



ENERGINET

SUMMARY  
SECURITY OF ELECTRICITY

# SUPPLY REPORT

# 2017





## SUMMARY

In 2016, Danish security of electricity supply was high once again. Danes had power 99.996% of the time on average. Thus, 2016 was yet another year where Danish electricity consumers enjoyed a security of electricity supply level that was among the highest in Europe.

The work to ensure security of electricity supply is undergoing major changes due to the green transition, which involves much more wind and solar power.

Energinet's goal is to maintain the high level of security of supply in the Danish electricity system and continue to rank among the top European countries. This ambition is laid down in Strategy Plan 2014 and reflects the fact that a high level of security of supply is an important foundation for society and of great value to both businesses and citizens.

Therefore, Energinet continuously analyse developments and implements measures to ensure continued stable and cost-effective operation of the electricity system.

In future, cooperation across national borders, cooperation throughout the entire value chain, more IT support and flexibility in electricity consumption will come to play a far greater role than today.

There is also an increasing need in the years ahead for reinvestment in existing infrastructure (the transmission grid) to ensure that it will support the high security of supply level. Parts of the transmission grid are approaching the end of their technical service life.

# STATUS ON SECURITY OF ELECTRICITY SUPPLY

## Outage statistics and incidents

In 2016, the security of electricity supply level was just under 19 minutes of outage per electricity consumer.

No electricity consumers were disconnected during the year to ensure stability in the overall electricity system, and only a few incidents in the transmission grid resulted in power outages for electricity consumers. Thus, outages experienced by Danish electricity customers in 2016 were mainly caused by conditions in the distribution grids.

Moreover, there are no signs of an increase in the number of near-miss incidents, even with the Danish electricity supply in transition and the electricity system being optimised.

There were no hours in 2016 when the supply in the market failed to meet demand. Also, there was only one alert situation in Energinet's control centre, caused by an IT incident which temporarily affected Energinet's monitoring of the

electricity system and suspended the market. There were no emergency situations in 2016.

An incident number comparable to that of 2015 was submitted to the European incident statistics in 2016. This was also yet another year with no incidents resulting in a violation of the voltage standards. The fact that, in recent years, Energinet's control centre has had great focus on voltage control has contributed strongly to this.

## Security of supply

Security of electricity supply is "the probability that electricity is available

TABLE 1: LIST OF INCIDENTS REPORTED TO THE INCIDENTS CLASSIFICATION SCALE (ICS) FOR DENMARK IN 2015 AND 2016.

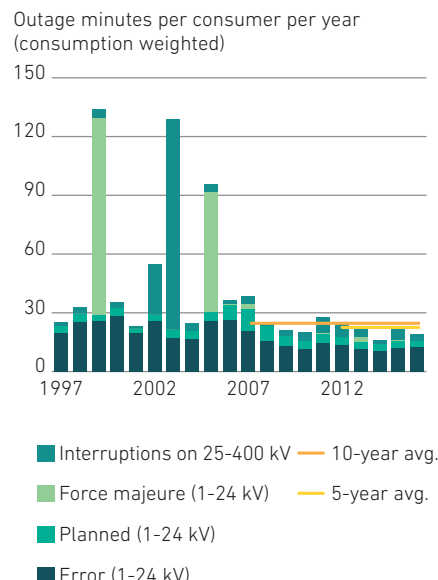
CRITERIA	Scale 0	Scale 1	Scale 2	Scale 3
Faults on elements in the transmission system	2015: 11 2016: 1	2015: 8 2016: 13		
Exceeding voltage levels	2015: 0 2016: 0	2015: 0 2016: 0		
Loss of IT tools		2015: 1 2016: 3		

Incidents are classified in reporting on a scale from 0-3, where 3 is the most serious level:

- Scale 0. Local deviations with low impact on operational reliability.
- Scale 1. Serious incidents
- Scale 2. Extensive incidents in a large area
- Scale 3. Major incidents resulting in a blackout

FIGURE 1: OUTAGE STATISTICS FOR DENMARK, 1997-2017.

Source: Danish Energy Association.



on demand". Security of electricity supply consists of 'system adequacy' and 'system security', which are two partially overlapping elements.

Potentially, the lack of system security in the Danish electricity system has the most far-reaching consequences, as this may result in sudden and extensive blackouts in one or both Danish regions in a worst-case scenario. Lacking system adequacy is also a significant threat where the consequence will typically be planned disconnections of consumers in limited areas (so-called brownouts).

**Ancillary services**

Ancillary services is the overall term used for the production and consumption resources that Energinet pays to have available during the delivery hour. These are activated automatically or manually to ensure balance and operational reliability in the electricity system. Ancillary services consist of reserves and properties required to maintain power system stability.

The total cost of ancillary services was up in 2016, with ancillary service purchases totalling DKK 758 million against DKK 592 million in 2015. The increase is primarily attributable to increased costs of manual reserves in Eastern Denmark, due to replacement purchases in connection with the maintenance of a unit at Kyndby Power Station, which normally supplies part of the manual reserves in Eastern Denmark. Energinet also had to order a power plant put into operation in the maintenance period to procure adequate reserves, and the replacement purchase auction prices were very high.

Purchasing reserves and properties required to maintain

FIGURE 2: ILLUSTRATION OF SECURITY OF ELECTRICITY SUPPLY CONSISTING OF SYSTEM SECURITY AND SYSTEM ADEQUACY, WHICH IN REALITY ARE TWO PARTIALLY OVERLAPPING ELEMENTS.

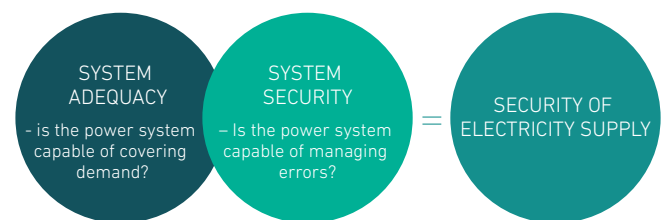
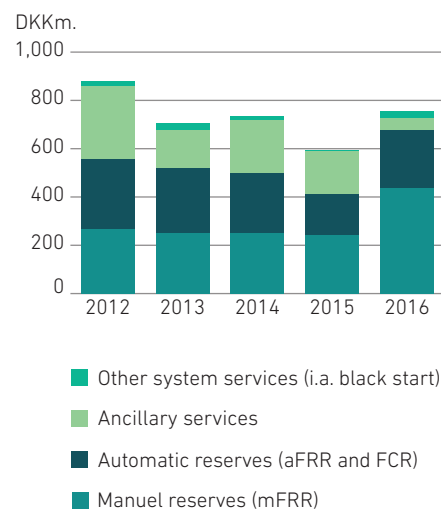


FIGURE 3: COSTS OF ANCILLARY SERVICES IN DENMARK IN 2012-2016.



power system stability gives Energinet's control centre manoeuvrability when faced with faults and thus contributes to system security.

The cost of purchasing properties required to maintain power system stability from market players in Western Denmark was down in 2016 as new analyses of the need for properties required to maintain power system stability documented a lower need than previously assumed. On the basis of these analyses, Energinet began to use existing components in the electricity system in a smarter way through automation.

In the course of 2016, Eastern Denmark's total need for properties required to maintain power system stability was analysed. The result was that in normal operating situations with optimised use of existing components, there is a total need for one ancillary services unit in Eastern Denmark. An ancillary services unit may be a

major power plant or a synchronous condenser. Previously, assessments necessitated three ancillary services units in operation as well as an additional unit ready for start-up. Therefore, the cost of procuring properties required to maintain power system stability are expected to drop even further in 2017 if no special situations occur in the grid that require increased supplies of properties required to maintain power system stability.

### Generation adequacy

There were no cases of power shortage in 2016, either by disconnection of consumers or by insufficient capacity in the market. However, there were a few operating situations in which the loss of the largest unit in the system could have resulted in a power shortage due to maintenance work and breakdowns in the electricity system.

### Grid adequacy

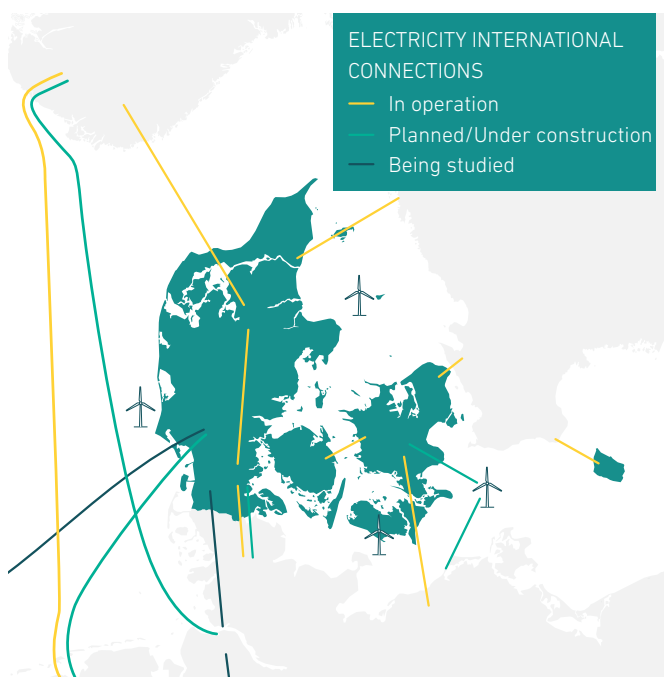
The total number of transmission grid faults rose in 2016 compared to last year. There were 13 incidents in 2016 in the HVDC (direct current) system which led to heightened awareness of the operation of the overall electricity system. None of the 13 incidents resulted in a disruption of supply for consumers.

### Information security

A high level of security of electricity supply requires great availability of IT tools. On one hand, modern IT plays a key role in the day-to-day operation of the electricity system. On the other hand, the use of IT also increases the electricity system's vulnerability to external attacks and internal faults in IT systems. Energinet continually works to ensure a high level of IT security and high IT system uptimes.

Energinet measures IT security based on the ISO 27001 IT security standard. At the end of 2016, it was found that Energinet's maturity level had reached the target for 2016 with an average Capability Maturity Model Integration value (CMMI value) above 3.5. The target is 4.0 in 2017. To obtain a CMMI value of 4, IT processes must have quantitative targets so they are predictable and meet the requirements of internal and external stakeholders.

FIGURE 4: INTERCONNECTORS IN DENMARK AND NEIGHBOURING COUNTRIES.



### International cooperation

Denmark is not the only country facing new challenges when it comes to ensuring security of supply while incorporating still more renewable energy. This is one of the reasons why common European rules on markets and electricity system operation are being prepared. More closely integrated and harmonised European electricity markets contribute to a cost-effective European electricity supply.

In 2015, the four Nordic TSOs decided to establish a joint office. The Copenhagen-based office will perform coordination tasks in relation to capacity calculations, outage planning and system reliability analyses. The initiative is in line with coming EU regulations which will require the establishment of Regional Security Coordinators (RSC) or regional security cooperation initiatives within the transmission area.

# CURRENT AND FUTURE INITIATIVES

Generally, Danish security of supply is very high and will remain high in the years ahead, but not necessarily at the current level. Any challenges must therefore be taken into account, for example those related to the green transition in the coming years.

While making the transition to an increased use of renewable energy, Energinet must also continue to focus on developing the work to safeguard security of electricity supply. Energinet works, among other things, to improve operating methods, contribute new markets, build new electricity infrastructure and maintain and renovate the existing transmission grid.

In the past year, Energinet focused particularly on implementing the initiatives presented in last year's security of electricity supply report that included topics such as generation adequacy, market trends, grid adequacy, Nordic RSC and IT security.

## **Generation adequacy**

Forward-looking risk assessments show that the risk of consumer outages is different for the two parts of the country. For Western Denmark, the risk of a power shortage is deemed very low for the 2017-2025 period.

In Eastern Denmark, Energinet projects that, over the next 10 years, the risk of power shortages in general will increase relative to today and will exceed Energinet's objective from Strategy Plan 2014.

According to the simulation results, an average consumer in Eastern Denmark will be without power for 7 minutes in 2018 and 33 minutes in 2025 due to power shortages. Seven minutes equates that the average consumer is expected to have 99.9987% of the demanded energy supplied, while 33 minutes correspond to 99.9937%. The risk of brownouts may be reduced by, for example, maintenance planning, market solutions (e.g. strengthened efforts to ensure flexible consumption), a new production capacity framework and establishment of new infrastructure for new areas. Calculation results are subject to uncertainty, but indicate that a few brownout situations must be expected over the next 10 years.

One specific initiative which may improve long-term generation adequacy in Eastern Denmark is an additional electricity connection to Western Denmark. A project has been launched to determine whether a new connection is a socio-economically attractive solution for strengthening the power balance in Eastern Denmark.

As one step towards ensuring generation adequacy in Eastern Denmark, Energinet wanted to create a strategic reserve in the 2016-2018 period to contribute to supply in highly critical situations Energinet decided to cancel the call for tenders in December 2015. The tender was called off because Energinet did not expect to be able to implement it, as the European Commission saw the reserve as a breach of the EU rules on state aid.

Since then, the European Commission has carried out a sector inquiry into capacity mechanisms. Based on this, Energinet assesses that it is not possible to make a call for tenders for a strategic reserve at present. Energinet reduces the risk of disconnecting consumers in the event of shortages in Eastern Denmark through improved coordination of maintenance work on international connections, power plants and own installations as well as generally optimised outage times in connection with construction projects. In addition, Energinet has ensured a shorter start-up warning time at one power plant.

## **The market**

Energinet is currently focussing on





132 kV power pylons near Copenhagen.

two key areas within market trends: Changes in the future market model are based in particular on the European network codes and the conclusions from the Market Model 2.0 project.

As concerns market initiatives, these must be coordinated to a large extent with international partners in accordance with, among other things, the pan-European network codes. In addition, amendments to the Danish Electricity Supply Act (Elforsyningsloven) may be required in order to implement a few of the initiatives.

#### **Grid adequacy**

Energinet currently faces substantial reinvestment in the Danish transmission grid. Extensive work is therefore being done to structure and optimise reinvestment in the existing transmission grid. Reinvestment planning takes into account the state of components and how critical the components are to the electricity system as a whole.

Reinvestment means more maintenance in the transmission grid than previously, which increases the risks in the electricity system in terms of both

system security and system adequacy. Energinet therefore focused heavily on maintenance planning, also in cooperation with neighbouring TSOs.

A particular focus area is Copenhagen where the rise in electricity consumption and the decommissioning of thermal power plants result in a need for a new supply structure. Energinet expects to establish a new transmission connection to Copenhagen to secure the supply from the rest of Zealand into Copenhagen. Today, Energinet already continuously assesses the need for local production in Copenhagen and when needed Energinet initiates measures such as orderings to ensure continuous high security of supply in Copenhagen.

#### **International cooperation**

A working group was appointed in 2015 at the European level to develop a new market-based and probabilistic method for assessing generation adequacy uniformly across borders. This major focus on transnational cooperation on assessing generation adequacy will also be a key point in the future. The next report is expected in autumn 2017. Within the Nordic cooperation, the

four Nordic TSOs decided to prepare common generation adequacy assessments for 2017-2018. The assessments aim to highlight the challenges faced by the Nordic countries, and place more emphasis on effective transnational solutions.

The establishment of the RSC office in Copenhagen significantly strengthens Nordic coordination. The office is already staffed with participants from the four TSOs and is expected to be in full operation at the end of 2017.

#### **Information security**

If the same focus and activity level are maintained throughout 2017, Energinet will be able to reach the target set for the end of 2017 of a CMMI value of 4.0. To raise maturity, Energinet is working to improve IT security at all levels, and to identify potential threats to electricity and gas system operations.

Energinet also aims to ensure that modern information technology is used in and seen as an integral part of the electricity and gas system design. This means incorporating data security in processes, systems and components.

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