement's perspectives for Energinet's work.

FOCUS ARTICLE

FLEXIBLE CONSUMPTION TO PAVE THE WAY FOR GREEN TRANSITION

PAGE 24

FOCUS ARTICLE

GREEN TRANSITION REQUIRES NEW ELECTRICITY HIGHWAYS

PAGE 28

FOCUS ARTICLE

GREEN GAS CROSSES BORDERS

PAGE 32

CONTENTS

THE BIG PICTURE

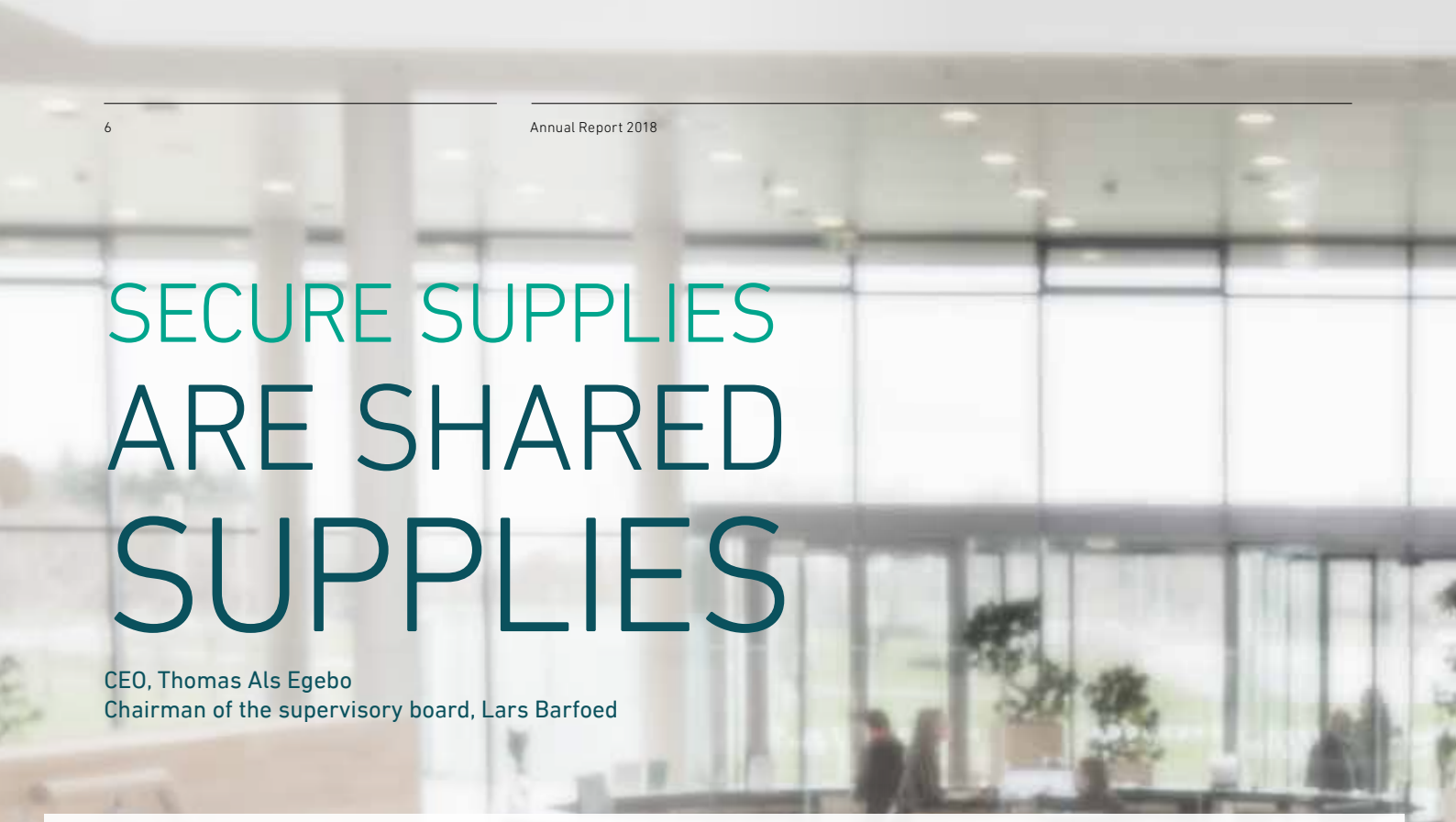
FOCUS ARTICLES

This is an abbreviated English-language excerpt from Energinet's annual report for 2018. The complete statutory annual report providing an extensive account of the year's activities and financial statements is available in Danish here: www.energinet.dk/aarsrapport2018

Energinet, March 2019
Document number: 18/02363-1

THE BIG PICTURE

THIS WILL GIVE YOU AN IDEA OF WHAT SORT OF COMPANY ENERGINET IS, WHAT WE ACHIEVED IN 2018 AND HOW WE LOOK AT THE FUTURE.



SECURE SUPPLIES ARE SHARED SUPPLIES

CEO, Thomas Als Egebo
Chairman of the supervisory board, Lars Barfoed

STATUS

Since the establishment of Energinet in 2005, one of the company's most important tasks has been to create the physical and system-related framework for open energy markets, energy connections and cross-border cooperation on system operation.

Renewable energy from solar and wind power cannot be stored on a large scale, and the energy generation cannot be planned independently of wind and weather. A considerable share of renewable energy must therefore be transported and used immediately after being harvested. The necessity of being able to share energy resources across countries and sectors is therefore increasing in step with the share of renewable energy increasing, not only in Denmark but also in the surrounding countries' energy mix.

In our 'Energy across borders' strategy, we have named this trend and its inherent challenge for the energy sector by making it clear that 'secure supplies are shared supplies'. The green transition requires that the resources used to safeguard Danish energy supplies must to an increasing extent be supplemented by cross-border markets and partnerships.

For Energinet, 2018 may be seen as a time of change in terms of the development towards secure supplies being shared supplies. A time of change in the sense that a number of the milestones reached during the year concerned this development – either because they boosted the development, or because, the other way around, they were indications of challenges with this development.

If we first take a look at Energinet's work in 2018 on establishing physical energy connections to the UK, the Netherlands, Germany and Poland, there is no doubt that this work has contributed to ensuring that secure supplies are shared supplies. Important milestones were reached. However, many citizens have expressed resistance and concern about the related infrastructure, not least in the form of the prospect of having electricity pylons and overhead lines installed in the areas in the western part of Jutland where they live. Therefore, it has been especially important for Energinet to spend time on a dialogue with the citizens and on examining all possibilities of limiting the nuisance for the citizens.

If we then look at the part of Energinet's work in 2018 which aimed at creating the market-related energy connections across national borders and across boundaries between players in the value chain, there are signs of both progress and challenges.

The realisation of market expansions, which has been decided in the EU, made great strides. The Nordic TSOs entered into an important agreement on market platforms for exchanging balancing services across borders, and activation of consumption flexibility is seeing a budding development.

The fact that the expansion of the internal market in the energy area has not yet been completed, however, is also evident in Energinet's 2018 working year. One of the signs of this is that, following analyses, Energinet had to recommend a temporary strategic reserve (read more on page 14) as a means of strengthening a declining level of security of supply in Eastern Denmark in the coming years. Just temporary, until market reforms and regional cooperation have been fully realised. Another sign is that there are still capacity limitations in the electricity grid across the Danish-German border, although a bright spot in this context is the coming capacity increase in 2019.

Energinet is working continuously on streamlining operations, and in the coming years, we will pursue clear and ambitious targets for more efficient operations.

OUTLOOK

These years, the climate is moving higher and higher up on the agenda. All parts of society and politicians, the corporate sector and citizens have increasing focus on the climate challenges.

In 2018, the Intergovernmental Panel on Climate Change (IPPC) and other international institutions issued climate warnings, emphasising the need to take the right measures if we want to safeguard the living conditions on our planet.

Society has entrusted Energinet with a vital role in the green transition, and we are dedicating our resources to cooperating with all relevant parties on finding and realising the best solutions.

Cooperation with stakeholders is a top priority for Energinet, and with a new stakeholder policy, we are dedicating ourselves to continually improving our ways of working together.

Society's significantly increased focus on the climate agenda is both necessary and welcome, as the challenges in the energy sector will only grow in the coming years when the energy systems are to be converted from being able to handle approx. 50% renewable energy to handling 100% renewable energy.

Denmark and the EU's political ambitions for the energy and climate area were thus also raised in the course of 2018, and this can be seen in light of the increasing evidence for the urgency of it all. It is vital for the green transition that cooperation on the physical energy infrastructure, on open energy markets and on the operation of energy systems across borders be continued and intensified.

Digitalisation plays a crucial role in terms of maintaining the momentum of the green transition. We must increase the share of renewable energy and maintain a high level of security of supply in the most cost-effective ways. Digitalisation constitutes an important part of the answer to this challenge, and Energinet therefore now increases its focus on digitalisation.

Overall, the momentum of the green transition will have a significant impact on Energinet's work. In 2018, the Danish Parliament (Folketinget) entered into a new energy agreement, which – particularly in three areas – sets the stage for the main challenges and initiatives for Energinet in the coming years.

Firstly, the continued expansion of offshore wind is a main theme in the energy agreement with three new offshore wind farms. The preparation of the electricity grid's capacity to receive the power from the offshore wind farms onshore is one part of the task, while another part is the considerable unexplored potential inherent in utilising the excess power for renewable energy products, among other things by linking the electricity and gas sectors closer together. (Read more on page 29 and page 33).

Secondly, the development of a national gas strategy constitutes a working point in the energy agreement. As transmission system operator and owner of the physical infrastructure for the gas in Denmark, Energinet has a significant responsibility for the green transition of the gas system. (Read more on page 33). The adaptation to local production and upgrading of green gases, which can then be transported over longer distances, are just a few of the tasks.

Thirdly, market development, digitalisation and increased stimulation of consumption flexibility form part of the energy agreement and are referred to under the heading 'market model 3.0'. While increased volumes of renewable energy in energy generation could play a dominant role in the first phase of the transition, the activation of more flexible consumption is becoming increasingly necessary on the path towards 100% renewable energy in energy supplies. Energinet must help to accelerate this development. (Read more on page 25).

VALUE CHAIN

RESOURCES 2018

FINANCIAL

2.7 DKK BILLION GRID AND SYSTEM TARIFFS
2017: 2.7

0.4 DKK BILLION GAS TRANSMISSION TARIFFS
2017: 0.4

28 DKK BILLION LOANS WITH DANMARKS NATIONALBANK
2017: 26

PHYSICAL

6,930 KM HIGH-VOLTAGE GRID
2017: 6,956

926 KM GAS PIPELINES (TRANSMISSION NETWORK)
2017: 926

7 INTERCONNECTIONS, 2 GAS CONNECTIONS AND 5 ELECTRICITY CONNECTIONS
2017: 7

8,465 KM GAS DISTRIBUTION NETWORK
2017: 6,600

2 GAS STORAGE FACILITIES
2017: 2

HUMAN

1,264 AVG. NO. OF EMPLOYEES
2017: 1,151

75* EMPLOYEE SATISFACTION
2017: 75

2.3 % ABSENCE DUE TO ILLNESS
2017: 2.0%

>80 DIALOGUE MEETINGS WITH CITIZENS AND MARKET PLAYERS
2017: 60

Energinet is charged with integrating renewable energy, ensuring equal access to the grids and ensuring security of supply in Denmark. The above examples of resources and results are intended to provide an immediate idea of what Energinet does. Some results are associated directly with Energinet's activities, while others are more indirectly related to Energinet.

RESULT 2018

SECURITY OF SUPPLY

11 SEC. NON-SUPPLIED ELECTRICITY
2017:. 92 SEK.

ZERO GAS SUPPLY FAILURE
2017: NUL

3.7 BILLION NM³ TRANSPORTED GAS
2017: 3.4

3.9 ON THE CMMI SCALE IT MATURITY
2017: 3.6

85*** STAKEHOLDER ASSESSMENT
2017: 86

RENEWABLE ENERGY

40.7 % OF DANISH ELECTRICITY CONSUMPTION COVERED BY WIND POWER
2017: 38

9** % OF DANISH GAS CONSUMPTION COVERED BY BIOGAS

81*** STAKEHOLDER ASSESSMENT
2017: 82

MARKET DEVELOPMENT

5.6 % CHANGE OF ELECTRICITY SUPPLIER
2017: 5,6%

83 % OF DANISH GAS CONSUMPTION TRADED ON GASPOINT NORDIC
2017: 57

77*** STAKEHOLDER ASSESSMENT
2017: 79

* Employees' assessment of satisfaction is from 2017. Employees answer questions about job satisfaction in a total of nine areas, with the index figure representing the aggregate employee satisfaction score. The model is called 'Global Employee and Leadership Index', which is a recognised and widely used method among Danish and international businesses. Energinet conducts an employee satisfaction survey every other year. ** In December 2018, biogas had reached a share corresponding to 9% of annual Danish gas consumption. *** Each year, in an online questionnaire Energinet's selected stakeholders are asked about their assessment of Energinet's performance of tasks. Responses are measured in an index where 100 is the most positive assessment.

ENERGINET

– How we perform our role

GRID

Energinet operates and develops electricity and gas grids and gas storage facilities in Denmark, and we establish energy interconnectors.

ENERGINET

The subsidiaries are working on different parts of the energy system. Thereby, they contribute to ensuring Energinet's overall ability to play the roles and perform the tasks in the green transition with which we have been entrusted by society.

ELECTRICITY TRANSMISSION

... converts and maintains Danish electricity grids and establishes interconnectors.

ELECTRICITY SYSTEM OPERATOR

... develops electricity markets and is responsible for the day-to-day security of electricity supply.

DATAHUB

... ensures uniform access to data on energy consumption and energy generation for players in the electricity market.

GAS TSO

... converts and maintains the Danish gas grid, develops gas markets and is responsible for the day-to-day security of gas supply.

DANSK GAS DISTRIBUTION

... supports the operation of the gas grid at distribution level, ensuring a stable and secure supply of gas to gas customers.

GAS STORAGE DENMARK

... contributes to security of supply in Denmark and sells storage services in the northwestern European gas market.

SYSTEM

Energinet has the day-to-day and long-term TSO responsibility for the overall electricity and gas system in Denmark.

MARKET

Energinet participates in the development of energy markets and market rules in Denmark, the Nordic countries and the EU.

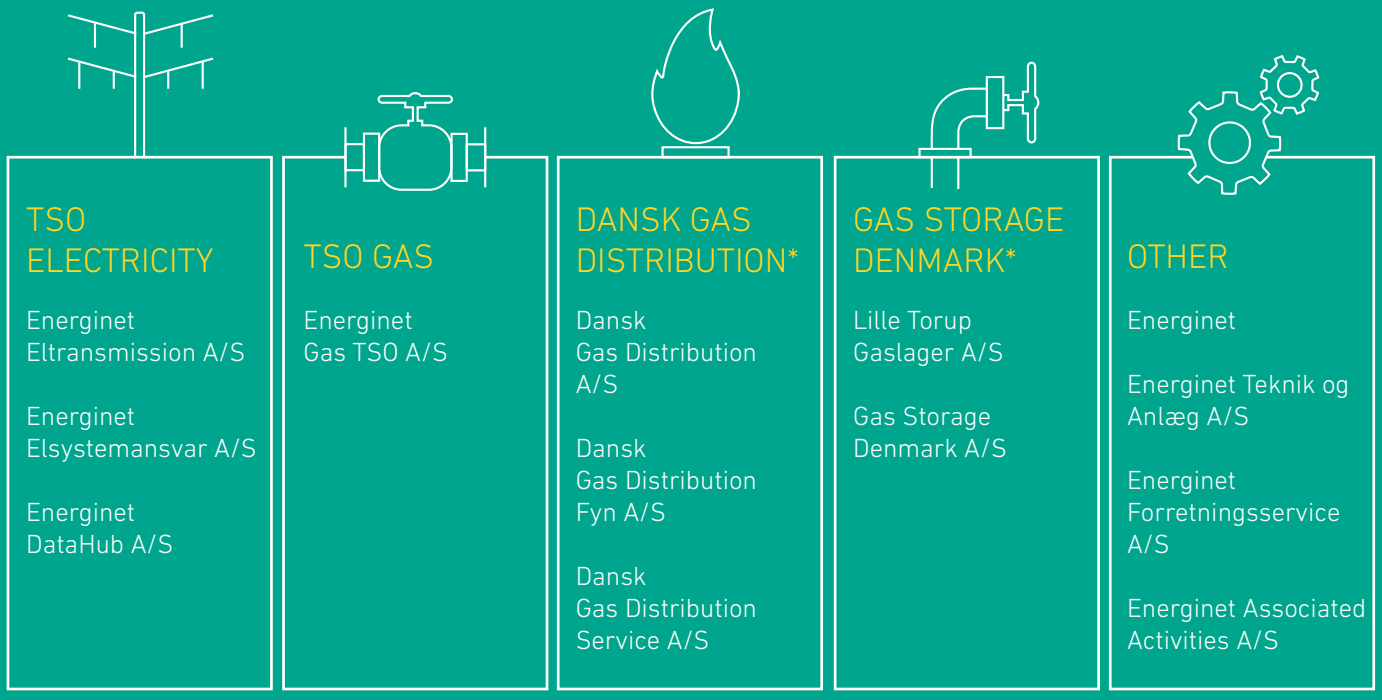
TASK

Energinet is part of the green transition. We convert the electricity and gas system to enable 100% renewable energy and to maintain a high level of security of supply.

Energinet is an independent public enterprise owned by the Danish state for the purpose of ensuring public control of critical infrastructure for electricity and gas. Energinet was established by the Danish Parliament (Folketinget) by an act of law in 2005, and its ownership falls under the Danish Minister for Energy, Utilities and Climate. Energinet's core tasks are to integrate renewable energy, ensure equal access to the grids and ensure security of supply in Denmark.

FINANCIAL REVIEW

Energinet's income stems primarily from tariffs, which are collected from the consumers, and which are subject to special legislation and supervision.



TSO ELECTRICITY

Energinet Eltransmission A/S

Energinet Elsystemansvar A/S

Energinet DataHub A/S

TSO GAS

Energinet Gas TSO A/S

DANSK GAS DISTRIBUTION*

Dansk Gas Distribution A/S

Dansk Gas Distribution Fyn A/S

Dansk Gas Distribution Service A/S

GAS STORAGE DENMARK*

Lille Torup Gaslager A/S

Gas Storage Denmark A/S

OTHER

Energinet

Energinet Teknik og Anlæg A/S

Energinet Forretningsservice A/S

Energinet Associated Activities A/S

** Also includes holding companies*

In its financial statements, Energinet determines income and expenses for each of the five accounting areas above.

NET PROFIT FOR THE YEAR
DKK MILLION

54

2017: -228

Net profit for the year is satisfactory.

BALANCE SHEET TOTAL
DKK BILLION

47

2017: 45.6

The balance sheet total increased primarily as a result of fixed asset investments.

DEFICIT
DKK MILLION

67

2017: 232 IN EXCESS REVENUE

The accumulated excess revenue at 31 December 2018 was DKK 176 million compared with DKK 243 million in 2017.

CORPORATE TARGETS

Energinet's corporate targets are indicators for whether our activities create value for society.

OPEX
(INDEX)

91/86 ELECTRICITY/GAS

TARGET: 91/99

TSO ACTIVITIES

STAKEHOLDER ASSESSMENT
(INDEX ON AVERAGE)

70 AVERAGE ASSESSMENT OF ENERGINET'S TASKS*

TARGET: 73

TSO ACTIVITIES

CAPEX
(INDEX)

81

TARGET: 88

TSO ACTIVITIES

GAS STORAGE DENMARK

3.7/35 RETURN ON CAPITAL EMPLOYED/SOLVENCY RATIO

TARGET: 4/30-40

REPAIRING EXCAVATION DAMAGE WITHIN 3 HOURS (%)

93

TARGET: 90

DGD

DANSK GAS DISTRIBUTION

1.2/15 RETURN ON CAPITAL EMPLOYED/SOLVENCY RATIO

TARGET: 3/30-40

NON-SUPPLIED ELECTRICITY (SEC.)

11

TARGET: MAX. 60

TSO ELECTRICITY

EMPLOYEE SATISFACTION
(INDEX)

75 THE FIGURE IS FROM 2017

TARGET: 76

JOINT CORPORATE TARGETS

GAS SUPPLY FAILURE

ZERO

TARGET: ZERO

TSO-GAS

ABSENCE DUE TO ILLNESS (%)

2.3

TARGET: 2.0

JOINT CORPORATE TARGETS

INFORMATION SECURITY

3.9

TARGET: 4.0

JOINT CORPORATE TARGETS

OCCUPATIONAL INJURIES

4.4 PER MILLION WORKING HOURS

TARGET: 4.0

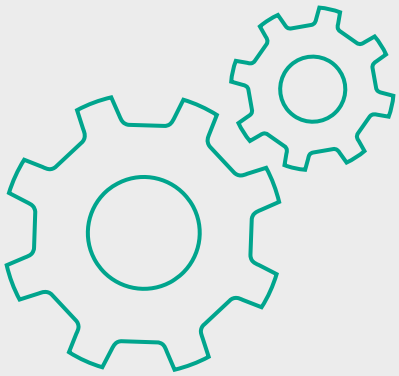
JOINT CORPORATE TARGETS

■ The target was not reached.

Energinet's corporate targets have been set by the Board of Directors in cooperation with Energinet's owner (the Danish Minister for Energy, Utilities and Climate). The graph above shows an overview of the targets and the relevant results for 2018.

OPEX: Operating expenses. The lower the number, the better the result. CAPEX: Construction costs The lower the number, the better the result. See also key figures and ratios on page 146.

*Selected stakeholders are asked about their assessment of Energinet's performance of tasks. Responses are measured in an index where 100 is the most positive assessment.



STRATEGIC OBJECTIVES

NEW SECURITY OF SUPPLY FRAMEWORK

Energinet cooperates with the energy sector on developing the new framework for security of supply, which the transition of the energy system requires.

Energinet is involved in a number of national and international partnerships on security of supply with public authorities, market players and other TSOs.

STATUS

Most important milestones and activities in 2018:

- In the coming years, security of supply in eastern Denmark will be challenged by increased electricity consumption and the phasing out of power plants. As this is the best socioeconomic solution, Energinet decided in 2018 to enter into dialogue with the Danish energy authorities about the possibility of applying to the European Commission for approval of a temporary strategic reserve in eastern Denmark.
- Energinet entered into a partnership agreement with the other Nordic electricity TSOs on the establishment and operation of the 'Nordic Balancing Model'. The development of common IT systems and mutual rules on trading is to make it possible for services which create balance in the electricity grid to be traded and delivered across borders.
- In February and March, Energinet declared an Early Warning, which is the lowest crisis level in the Danish model for security of gas supply. Unusually cold weather in Europe created a high demand for gas in Europe, and too much gas was about to be traded out of Denmark. No consumers were disconnected.
- Energinet continued connecting more biogas plants to the distribution network, and the first plants which are to supply excess biogas from the distribution network into the gas transmission network were also completed.

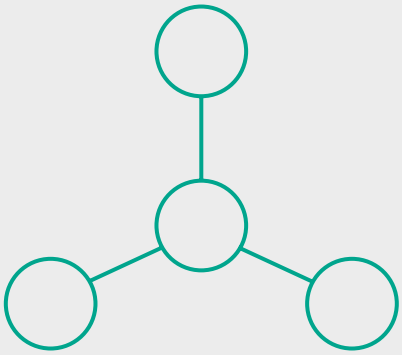
ASSESSMENT

Executive Board's assessment:

In 2018, Energinet's work contributed to developing a new framework for security of supply. The new framework is to ensure that security of supply is maintained at a high level in Denmark, also in the coming years, as the green transition moves forward.

Energinet's work is based on ambitions of security of supply to a high extent being safeguarded by markets which are well-functioning and wisely regulated. This is in line with political desires in Denmark and in the EU. The work on preparing an application for a temporary strategic reserve should therefore be seen precisely for what it is, namely temporary, and should, in Energinet's opinion, become superfluous once the development of the European and Nordic energy markets is at a more advanced stage than today.

The expansion of the energy markets in the Nordic region and the strengthening of the future security of supply, which this expansion entails, took an important step forward with the conclusion of the agreement on the 'Nordic Balancing Model'. In the gas area, experience from the Early Warning in 2018 showed the importance of close cooperation with the market players on security of supply, and the crucial importance of the gas storage facilities to Danish security of gas supply also became clear. Experience showed that incentives in the market may result in a step in the wrong direction in relation to security of supply.



STRATEGIC OBJECTIVES

DENMARK AS AN ENERGY HUB

Energinet is working to strengthen Denmark's position as an energy hub between the Nordic countries and Europe.

Energinet is in the process of preparing for and establishing a number of interconnections to ensure that electricity and gas can be traded and transported between countries in Europe to an even greater extent.

STATUS

Most important milestones and activities in 2018:

- Together with Polish GAZ-SYSTEM, Energinet made the final investment decision on the realisation of Baltic Pipe, a gas pipeline making it possible to transport natural gas between Norway, Denmark, Sweden and Poland.
- Platforms for collecting wind-generated electricity by the coming Kriegers Flak offshore wind farm have been successfully established, and the submarine cables which are to interconnect the Danish and German electricity grids via the platforms have been connected.
- Viking Link, a planned electricity connection to the UK, was delayed for about a year as a result of outstanding issues in British planning permissions.
- A public consultation on the planned reinforcement of the high-voltage grid in the western part of Jutland met with strong protests from citizens.
- Based on the citizens' resistance, Energinet was charged with carrying out a supplementary technical investigation of alternatives to 400 kV overhead lines in the western part of Jutland. This showed that up to 15% of the route can be placed underground. A conclusion which was later confirmed by an independent, international consulting firm.

ASSESSMENT

Executive Board's assessment:

In 2018, Energinet's work on interconnections helped to strengthen Denmark's position as an energy hub. Baltic Pipe will turn Denmark into a transit country for gas between the Nordic countries and the European continent. The operation of the Danish gas system, which plays a crucial role in the green transition, will be considerably less costly for the consumers than if the Baltic Pipe project was not realised. The pipeline is thus expected to result in tariff reductions of DKK 1.9-2.9 billion in present value.

There is a need for the energy sector to cooperate on creating a framework for more widespread and earlier dialogue with citizens about infrastructure needs. The experience from 2018 shows this based on the strong and understandable protests voiced, particularly against the new 400 kV overhead lines in the western part of Jutland.

Expansion with intrusive infrastructure will also be necessary in the future, when more renewable energy is to be integrated at Danish and European level. Therefore, there is an increasing need for continuous and well-qualified public information and debate about the energy infrastructure between all relevant parties in society.

STRATEGIC OBJECTIVES

SOCIAL RESPONSIBILITY THROUGH EFFICIENCY

Energinet is working to supply the Danes with sustainable energy using the most cost-effective means available.

Upon political request, Energinet is in the process of acquiring and consolidating the gas distribution sector with the aim of realising the potential for efficiency improvements and promoting the transition of the gas system to renewable energy. Internally, Energinet is working continuously to streamline operations, including through organisational adjustments.

STATUS

Most important milestones and activities in 2018

- Energinet completed the acquisition of the gas distribution network on the island of Funen and, in the course of the year, successful integration with Energinet's subsidiary Dansk Gas Distribution A/S was achieved. One important element in the consolidation of the gas distribution sector was thus realised.
- In 2018, Energinet completed a major organisational restructuring resulting in an actual group structure with subsidiaries which, via their own Boards of Directors and Executive Boards, operate their business, are subject to somewhat different conditions and pursue specific, unique potential falling within the Group's overall mission.
- Energinet entered into a conditional purchase agreement with HMN Naturgas A/S on the acquisition of their gas distribution network in Northern and Central Jutland, in the greater Copenhagen area and in northern Zealand. With this purchase agreement, the total Danish gas distribution network is now gathered under Energinet and is thus state-owned.
- Energinet has intensified its cooperation with the Danish Energy Agency and with the Danish Ministry of Energy, Utilities and Climate on developing a new strategic investment plan and on developing the technical framework for new financial regulation of Energinet.

ASSESSMENT

Executive Board's assessment:

In 2018, Energinet's efforts to consolidate the gas distribution network contributed to shouldering social responsibility through efficiency. The Danish gas grid is facing extensive changes on the road towards the green transition, and the consolidation of the gas distribution network under the same owner will contribute to Danish gas consumers in the future being able to benefit from increasing volumes of green gas with the help of a cleverly utilised gas infrastructure.

Internally, Energinet is dedicated to continuously raising the Group's productivity, which is to be realised through, for example, focused operation of the new group structure with independent subsidiaries. In addition, the development and implementation of the new financial regulation of Energinet is to underpin the Group's ability to handle the long-term development of the energy system during the green transition in the most effective ways.

STRATEGIC OBJECTIVES

DIGITALISATION

Energinet is working to utilise the potential in digitalisation for smarter operating solutions and for new, innovative business models in the energy sector.

Energinet is at an early development phase within digitalisation, but is moving full steam ahead with both the development of concrete digitalisation projects and the build-up of the organisation's approach and competencies.

STATUS

Most important milestones and activities in 2018:

- In spring, Energinet brought together high-ranking representatives from international companies etc. to share knowledge and network at the conference 'Green ambitions and digital promises – a power couple of the future'. Read more at www.energinet.dk/digi.
- A number of experiments and development projects regarding digitalisation have been launched in order to ensure more efficient utilisation of Energinet's resources and to improve Energinet's performance of tasks in relation to the operation of the energy system. The projects are wide-ranging, from cooperation between Energinet and the Danish Meteorological Institute (DMI) on data from solar cells to algorithms predicting the migration of gas underground. Read more about the projects at www.energinet.dk/digi.
- Energinet supports current and future digital-based business models by making massive amounts of data about Danish energy consumption available via the DataHub and Energy Data Service, Energinet's open data portal on consumption and generation in the Danish energy system. (Read more on page 52).
- In the second half of 2018, Energinet initiated work on a digital strategy, which will be presented to the Board of Directors for approval at the beginning of 2019. Energinet has also appointed a director of digitalisation, who reports directly to CEO Thomas Egebo.

ASSESSMENT

Executive Board's assessment:

In 2018, Energinet contributed to increased digitalisation of its own operations and to creating a framework for tomorrow's innovative digital solutions and business models which are becoming more and more necessary in the green transition. But Energinet's work in 2018 first and foremost resulted in the launch of both experimental and systematic efforts aimed at enhancing Energinet's ability to harvest the potential of digitalisation in a more comprehensive and efficient manner going forward.

Energinet realises that it is at an early stage in relation to digitalisation. In turn, the Group's activities and initiatives so far should be seen as an expression of a clear recognition of the fact that digitalisation is a crucially important development area, if Energinet is to succeed with its tasks in the green transition.

EXECUTIVE BOARD'S PRIORITIES FOR 2018

Energinet adopted a number of strategic priorities for 2018. The one-year strategic priorities each contribute to one or more of the four overall objectives, which Energinet has adopted for the 2018-2020 strategy period. Read more on page 15.

GAS INFRASTRUCTURE SUPPORTING GREEN TRANSITION

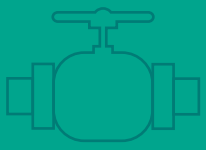
Today, green gas is used to support the green transition to a limited extent only. The socioeconomic value of the gas system can be better utilised if green gas is developed for use in, for example, heavy transport, heating using hybrid solutions etc. Energinet supports the green transition of gas by making knowledge, data and analyses available, and by entering into partnerships with relevant experts and stakeholders.

DIGITALISATION – DEVELOPMENT OF APPROACH, COMPETENCIES AND SOLUTIONS

New technologies within digitalisation (eg artificial intelligence, machine learning, drone technology and software robots) harbour great and absolutely necessary potential for the implementation of the green transition. For Energinet, digitalisation is a high-priority development area, and we focus on supporting new digital business models and on streamlining own business processes and plant operations by means of digital technologies.

MAJOR CONSTRUCTION PROJECTS PROGRESSING AS PLANNED

At present, Energinet has been tasked with realising a large portfolio of construction projects which, in an energy-historical perspective, are extensive and complex. This concerns, among other things, electricity and gas interconnections to the UK, the Netherlands, Germany and Poland as well as, for example, reinforcement of the electricity grid in the Copenhagen area. The socioeconomic gain from the large investments depends to a considerable degree on the construction projects being completed on time.



BASIS FOR INVESTMENT DECISION ON BALTIC PIPE

Baltic Pipe, a new gas pipeline between Denmark and Poland, will result in more cost-effective utilisation of the Danish gas system. The gas pipeline will also contribute to achieving the European climate targets and to increased diversification of gas sources in the European gas market. Energinet has worked to create a design concept for the construction of Baltic Pipe that ensures the best possible socioeconomic gain.

GAS SUPPLY DURING TYRA PLATFORM RENOVATION

The Danish gas supply will be challenged when the Tyra platform in the North Sea is shut down in the period 2019-2022. The Tyra platform covers approx. 90% of Danish and Swedish gas consumption, and while the platform is shut down, the markets must predominantly be supplied with imports from Germany. Energinet works to minimise the risk of supply failure due to the temporary shutdown of the Tyra platform, among other things by means of market measures and optimisation of the role played by the gas storage facilities.

CONSOLIDATION OF GAS DISTRIBUTION SECTOR

The Danish Parliament (Folketinget) has asked Energinet to handle the task of consolidating the gas distribution sector on behalf of the Danish state; a task involving acquisitions of the existing municipal and consumer-owned gas distribution companies and gathering of these into one state-owned company. A task which aims at lowering expenses for the operation of the gas distribution network as well as at preparing the network for tomorrow's green gases.

IMPLEMENTATION OF PAN-EUROPEAN NETWORK CODES

At present, a wide range of pan-European rules on system operation and the electricity market are being implemented under the auspices of the European Commission. These rules are the so-called network codes, the aim of which is to expand the internal energy market and promote the green transition. In close cooperation with Danish, Nordic and European TSOs and regulators, Energinet participates in the extensive efforts to establish market platforms and translate the network codes into daily operations etc.

STATUS

COMMENCED

The efforts are on track, but at an early stage, and several sub-targets still need to be reached before the efforts have created the intended value.

ON THE WAY

Several sub-targets have been reached, which has already created value, but other sub-targets still need to be reached before the overall efforts are completed.

COMPLETED

The most important targets of the efforts have been reached and have created value, even though activities are still linked to the efforts.

EXECUTIVE BOARD'S PRIORITIES FOR 2019

Each year, Energinet's Executive Board adopts a range of overall initiatives which together constitute the Executive Board's focus for the coming year. The Executive Board's focus consists of limited one-year initiatives which are to ensure progress for long-term strategic goals. The Executive Board's focus has resulted in a wide range of more specific initiatives in the individual companies and business areas (read more about the companies' work on pages 42-67).

ENERGINET IMPROVES PRODUCTIVITY IN 2020-2022

ENERGINET OPTIMISES GAS COMPANIES' VALUE CREATION

ENERGINET PREVENTS DECLINE IN SECURITY OF SUPPLY

ENERGINET IMPLEMENTS TRANSITION TO GREEN GAS AND WORKS FOR SECTOR COUPLING

ENERGINET IS OPEN AND COOPERATIVE

ENERGINET BUILDS ENERGY CONNECTIONS ON TIME AND WITHIN BUDGET

ENERGINET CREATES DIGITAL TRANSFORMATION

Energinet is to contribute to securing an energy infrastructure for the Danes which provides the most extensive green transition for the money. In 2019, Energinet will focus on specifying measures to improve productivity based on analyses. Energinet must prepare for a new revenue cap adjustment, which will increase the need for a cross-organisational approach to productivity increases. Therefore, a coherent KPI structure for finances and quality, among other things, was established, and ongoing monitoring and communication of productivity increases will also be given higher priority.

Energinet's tasks of converting the gas system play a central role in the green transition. After entering into a conditional agreement in December 2018 on the purchase of the last independent gas distribution company in Denmark, Energinet is to prepare the future overall organisation of the gas distribution in 2019. Moreover, Energinet will focus on ensuring a sustainable business foundation for the Danish gas storage facilities and bring the Group's knowledge into play to ensure that the gas sector is exploited optimally in conjunction with the other energy sectors.

Energinet is responsible for maintaining a high level of security of supply for the benefit of Danish citizens, businesses and institutions. A number of extensive changes to the Danish and European energy system in recent years require new approaches to maintaining security of supply. The changes concern infrastructure, market expansions and increasing Danish electricity consumption. In 2019, Energinet will focus on a call for tenders for a temporary strategic reserve, the implementation of operating systems for handling an expanded electricity grid and on avoiding gas supply failure during the shutdown of the Tyra platform.

Energinet contributes to converting the gas sector to green gases and to enabling coupling of the electricity and gas systems for the benefit of the green transition. The energy agreement from 2018 points out that Denmark must have the most market-based and flexible energy system in Europe, with energy utilisation across the electricity, heating and gas sectors. In 2019, Energinet will focus on contributing to the gas strategy which will be launched with the energy agreement. Moreover, focus will be on continued progress in connecting biogas plants to the gas grid.

Energinet is a publicly-owned company with strong social responsibility and clearly acknowledges that this entails a stricter duty of openness. In addition, in its current strategy 'Energy across borders', Energinet has registered a strong need for increased cooperation and new forms of cooperation in the energy sector if the green transition is to be realised. Energinet adopted a new stakeholder policy at the end of 2018, and in 2019 Energinet will focus on implementing the stakeholder policy ambitions through targeted initiatives and approaches.

Energinet is currently undertaking a historically large portfolio of extensive infrastructure projects contributing to the transition. The construction projects are of a complexity and a scope which present special challenges for the planning and for dialogue with stakeholders. In 2019, Energinet will focus on continued improvement of the approach to local involvement and communication, system support for project management and the introduction of a mass production approach in order to achieve construction cost reductions.

Digitalisation is one of four overall objectives in Energinet's current 'Energy across borders' strategy. Digitalisation will be a key driver in the next phase of the green transition. Energinet has dedicated itself to using digital technologies in the optimisation of its own operations and to support other players' possibilities of creating business models that promote the green transition. In 2019, Energinet will focus on creating joint and coordinated progress in the Group's and the companies' digitalisation initiatives.

FOCUS ARTICLES

IN 2018, ALL PARTIES IN THE DANISH PARLIAMENT (FOLKETINGET) UNDERTOOK BINDING POLITICAL COMMITMENTS REGARDING A NEW ENERGY AGREEMENT. THE THREE FOCUS ARTICLES IN THE ANNUAL REPORT PROVIDE A PICTURE OF THE ENERGY AGREEMENT'S PERSPECTIVES FOR ENERGINET'S WORK.


SAMMEN
Kvickly
SAMMEN
Kvickly
coop

FOCUS ARTICLE

FLEXIBLE CONSUMPTION

TO PAVE THE WAY FOR GREEN TRANSITION

Energy from weather-dependent energy sources will come to play an increasingly important role, and the energy agreement from 2018 lays down that Denmark must have an electricity system based on 100% renewable energy already in 2030. This leaves only 11 years to prepare for the total consumption of electricity in Denmark being covered by energy generation that we cannot switch on and off at will. Instead, it is therefore necessary that we become better at switching the power on and off in line with the varying generation.

Line Kamp Bräuner is market developer in Energinet Electricity System Operator's Ancillary Services department. Together with her colleague Henning Parbo, she is in regular contact with Coop's Head of Energy and Green Transition, Peter Kjærgaard Svendsen, in order to help Coop explore how the 1,100 refrigerating plants in Coop's Danish grocery shops can be enabled to provide ancillary services, ie adjust their energy consumption based on the electricity system's ongoing needs.

READ MORE »

«

Henning Parbo and Line Kamp Bräuner, Energinet, together with Peter Kjærgaard Svendsen, Coop, in Kvickly in Albertslund.

Energinet is seeing an increase in enquiries from market players such as Coop wanting to do good business while contributing to the green transition by managing their energy consumption so they can provide ancillary services. This has not always been the case, particularly for the part of the market for ancillary services where the service concerns energy consumption management, which is not particularly intuitive and still unknown territory for most people.

"But now that we're seeing an increasing number of consumers contacting us and asking about ancillary services and consumption flexibility, we're starting to believe that there is actually a constructive development in progress," says Line Kamp Bräuner and continues by pointing out Energinet's role: "We must act as sparring partners; as the ones with knowledge about the electricity system. We must help sow seeds and create ripples to enable consumption flexibility to gradually grow and contribute to the green transition."

EXAMPLES OF FLEXIBLE CONSUMPTION

The largest current potential for flexible consumption can be found in large electric boilers used, for example, at CHP plants. But the development of digital solutions and intelligent appliances means that future flexible consumption may to a greater extent come from private consumers.

- Electric vehicles. Future electric vehicles make up the largest part of the potential for flexible consumption. By means of intelligent data control, the market players can offer owners of electric vehicles solutions where they, without a loss of comfort and with a financial gain, will be able to charge their vehicles at the right times as well as possibly providing ancillary services from their batteries back into the system.
- Heat pumps in private homes. EcoGrid 2.0 is a demonstration project which remotely controls 1,000 heat pumps and electric radiators on the island of Bornholm with a view to demonstrating the possibilities for ordinary consumers to contribute to flexible consumption, and what this requires. Read more at www.ecogrid.dk.
- Batteries for solar cell power. Batteries used for storing solar cell power in private households may, through communities, be used to provide ancillary services to the electricity grid. The German TSO, TenneT, cooperates with sonnenCommunity, which is a virtual platform for electricity trading between battery owners. In the cooperation, possibilities for battery owners to deliver ancillary services to the grid are being tested.

Flexible consumption has business potential

Peter Kjærgaard Svendsen, Head of Energy and Green Transition in Coop, describes himself as a non-technician hunting for cash flows by means of technical installations. He took the initiative himself for the pilot project with Coop's refrigerating plants a couple of years ago because he could see obvious potential given Coop's technical setup:

> In Energinet, we are working on several fronts to support the future electricity market as part of the green transition. We create a digitalisation-ready market framework, among other things with the DataHub and by setting data free. We remove the barriers for new players, eg through project partnerships such as the Coop project, and we have launched systematic cooperation with the grid companies at distribution level on tariff design, markets for local flexibility etc.

Signe Horn Rosted, Director, Electricity Market in Energinet Electricity System Operator.

"We have 1,100 refrigerating plants in our Danish shops, which are almost all operated by a central player, and they can potentially both be switched off and increase performance quickly and for short periods of time. I thought this might be a good basis for providing ancillary services, and we therefore began looking into the possibilities."

The current barriers preventing Coop from using the shops' refrigerating plants to provide ancillary services in the form of flexible consumption are primarily technical, but Peter Kjærgaard Svendsen believes that these barriers are relatively simple to overcome:

"It's technically feasible to switch our refrigerating plants on and off very quickly, but it hasn't been necessary until now, and the central controller which controls the operation of the plants therefore simply hasn't been designed for this. But I think it's only because there has been no demand for such a quick response in this type of plant."

This is also why Peter Kjærgaard Svendsen has entered into dialogue with the players that deliver and operate the central control for the refrigerating plants in order to bring them on board and get them to develop technology that can accommodate a quicker response. Coop's refrigerating plants are also an example of how the electricity system's growing need for flexible consumption during the green transition can set innovative processes moving which in themselves promote the green transition.

But it will also be a commercial advantage for Coop if they can succeed in providing ancillary services in the form of flexible consumption. Based on an assessment of the potential of 379 refrigerating plants in western Denmark, Peter Kjærgaard Svendsen has calculated that Coop, with these plants, will be able to sell ancillary services worth a large million kroner amount on a yearly basis. When scaled up to all relevant refrigerating plants, this means a business with a value for Coop of tens of millions of kroner annually.

Market model 3.0: new agenda in the energy agreement

Flexible consumption, for example in the form being looked into by Coop, is an important tool in the next phase of the green transition, where new business models and new forms of flexible consumption are to help integrate the last renewable energy half into the electricity system (in 2030) and in all Danish energy consumption (in 2050).

The barriers to be overcome are sometimes technical and other times regulatory (eg electricity taxes and requirements for tender sizes in the market). But there are also basic human barriers or barriers to understanding. Understanding the timing of one's energy consumption as a commodity which has value for the electricity system is simply not very intuitive. The reason for this is, of course, that energy first and foremost creates benefit for the end-user, no matter whether, as in Coop's case, this concerns refrigerating goods in shops or whether it concerns charging electric vehicles or using heat pumps etc. in private homes.

Henning Parbo has worked with ancillary services in Energinet for many years and has built up in-depth specialist knowledge within the field. He explains that, while the players on the generation side, particularly the CHP plants, over the past many years have discovered and cultivated the market for ancillary services, the consumption side is only in its infancy:

"One of the things we still haven't seen on the consumption side is a budding interest in earning money on flexible consumption among those who are to help sell these services into the system. But it's starting now, so I'm optimistic."

Flexible consumption now and in the future

Large consumers, such as Coop, are the first to start working up the flexible consumption market. But in a slightly longer perspective, it is a goal for electricity suppliers to be able to do business by gathering and pooling electricity consumption from many scattered small consumers, including not least owners of both electric vehicles and electric vehicle fleets. This is an important objective in many ways. The objective is to balance the electricity system, but also to do so in a cost-effective manner. Analyses show that savings of EUR 90-120 million can be achieved on saved expansions of the Danish electricity grid alone. Expansions which can be avoided if the total potential for flexible consumption is realised towards 2035.

The development of a good market framework and good technologies, including not least setting data free and supporting digital solutions, is crucial for enabling market players to carry on a business in selling useful timing of electricity consumption into the electricity system in ways which do not affect customer comfort. The development of such a market framework is an important focal point in the energy agreement, and Energinet is responsible for contributing to the development.

ENERGY AGREEMENT

The energy agreement on 'a smart and flexible energy system'

"Denmark must have the most integrated, market-based and flexible energy system in Europe, with efficient energy utilisation across the electricity, heating and gas sectors, and with a continued strong security of supply. There is also a need to further develop the electricity market [...]." The energy agreement emphasises the following as one of the initiatives that is to realise this: "Development of a market model 3.0, which will improve the electricity market model: 24.5m DKK."


COBRAcàbe

FOCUS ARTICLE

GREEN TRANSITION

REQUIRES NEW ELECTRICITY HIGHWAYS

World-class offshore wind and solar cells are delivering more and more power to Danish sockets. This promotes the green transition, while placing heavy demands on the electricity grid. The solution is, among other things, stronger electricity connections in Denmark and new interconnections. Because when power is generated as the wind blows and the sun shines, the electricity highways in the transmission network must be able to transport larger volumes of electricity over longer distances.

The brown walls dominate the landscape. The new converter station near Endrup has an area of 6,000 square metres and a height of approx. 21 metres, so the building leaves its mark on the surroundings.

Here the 324 km long submarine cable system COBRAcable will be connected to the Danish electricity grid, giving Denmark an electricity connection to the Netherlands. On most sections, the cable is hidden in the sea, but the project is very visible right here.

READ MORE »

«
Poul-Jacob Vilhelmsen, Chief Project Manager at Energinet, at COBRAcable's converter station in Endrup.

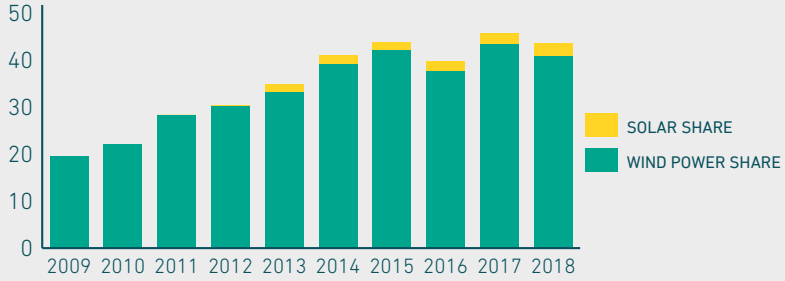
"Obviously, most people want to avoid living close to a building like this. Therefore, in a dialogue with the people living in the area, we made great efforts to create a building that blends into the landscape as well as possible," says Energinet's Chief Project Manager on COBRAcable, Poul-Jacob Vilhelmsen, and emphasises the façade clad with varying aluminium sheets which, at a distance, is designed to resemble a forest landscape.

The converter station is just one of a number of milestones that have been reached for COBRAcable. During a couple of cold and misty days in November 2018, the submarine cable reached shore in the Netherlands, and as the cable was pulled ashore on the island of Fanø in Denmark already in 2017, the only thing remaining now is the laying of a cable section further out at sea before the first electricity connection between the Netherlands and Denmark is a reality. It will be the first time in more than 40 years that Denmark will get an electricity connection to a new country.

Unfortunately, challenges in connection with the installation of the offshore cable have delayed the project, which means that the cable will not be commissioned until the third quarter of 2019.

SHARE OF RENEWABLE ENERGY

Wind and solar energy plays an increasingly important role in the Danish electricity system. Over the past ten years, the share of wind and solar energy relative to total Danish electricity consumption has increased from 19.4% to 43.5%.



World-class offshore wind requires robust infrastructure

COBRAcable is important for the green transition because both countries can integrate more renewable energy when wind and solar energy can be sold across borders during periods when there is plenty of energy in one of the countries. The project will generate a socioeconomic profit of around DKK 1 billion, partly because the Danish electricity generators will be able to sell electricity to a large European market. This is explained by Henrik Riis, CEO of Energinet Electricity Transmission:

"When we get much more wind energy, it's good to be able to export to people who are willing to pay more. There will be many more hours and days where wind power generation will exceed our total consumption. If we were unable to export power, we would have to switch off the wind turbines."

The task of integrating larger volumes of wind power into the electricity grid is becoming even more relevant with the summer's energy agreement, which makes it clear that three new large offshore wind farms must be established between now and 2030.

> There is huge potential in a well-developed electricity grid with interconnections such as Viking Link, not least because it increases security of supply in Denmark and makes it possible to take advantage of our favourable position on the 'silk road for green power'. Viking Link alone is expected, on an annual basis, to enable electricity exports at a value more than twice the value of the bacon exports to the UK. Export of green power via the electricity highways is good business for Denmark and may in some ways be considered 'the new bacon'.

Martin Risum Bøndergaard, Head of Policy in the Danish Wind Industry Association.

Under the heading 'World class offshore wind', the parties to the agreement define the clear goal that Denmark must maintain its leading international position within offshore wind.

The agreement also makes it clear that this "... requires the electricity infrastructure to keep pace with new developments."

"When we become aware of a need in the electricity system, we assess how best to solve it. In cases where there is a need to establish or expand plants, we do this based on a wish to bother as few as possible as little as possible," says Henrik Riis.

The electricity system's challenge is twofold. For one thing, the highly variable generation of renewable energy must be taken into account; for another, electricity will no longer primarily be generated at power plants located close to the large cities, but to an increasing extent far away from the cities and far out at sea.

"The green transition places new demands on the electricity grid, as much more power is generated as the wind blows and the sun shines. We must therefore, in cooperation with the industry, continue to develop the electricity infrastructure so we can transport electricity over much longer distances and conduct much more trade across borders. We must of course also work on making it possible, to a higher degree, to utilise the electricity in the areas where it's generated, and as far as possible to distribute the generation so it makes sense geographically," says Henrik Riis.

New power backbone along the west coast

The new needs are why Energinet is establishing new 400 kV overhead lines along the west coast of Jutland in the projects Endrup-Idomlund and Endrup-German border.

The two projects are to reinforce the Danish grid and ensure a new connection to Germany, while also ensuring optimum utilisation of the Viking Link connection to the UK.

In 2015, Energinet applied to the Danish Minister for Energy, Utilities and Climate for permission to implement the projects, and since then, decisions to construct the two near-shore wind farms on the west coast have been made, as well as a decision on further expansion with new offshore wind in connection with the energy agreement.

"Developments within wind and solar power are moving incredibly fast. It's therefore essential to ensure robustness when we expand the electricity grid. If we only expand on the basis of the needs from already planned plants, the developments will overtake us, and we thus won't come up with the best socioeconomic solutions," says Henrik Riis.

400 kV overhead and 150 kV underground

In spring 2018, the new 400 kV overhead lines encountered strong resistance as many residents in the affected areas wanted the overhead lines to be changed to underground cables. The citizen protests resulted in the Danish Minister for Energy, Utilities and Climate deciding that Energinet was to prepare a technical report on the possibilities of placing cables underground on all or parts of the section. The report showed that underground cabling was possible for up to 15% of the section, whereas longer lines would entail considerable technical risks. The conclusion was backed by the foreign consulting firm WSP, and in December, the Danish Minister for Energy, Utilities and Climate then announced that the work on the section can continue, but that Energinet must concurrently underground the existing 150 kV lines in the affected areas.

"I understand the citizens' wish for the entire connection to be placed underground. But we need to create a solution that we're certain we're able to operate. Worldwide, there is very limited experience with 400 kV AC cables placed underground, and not at all for such long lines and for transport of the energy volumes that Denmark needs," says Henrik Riis.

Expectations are that the first 150 kV overhead line can be taken down in connection with the establishment of the 400 kV overhead line. The changes in the project cause a one-year delay.

Ever improving interconnections between Denmark and other countries

While the pylons in Western and Southern Jutland stole most of the spotlight, work on a number of other interconnections progressed. Further east, Energinet is establishing a 30 km long 400 kV overhead line from Kassø near Aabenraa to Frøslev at the Danish-German border.

Several milestones were also reached in the Kriegers Flak project, when Energinet in May managed to complete the installation of three offshore platforms, which are to be used to collect the green power from the future offshore wind farm at Kriegers Flak and to exchange electricity between Denmark and Germany.

ENERGY AGREEMENT

Offshore wind in the energy agreement:

"Denmark holds a strong position in offshore wind ... the potential in these positions must be utilised for maximum benefit to ensure that Denmark maintains its position as the world's leading offshore wind nation with world class companies ...A successful, large-scale and market-driven expansion of offshore wind also requires the electricity infrastructure to keep pace with new developments. This is true both within Denmark's borders, where the electricity system must improve its ability to handle the major fluctuations in output from offshore wind farms, and even more so at the international level, where electricity grids need to be better integrated to enable the export of large volumes of offshore wind electricity to foreign markets."


PUREGAS
SOLUTIONS

FOCUS ARTICLE

GREEN GAS CROSSES BORDERS

The gas system is changing rapidly. While 2018 set new records for the share of biogas in the grid, decisions were also signed to connect the Danish gas system to Norway and Poland via Baltic Pipe. Ahead awaits the work on contributing to a gas strategy which, among other things, is to describe the role which the gas system is to play on the road towards a 100% CO_2-neutral energy system in 2050.

The chimney reaches towards the sky from a black container connected to shiny pipes. The biogas from Nature Energy's biogas plant near Korskro is upgraded here prior to being injected into the gas grid.

The plant was connected to the gas grid in 2018, as were four other new plants in Dansk Gas Distribution's area alone. Here the number of connected biogas plants rose from 8 to 13 in the course of the year.

READ MORE »

«
Stig H. Andersson, Senior Consultant in Dansk Gas Distribution, by the upgrading facility in Korskro.

"The connection of new biogas plants is beyond our wildest dreams. We've noticed a great interest in recent years, but we were so busy in the autumn that we had difficulties keeping up," says Senior Consultant Stig H. Andersson, who has the main responsibility for connection agreements regarding biogas plants in Dansk Gas Distribution.

The interest in being connected has increased after the energy agreement made it clear that the subsidies for new plants under the current framework conditions will be abolished in 2020.

Since the first upgrading facility for biogas was connected to the gas grid in 2011, the volume of biogas has increased year by year. This is reflected in the share of biogas in the grid relative to total Danish gas consumption, which was 9% at the end of the year.

The large volumes of biogas are just one element in ensuring a greener gas system, and an agreement was signed in 2018 on a construction project on a completely different scale.

Gas across borders
In November, the final investment decisions were made in the Baltic Pipe project. The 900 km long pipeline will interconnect Norway, Denmark and Poland and is expected to be commissioned in 2022. At that time, three to four times more gas than the gas currently transported in the Danish gas system will be transported.

Although fossil gas will generally also flow in the gas pipeline, the project benefits the green transition. Poland is the world's tenth-largest coal consumer, and if as little as 15% of the gas in Baltic Pipe replaces coal in the Polish power plants, it will mean an annual reduction of Poland's CO_2 emissions of 1% – corresponding to 4-5% of annual Danish CO_2 emissions.

Baltic Pipe also benefits Denmark more directly, as the project will increase the gas volumes in the Danish gas system, which means that the operating expenses can be distributed on more parties.

"Baltic Pipe helps to maintain stable tariffs for Danish consumers and businesses, and this contributes to future-proofing our gas system, which will play an important role in the future CO_2-neutral energy system," says Torben Brabo, CEO of Energinet Gas TSO.

With the summer's energy agreement, it became clear that a gas strategy is to be prepared which, among other things, describes how a framework can be created for a competitive expansion with biogas and other green gases and for integration of different energy systems.

BALTIC PIPE:

The project is a partnership between Energinet and the Polish gas transmission system operator GAZ-SYSTEM S.A.

The gas pipeline consists, among other things, of 800-950 km of new gas pipes and is planned to be ready for commissioning in 2022.

The capacity will be up to 10 billion cubic metres of gas a year, corresponding to four times the total Danish gas consumption in 2016.

The project is on the EU's list of projects of particular European interest.

Electricity from wind turbines and solar cells is converted into hydrogen via electrolysis. In HyBalance, industry and the transport sector purchase our hydrogen in pure form. And in 2019, we will produce electrofuels in a pilot plant by combining hydrogen with CO_2, which may come from industrial gas or biogas in the long term, providing us with a CO_2-neutral liquid fuel.

Søren Bjerregaard Pedersen, CEO of Hydrogen Valley. Hydrogen Valley works with the role of hydrogen in the green transition. In 2018, Hydrogen Valley inaugurated the HyBalance electrolysis plant, which produces hydrogen and helps to balance the electricity grid.

"The future gas system will cross many borders – not just between countries, but also in terms of sectors and time. The gas system will play a central role in relation to transport, flexibility and storage of energy," says Torben Brabo.

From wind power to gas
Sector coupling is a central concept in Energinet's work on meeting the targets of Denmark having 100% green power in 2030, and a completely CO_2-neutral energy system in 2050.

The System Perspective 2035 analysis describes, among other things, energy plants where 'excess' wind-generated electricity, by means of electrolysis, can be converted into hydrogen, which in turn can be further processed into methane or liquid fuels such as methanol.

One of the authors of the analysis, Chief Engineer Anders Bavnhøj, explains:

"The Danish North Sea holds enormous resources in the form of offshore wind, and on top of that, in areas which are among some of the cheapest places in the North Sea to establish offshore wind power generation. The North Sea offshore wind must be exploited if Europe is to achieve its climate targets, and Denmark has the potential to become a real 'sweet spot' in a completely new green energy industry, which can refine excess wind power into green gas and green fuels."

The conversion of electricity to gas or other fuels provides better opportunities for storing energy. While batteries can be a good solution for short-term storage of energy, the gas system harbours great potential for long-term storage of large volumes. The two Danish gas storage facilities alone can hold 11 TWh, which is 84,000 times more than the world's largest battery, which was built by Tesla in Australia.

"The gas storage facilities may be one of the keys to storing renewable energy, and the infrastructure is already in place. We already have biogas in our plants, and we also have the basic technology for the ability to store hydrogen from electrolysis on a very large scale," says Adam Elbæk, CEO of Energinet's subsidiary Gas Storage Denmark.

The gas can be stored as a reserve for electricity and heat generation, and it can be used in, for example, the transport and industrial sectors, where it has great value.

European focus on gas
Internationally, there is also focus on the potential of the gas system. The EU is working on plans for a new gas regulation which is to promote the green development of the gas system and the coupling between energy sectors.

As a growing number of countries harvest increasing volumes of wind and solar energy, there is a growing awareness of how the gas system can interact with an increasingly weather-dependent electricity system.

"The gas system is a perfect partner for the electricity system, and this realisation is becoming more and more widespread. At the wind industry's large WindEurope conference in Hamburg, Germany, sector coupling was one of the major topics, and this goes to show that the electricity generators are also aware of the potential. This is important, for if we are to ensure a successful transition to green energy, the coupling between the different energy sectors is crucial," says Torben Brabo.

New plant ensures injection of more biogas into the gas system
While the awareness of the importance of sector coupling is thus increasing, Danish biogas generation is already of such a scope that all the gas can no longer be consumed in the local areas in which it is produced. Most of the Danish biogas is injected into the local distribution network, but with the increasing volumes of biogas, it is now necessary to think innovatively. In some places, the solution is to couple different distribution networks, but elsewhere it is necessary to lead the green gas on to the gas highway – the transmission network.

Energinet has therefore constructed plants which ensure that the biogas can be injected into the transmission network. One such plant is the green gas connector plant in Store Andst near Vejen. The plant raises the gas pressure and removes the odorant which is added to the gas in the distribution network for safety reasons, but which must not be present in the transmission network.

"Energinet is responsible for preparing the gas system for the green gas in the least expensive way socioeconomically. In this context, such a plant constitutes an important element which ensures that more biogas can be injected into the system," says Torben Brabo.

The plant will mainly operate during the warm months, when the total consumption of gas is at its lowest level and there is therefore more 'excess' biogas in the distribution network. The plant has been installed and is ready for new biogas records in summer 2019.

ENERGY AGREEMENT

Green gas in the energy agreement: "A gas strategy will be developed, focusing on the continued commercial utilisation of the Danish gas infrastructure, including as part of the green transition. The strategy will also examine the framework conditions for a competitive expansion of biogas and other green gases, as well as the overall finances of the Danish gas sector, including investments and activities in the North Sea and potential scenarios for a long-term phasing-out of natural gas. The strategy will also examine the framework conditions for integration of the energy systems, including opportunities for converting and storing electricity as gaseous fuel, e.g. through methanation."

ENERGINET

Tonne Kjærsvej 65
DK-7000 Fredericia
Tel. +45 70 10 22 44

info@energinet.dk
www.energinet.dk