

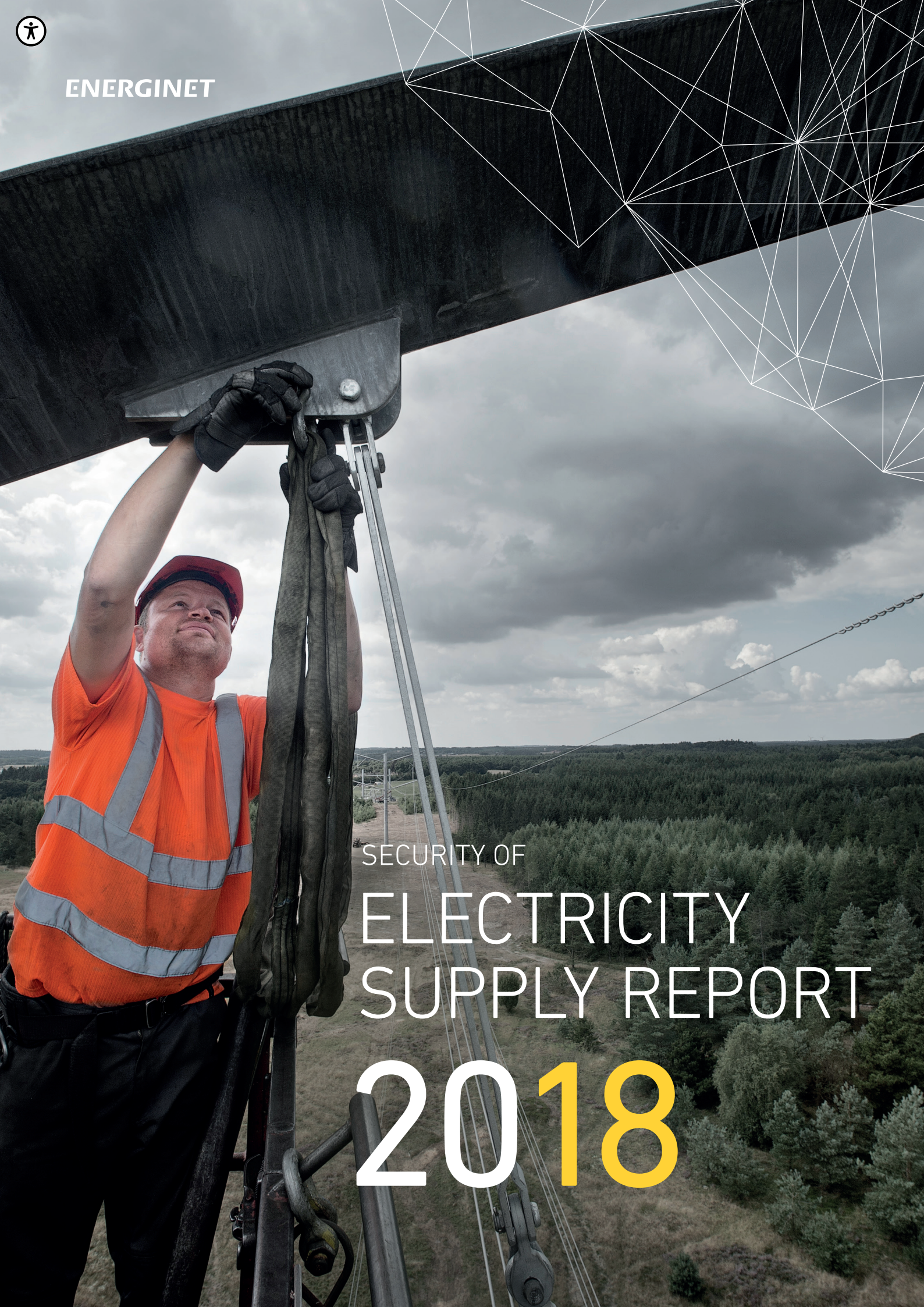


ENERGINET

SECURITY OF

ELECTRICITY SUPPLY REPORT

2018



SUMMARY

In general, Denmark's security of electricity supply level ranks among the highest in Europe, and the 2017 level was no exception. Danes had power available 99.995 per cent of the time. This means that the average consumer experienced less than 25 minutes of outage. Though this is slightly more than in 2016, the figure is still very low. The high level of security of electricity supply is mainly due to conversion to cables in the distribution grids

The Security of electricity supply report 2018 uses selected highlights and analyses to sum up the security of electricity supply for 2017 and includes a related forward-looking risk assessment.

Energinet's goal is for Danes not to experience outages, resulting from faults in the power transmission grid, for more than 60 seconds in total during a normal year.

Of the 25 minutes outage in 2017, 92 seconds resulted from incidents in the transmission grid. The transmission grid fault that affected the most consumers occurred at Svanemøllen station in Copenhagen in October. It was a procedural error in connection with planned maintenance at the station.

Minimizing faults is essential to Energinet, as a single fault in the electricity transmission grid can escalate and lead to extensive outages for Danish electricity consumers. Energinet aims to avoid faults by continuously optimising work processes and component maintenance.

Key challenges for the high Danish security of electricity supply

The Danish and European electricity systems are undergoing significant changes. Extensive wind and solar power capacity is integrated in the electricity system, while many traditional thermal power stations are phased out. As more electricity interconnectors link different countries' electrical grids together, the security of electricity supply becomes an increasingly

regional, instead of simply a national, issue. At the same time, electricity markets and operational collaboration across Europe are harmonised via new European regulations. This all greatly influences how Energinet will ensure the Danish security of electricity supply in the future.

In this 2018 report, Energinet describes the main challenges for the security of electricity supply. Examples are listed below.

Risk of no electricity east of the Great Belt

The Danish electricity grid has an eastern and a western section with the Great Belt as the dividing line. In Eastern Denmark, the risk of the electricity supply not meeting demand will increase in the coming years. Although Energinet's 10-year outlook shows an increased probability of brownouts - i.e. controlled disconnections of electricity consumers in limited areas - such situations are expected to be very rare events.

Energinet introduces concrete measures to address the Eastern Danish challenge. Among other things, Energinet is working to make better use of existing infrastructure, such as an upgrade of the domestic electricity grid close to the Øresund Link that will increase capacity in case of outages or revisions. Energinet is also looking into the possibility of obtaining approval for a temporary introduction of a strategic reserve. At the same time, Energinet is working determinedly to implement current electricity market

reforms, which will combine with other new initiatives to ensure increased flexibility in both electricity generation and consumption, bringing new market solutions to ensure the security of electricity supply.

Renewal of the Copenhagen power grid

Operation of the power grid is changing in these years as a consequence of increased renewable electricity generation, a rise in electricity consumption, especially from data centres, and an ageing power grid. This requires expansion of and reinvestments in the domestic electricity grid, for example in Copenhagen.

In Copenhagen and the surrounding areas, the security of electricity supply is challenged by an ageing electricity grid with still longer outage times due to regular maintenance. In addition, electricity consumption is expecting to rise while electricity generation by Copenhagen thermal power stations is declining.

As a result, Energinet is in the process of laying new cables leading into Copenhagen, and these should be operational by the beginning of 2019. Energinet finds that the risk of load shedding is unacceptably high during the construction phase. Therefore, Energinet has ordered a thermal power station in operation to maintain the high security of electricity supply in Copenhagen until the cable is put into operation.

Changes in need for properties required to maintain power system stability

Properties required to maintain power system stability are important to ensure the robustness of the power system, as these properties help to ensure the stability of the electricity grid in case of faults or outages.

Energinet's most recent and most comprehensive analyses of the need for properties required to maintain power system stability show that the electricity system is more robust than previously assumed. This is due to, for example,

the fact that today's modern wind turbines help to stabilise the system, and that Energinet can use automation to operate the grid closer to the limit.

Thus, Energinet can operate the electricity grid more stably, even without power stations running. Optimised utilisation of the electricity system's components facilitates the integration of renewable energy sources while maintaining a high level of security of electricity supply.

Greater focus on IT security

The electricity system's increasing dependence on IT requires high uptimes on crucial IT systems. It also triggers focus on external threats, as well as national and international preparedness cooperation. One measure implemented is a joint Nordic preparedness drill.

TOTAL OUTAGE MINUTES



2017, minutes: **25**

2016, minutes: **19**

Outage minutes for an average consumer in the Danish electricity system.

OUTAGE MINUTES DUE TO FAULTS IN THE TRANSMISSION GRID



2017, seconds: **92**

2016, seconds: **48**

Target, seconds: **60**

Average outage minutes due to system disturbances in the transmission grid (above 100 kV).

ALERT STATE



2017, no. of times: **1**

2016, no. of times: **1**

The 2017 outage was caused by a fault in a cable into Copenhagen.

IT SECURITY



2017, no. of incidents: **0**

2016, no. of incidents: **3**

No incident with loss of critical IT tools in 2017.

PREPAREDNESS



2017, no. of incidents: **1**

2016, no. of incidents: **0**

The single 2017 incident was caused by a fire in a station.

ANCILLARY SERVICES



2017, DKK million: **626**

2016, DKK million: **758**

Costs of procuring ancillary services.

GENERATION ADEQUACY 2025



More data centres.
Fewer power stations.
More interconnectors.
More renewable energy.

Impact security of electricity supply in Denmark.

GENERATION ADEQUACY 2025



Eastern
Denmark,
minutes:

11

Western
Denmark,
minutes :

<1

Generation adequacy in Eastern Denmark is challenged.

GRID ADEQUACY



Ageing electricity grid and more reinvestments, e.g. in Copenhagen, may challenge security of electricity supply.



Units in the electricity grid required to maintain power system stability and greater extent of automation contribute to electricity system robustness.

IT SECURITY



Increasing dependence on IT in the electricity system requires high uptimes on critical IT systems.

OPERATIONAL AND MARKET DEVELOPMENT



Pan-European projects aim to ensure security of electricity supply efficiently.

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