



ANNUAL MAGAZINE

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in European green transition

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Energy motorways have to be upgraded
for more traffic



ANNUAL MAGAZINE

Energinet's annual magazine 2022 provides an easy-to-read update on Energinet's activities, and the opportunities and challenges the company is facing.

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ROCK ISLAND TO BECOME WORLD'S FIRST ENERGY ISLAND

Bornholm is to become world's first energy island. New technical solutions for green energy have to be developed on the rock island in the Baltic Sea, and the green transition must spread from here to beyond Denmark's borders. >>

>>

As an energy island, Bornholm will be home to large offshore wind turbines and a large transformer system on land. New technological solutions have to be developed and may serve as a model elsewhere. And clean, green wind power will be transmitted from Bornholm to Zealand and out into Europe.

Green power for consumers

Bornholm has strongly indicated that it wants a share of the green power in return, and Energinet has promised to work towards such a solution.

"Seeing that we're building an energy island in the islanders' backyard, they're very keen on having green electricity from the island available for local use. We want to fulfil this wish," says Kim Søgaaard Mikkelsen, Energinet's project manager for the Bornholm Energy Island.

Solutions of the future

Constructing energy islands is a complex project in itself and requires that many bright minds get together and think innovatively. But it will also be the first



We help to find future green energy solutions ...

Claus M. Andersen
CEO of Bornholms Energi & Forsyning



time in the world that a large DC system (the energy island) is connected to a small AC grid (the power grid on Bornholm). This is an opportunity for Bornholm to take the lead in technological development – development that may be brought into play elsewhere in the world. There are also expectations on Bornholm that the new status as an energy island could pave the way for new jobs, educational activities or even energy tourism.

"We're involved in finding future green energy solutions, and this may have a lot of positive effects, for example in relation to outside interest in Bornholm," says Claus M. Andersen, CEO of Bornholms Energi & Forsyning.

Good for Bornholm

He is one of the people who is pleased that Energinet will work to connect Bornholm to the green electricity.

>>

BORNHOLM ENERGY ISLAND

The Bornholm Energy Island will be able to generate 2GW of electricity, equivalent to the consumption of up to two million households. There is the option to increase the offshore wind farm to 3GW, but this will require a new political decision. Bornholm will house a transformer system on land. Energinet has identified a potential site for the high-voltage substation, which will be investigated in 2022.

In late 2021, Energinet signed an agreement with 50 Hertz, the German transmission system operator, to collaborate on a possible connection to Germany.

THE NORTH SEA ENERGY ISLAND

One energy island will be located in the North Sea. A reclaimed island will be constructed, with a capacity of at least 3GW in 2030, and space for at least 10GW in the long term. In late 2021, Energinet also signed an agreement with Elia, the Belgian transmission system operator, to collaborate on a possible connection to Belgium.

Read more about energy islands:
www.en.energinet.dk/energyislands



The energy islands will serve to accelerate the **green transition**. In 2022 we will begin serious preparations for the large facilities on land. It will be very exciting to see our grand dreams becoming a reality!



Hanne Storm Edlefsen,
Vice President for Energy Islands in Energinet



"It's good for Bornholm, because it will increase security of supply and provide lots of opportunities. For example, we'll be able to attract energy-intensive companies to Bornholm or establish Power-to-X production. I'm fully convinced that this will help ensure that the business sector will look towards Bornholm," says Claus M. Andersen.



It's really big business and a great opportunity for Denmark and the Danish wind turbine industry.

Jacob Østergaard
Head of the Centre for
Electric Power and Energy at DTU



Professor Jacob Østergaard, head of the Centre for Electric Power and Energy at DTU, agrees: "If we're the first to acquire experience with this in Denmark

and we can implement new solutions in the world, the business potential will be huge. It's really big business and a great opportunity for Denmark and the Danish wind turbine industry," he says.

Sand box to be expanded

He points out that, with its unique status as a bounded electricity grid, Bornholm has long been a laboratory for research and development, for example into how to create demand-side response suitable for wind power and solar energy. Projects in which Jacob Østergaard and DTU have also been closely involved and which have continuously made the world pay attention to Bornholm. "And we're now expanding the 'sand box' that Bornholm offers for the solutions of the future," he says.

Unlike the energy island in the North Sea, the outside world will be able to follow the construction of the energy island on Bornholm at close range.

"It could serve as a great case. It's one thing that we can make theoretical calculations and model simulations, but real tests must also be done before it has to be implemented on a 10-GW scale 80 km out in the North Sea. It must be tested experimentally, and this is what makes Bornholm so unique," says Jacob Østergaard.



Illustration of a potential converter substation on Bornholm

WHY ENERGY ISLANDS?

In 2020, the Folketing decided that two energy islands should be constructed in Denmark, and Energinet is making preparations together with the Danish Energy Agency and other parties.

Energinet is also responsible for installing and operating electricity cables to other countries – and for connecting and integrating renewable energy from the energy islands with the onshore energy system.

The energy islands will make it possible to pool and distribute large quantities of offshore wind power and supply green electricity and derived forms of energy to multiple countries. Each energy island must be established with a trading connection to neighbouring countries.

3

EXAMPLES THAT EXPLOIT DATA TO ADVANCE THE GREEN TRANSITION



ProjectZero
SONDERBORG

Data helps Sønderborg region achieve ambitious carbon targets

Sønderborg established the ProjectZero public-private partnership in 2007, which aims to achieve a carbon-neutral energy system by 2029. There is a strong focus on improving efficiency through sector coupling, where data is exploited to optimise control and processes to balance energy production and consumption optimally, in order to minimise investments in plant and operating expenses – for the benefit of the citizens and businesses in the Sønderborg area. ProjectZero closely monitors developments in energy and carbon reductions in order to meet its targets, using Energinet's Energy Data Service (www.energidataservice.dk) in its monitoring, which shows changes for various segments, such as households, businesses and transport. Find out more at www.projectzero.dk

watts

APP brings green transition to the dinner table

An app is bringing the green transition into consumers' homes. The Watts A/S energy company has developed a smartphone app that links data from Energinet's power overview (www.eloverblik.dk) with advanced technology such as machine learning algorithms, to monitor how energy consumption is impacted by factors like outdoor temperatures, time of day and various consumption patterns. Based on the household's previous consumption, the app can estimate the budget for the current year. The app also shows how power is being generated right now, and indicates at what time of the day to switch on the washing machine in order to have the lowest carbon emissions per kWh. See www.watts.dk

SIEMENS

Customers will help keep tomorrow's energy system in balance

Siemens is working on a digital platform to allow customers of the technology company to achieve savings by offering flexible consumption. They can also help make the green transition of the electricity system cheaper for Denmark at the same time. In practice, it will mean that schools, swimming pool centres, shopping centres, warehouses etc. reduce or switch off their electricity consumption for a number of seconds or minutes when Energinet sends a signal indicating a shortage in the power grid (for example on a day with light wind). They will thereby become like small virtual power stations connected to the electricity system and Energinet through Siemens' new digital platform. See www.siemens.dk/vpp for more information.

ENERGINET

THINK GREEN IN YOUR BUSINESS DEVELOPMENT

We are looking for innovation partners who can overlay intelligent solutions on energy data to advance the green transition.

- Perhaps while also helping your company's carbon targets and bottom line?

If **your company has an idea**, technology or smart digital solution, we are ready to assist you, drawing on our deep knowledge of the electricity and gas systems, the market frameworks – and energy data.

www.energinet.dk/open-door-lab



THE GREEN MUST **NOT** GO BLACK

For decades, we have been integrating more and more wind and solar power into a power system originally designed with large central power stations to ensure security of supply. However, an entirely green electricity system will fundamentally change the way we ensure that Danes always have electricity available. We need to totally rethink the electricity system – otherwise we will see far more power outages. >>





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When our electricity becomes completely green in the future, it does not just mean that wind turbines and solar cells will supply the vast majority of our electricity during most hours of the year. It also means removing several of the pillars supporting security of supply in Denmark as fossil fuel CHP plants are phased out. Much of the foundation that has ensured stability and balance in the electricity system for decades, and given Danes one of the world's most secure electricity supplies, will disappear completely or play a much smaller role, notes Søren Dupont Kristensen, Director of Energinet System Operation.

"We have continually integrated more and more green energy into the electricity system we have known for many years. But an entirely green electricity system is fundamentally different. We essentially have to create a completely new power system, and totally rethink security of supply," he says.

Most people find concepts such as 'generation adequacy', 'grid adequacy', 'ancillary services' and 'stability' (see the figure on page 14) tedious, but these are critical to security of supply and therefore factors which Søren Dupont Kristensen keeps his eyes fixed on. If we do not find completely new solutions in these areas, Danes will see far more power failures in the future, he explains.

Windless nights

"When I talk to people who are not immersed in the engine room of the power system, unlike my colleagues and myself, they often raise the concern: 'What do we do when there is no wind or sunshine? Where do we get electricity from on a windless night?' This is one of the key challenges we need to address. But 'generation adequacy' – ie generating sufficient electricity to meet consumption – is just one of the elements needed to ensure stable supply, and perhaps the easiest to achieve," notes Søren Dupont Kristensen.

Today, Denmark has numerous electricity generation plants around the country, and is highly connected to the power grids in our neighbouring countries. We have a lot of wind turbines and solar cells, and more international connections are in the pipeline. Denmark will be linked to the UK, and the future energy islands in the North Sea and on Bornholm will also have connections to neighbouring countries. Electricity imports and exports will play a key role in supply, because levels of wind and sunshine will vary greatly across Europe. However, the same factors also make it much more complex and unpredictable to secure

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“We essentially have to create a completely new power system, and totally rethink security of supply”

Søren Dupont Kristensen
Director, Energinet System Operation

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supply in Denmark, as neighbouring countries are essentially engaged in exactly the same green transition.

The biggest challenge in relation to generation adequacy will no doubt be to make consumption flexible, notes Søren Dupont Kristensen. We are basically moving from a system in which electricity generation has been precisely matched to the needs of electricity consumers every day, to a system where consumption must largely adapt to the power being generated by wind turbines and solar cells.

Power stations, grid and market

The electricity system we know, and into which more and more fluctuating electricity generation from wind and solar power has been integrated for decades, was originally built around the large central power stations. Flexible power stations, a strong electricity grid and an efficient market – which aligned supply and demand – together guaranteed that Danes were supplied with the electricity they needed every day. The power stations also provided the services that are essential to ensuring that the electricity system is always balanced, robust and stable.

It is still often power stations that are waiting behind the scenes and ready to increase or reduce production within split seconds or minutes, thereby ensuring there is always stability and balance between

electricity generation and consumption. Reserves are needed in case unexpected events occur in the electricity system, such as failure of a component in the transmission grid, outage of an interconnector or a wind front that arrives later than expected. If power generation exceeds consumption, the system becomes overloaded, whereas if generation is less than consumption, or power cannot be transmitted, there will be power failures.

Electricity with heat or heat with electricity

But as conventional power stations are closing down or operating for fewer and fewer hours, for example only when district heating is being generated, new green solutions have to be able to provide reserve and balancing services. Just as the old CHP plants are increasingly playing a role as 'thermal power stations', future heating plants may play a bigger role in balancing the power system. The heating sector is being electrified, using large electric boilers and heat pumps. They can consume electricity when it is windy, helping to provide the necessary balancing services.

"I do not foresee an electricity system without CHP plants," says Søren Dupont Kristensen. "They will exist and play a significant role, but will be based on biomass or other renewable energy, and will have less power output and fewer hours of operation than

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before. They will also most likely have carbon capture and storage (CCS) technology installed.”

Similarly, the hydrogen plants and Power-to-X plants of the future, which will produce green fuels using wind and solar power, may play an ‘X-to-Power’ role by generating electricity back into the grid at times. Søren Dupont Kristensen mentions the Green Hydrogen Hub partnership, which Energinet is involved in via Gas Storage Denmark, as an example. One of the other partners, Corre Energy, aims to establish a Compressed Air Energy Storage plant. The plan is for compressed air to supply 320 MW to the power grid in a few years.

Other technologies and plants, and large batteries which can quickly balance the electricity grid for short periods, will also spring up,” predicts Søren Dupont Kristensen.

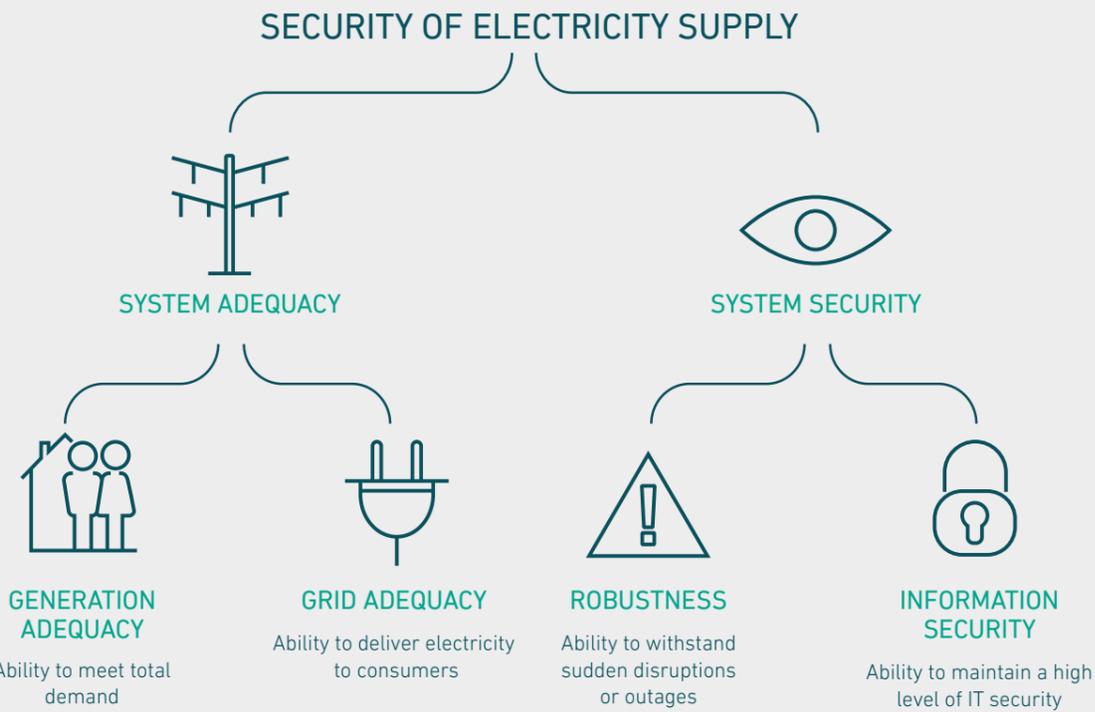
Rotating machines

As the power grid loses some of its traditional balance providers when the power stations no longer operate, some of the robustness and resistance of the power system will also be lost. The large generators at the power stations rotate several thousand times

a minute and continue to operate and keep the electricity system in operation despite short circuits or other sudden events in the grid. These are small things in relation to the large grid, but could still have huge consequences if the electricity system is unable to maintain its ‘pulse’.

The wind turbines and solar cells which will become the backbone of the future electricity system are designed very differently to power stations. Unlike the rotating machines of thermal power stations and the Nordic hydroelectric power stations, they have power electronics, which do not support the stability of the electricity system in the same way when unexpected events occur. In some cases, the power electronics can actually make things worse.

Søren Dupont Kristensen foresees that power stations will still be able to provide some of the necessary balance and stability in the future – power stations that run on green fuels and might only be in the market to provide ‘ancillary services’. It will also be possible to purchase the services in international markets to a greater extent, for example from other Nordic countries. >>



Ensuring that electricity is available for use is a complex issue, and many factors need to be met. If just one of the elements underlying security of supply drops out, everything could be blacked out.



Kia Marie Jerichau
Head of Ancillary Services



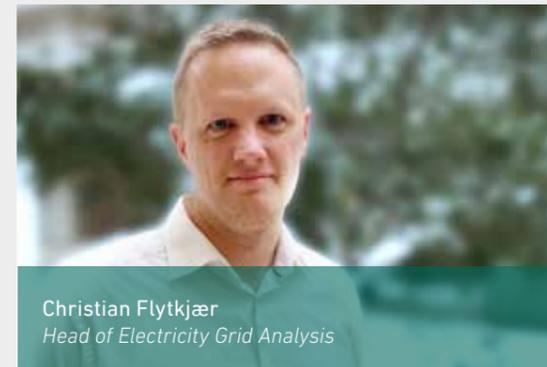
“Increased generation from renewable energy leads to more imbalances in the electricity system. The players involved are also changing significantly – reserves must come from new green sources. We have to teach new players that they can provide ancillary services and how to do it – because the electricity market is not necessarily their primary business area.”



Anders Steen Kristensen
Head of Electricity Grid Planning



“Generation and consumption will be widely spread – over both time and geography – and there will be a need for more electricity grid capacity. We must expand wisely though, and society will probably have to accept that there may be hours during the year when a solar cell plant cannot distribute 100% of its production, and so on. If we have to build an electricity grid to cover all occasions, it will be expensive, and mean more cables and power lines causing inconvenience to citizens.”



Christian Flytkjær
Head of Electricity Grid Analysis



“The green generation plants of the future will not have the same stabilising effect on the electricity system as the classic heavy power stations had. There is therefore extensive debate among the TSOs of the world, including Energinet, research institutions and plant developers on how green generation plants can contribute to this.”



Bent Myllerup Jensen
Head of the control centre



“When we have to monitor a green electricity grid in the future and be able to secure the Danish electricity supply, hours and days ahead, this will require decision support on a whole new level. Information and data from thousands of smaller units will require intelligent digital solutions that allow us to make the right decisions in just a few minutes. More data and IT systems are necessary, but also increase the demand for a high level of IT security.”

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But this will not be enough to ensure a continued high security of supply.

Solutions do not currently exist

It is therefore necessary to find new, green ways to balance the electricity system in everyday situations, as well as technical solutions for the rare incidents that can black out entire regions if the electricity system is not robust.

This is why Energinet is working across departments and with feelers out to companies and researchers in Denmark and abroad, to find and create the market models and technical solutions to secure the electricity supply in a fundamentally different electricity system. Many of the solutions do not yet exist.

"We are one of the countries that has come furthest towards a system dependent on the wind blowing and the sun shining, and are therefore facing the challenges before most others. Many other countries will experience the same problems sooner or later, but since we are among the first, we have nowhere to go to find ready-made solutions," says Søren Dupont Kristensen. He highlights three of the many measures aimed at taking the Danish electricity supply securely into a green future.

Three initiatives that contribute to a secure future supply

Texas, California, Australia, Ireland and the UK also have large quantities of fluctuating energy and periods when the sun or wind are supplying all their energy. Energinet has therefore recently joined forces with the TSOs in these countries in the Global Power Transmission Consortium (G-PST). With leading researchers and companies, G-PST is looking at how technology can be applied to ensure the stability and robustness of the future power system.

A pilot project here in Denmark has shown that the forecasts for wind power generation are so accurate that the wind turbines can now bid on and supply some of the reserves and balancing services needed by Energinet, on equal terms with traditional power stations.

Energinet has been working with Siemens and Danfoss to investigate what it will take for many of Siemens' refrigeration and ventilation systems in shopping centres, institutions etc. and a hydrogen plant at the Danfoss factory in Nordborg to start and stop operating depending on the balance needs of the power system. In addition to being technically possible, it must also be profitable for new suppliers to offer flexibility and participate in the balance markets.

"We are in the process of leaving an electricity system where generation is adjusted to exactly match the amount consumers want to use, without even glancing at the current price in the electricity market. In an entirely green electricity system, generation will fluctuate greatly, and consumption will have to be more flexible and matched to the wind and weather conditions. And as if that is not enough, the electricity will not be generated close to major cities and consumption centres, but far out at sea or in parts of Denmark where there is no consumption to take up generation, or electricity grid with sufficiently capacity to transmit the electricity away. Furthermore, during the next decade we have to find completely new ways to ensure that the electricity system is balanced and always stable. It's a huge undertaking. Electricity is vital to the functioning of society, and we must not end up with a green electricity system in which outages are more common," says Søren Dupont Kristensen.

CONTROL CENTRE TO GO ON AUTOPILOT

Energinet's control centre is the heart of our Danish electricity system. A team of employees here ensure that the electricity system has the right pulse, so that Danes can be confident that the lights will never go out. Just as you can monitor heart rhythm on a screen, electronic maps of the Danish electricity grid ensure that control centre staff can monitor the primary grid 24 hours a day. They have to be able to react quickly, and ideally stay one step ahead, so they can predict and prevent incidents which could have a negative impact on the electricity system.

A system overload – or a situation where not enough electricity is being generated to meet consumption – could be handled a few years ago by contacting one of the relatively few and large CHP plants, by telephone or email, and asking them to increase or decrease electricity production. But the green transition of our energy system represents a major upheaval.

Bent Myllerup Jensen, head of Energinet's control centre, comments: "When power stations are operating for fewer and fewer hours or shutting down, the task of creating balance in the electricity grid becomes far more complex. The control centre will receive information from a large number of small units scattered across Denmark – thousands of wind turbine and solar cell plants, etc. This is much more complex, and changes are happening quickly! And it will demand decision support at a whole new level."

Need for quick decisions and overview

The control centre therefore needs intelligent digital solutions that can help to constantly provide an overview and thereby secure the electricity supply. In other words, a flexible real-time platform which enables the control centre to make the decisions needed to balance the electricity grid in just a few minutes.

"In principle, the new IT platform must connect a wide range of programs that address specific challenges – and together provide solid decision support in an energy system that has been turned upside down. Development is well underway and proceeding rapidly, but not so fast that we are unable to maintain a firm grasp on security. This is essential in order for us to be able to go digital."

He compares the current development with a plane cockpit: "Pilots used to guide planes manually using a joystick. But then came the autopilot – and this is essentially what we are building in the electricity system. Once everything is automated, we need to spend more time in the training simulator, so we are able to guide the electricity system securely forward when something goes wrong."

CONTROL OF ELECTRICITY AND GAS NEEDS TO BE INTEGRATED

Electricity and gas are currently handled separately, but will be coupled and affect each other in future, driven in part by huge Power-to-X plants that convert electricity into gas. And we need to have this under control.

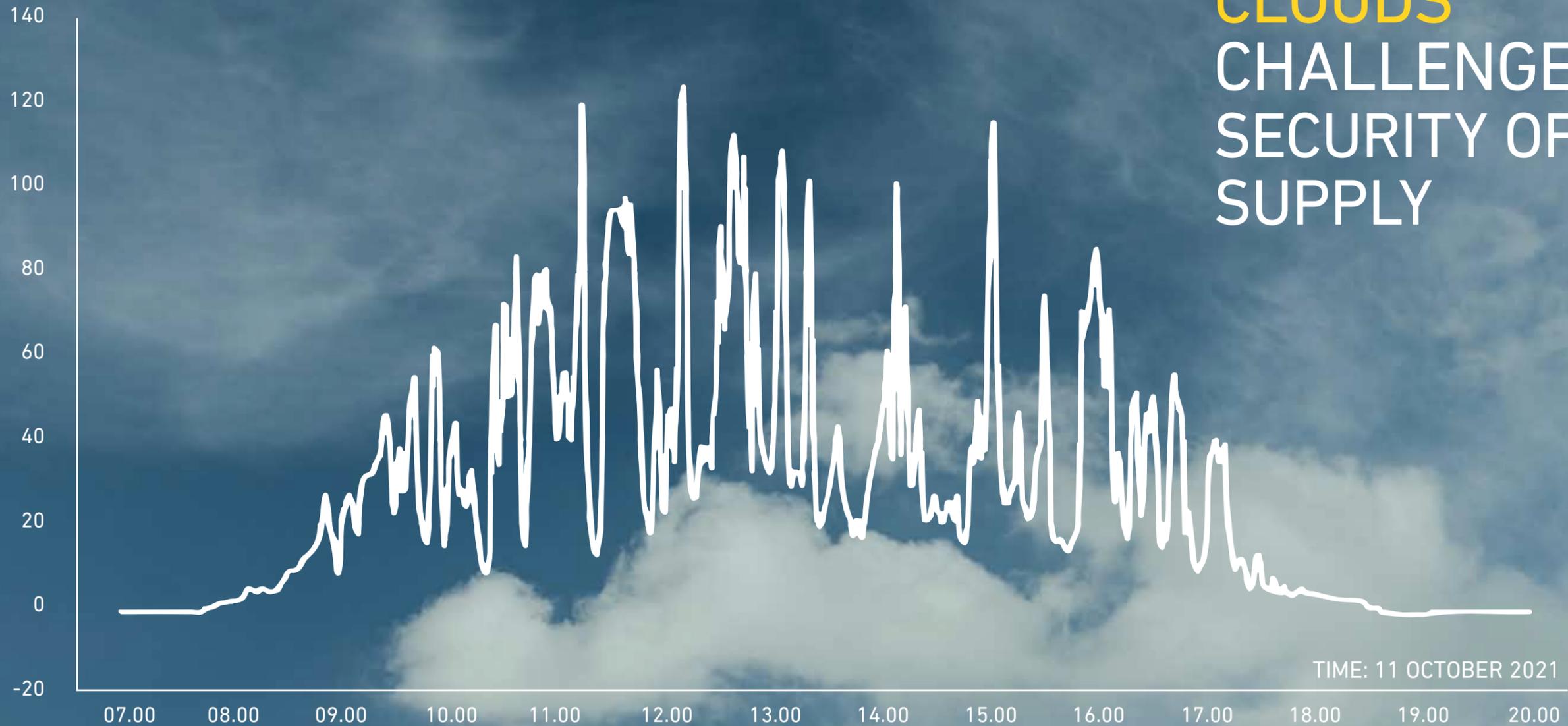
FUTURE DIGITAL CONTROL CENTRE IN BRIEF

The new IT platform must provide a complete foundation for a number of programs – like a Lego building board that you can place bricks on. This will ensure we have a dynamic platform that can be developed as new needs arise. Specialists at Energinet are currently working on the platform, and the first functionality is being put to use in the control centre.

"We are one of the countries that has come furthest towards a system dependent on the wind blowing and the sun shining, and are therefore facing the challenges before most others."

Søren Dupont Kristensen, Director, Energinet System Operation

ACTIVE POWER (MW)



WANDERING CLOUDS CHALLENGE SECURITY OF SUPPLY

The first large PV power plant was connected directly to the Danish electricity transmission grid and put into operation near Holstebro in autumn 2021. Experience from the first months shows that the power grid comes under pressure on days when white clouds blow across the sky. This results in large fluctuations in energy production minute by minute, and forces Energinet to use a large portion of its automatic reserves – ie the

power reserves purchased and available for the purpose of keeping the electricity system in balance and maintaining security of supply. The PV power plant complies fully with current rules, but Energinet is closely monitoring developments.

This is an example of the new conditions and challenges we face as solar and wind power account for much more of our electricity supply.



ARE DATA SPACES FROM OUTER SPACE?

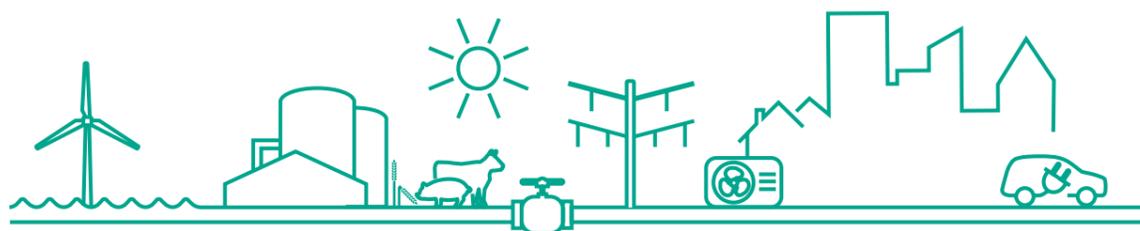
Data Spaces are no longer something we talk about as being from outer space. Work is being done across sectors, stakeholders and national borders to establish a digital infrastructure for the energy system, in the same way as the internet has been built. Get a brief introduction to Data Spaces here.

Heat pumps of various sizes, hydrogen plants and electric vehicles are driving electrification, and are thus major contributors to the green transition. But how much green energy is available, and when is there capacity in the electricity grid to transmit it? What does this energy cost at any given moment? And how does all this interplay with the consumption, storage and production of natural gas, biogas, hydrogen, e-methanol, heat and water?

In future, when we will be basing our entire energy consumption on renewable energy, it is important that we are able to send the energy where it is needed, when it is needed. Control will become so complex and data-intensive that it no longer makes sense to build a single system. In principle, the digital infrastructure for the energy system has to be built in the same way as the internet was built – as an ecosystem. We call such an ecosystem for energy and supply data a Data Space.

A Data Space for energy and supply data is one of the energy sector's most important digital initiatives. This will ensure access to standardisation and exchange of data and thus transparency across players and users in the electricity, heating, water and gas sectors – and others. And in principle across national borders also. The Data Space is set to become critical digital infrastructure that creates trust and a foundation for innovation in the energy and supply sector – just like NemID and e-Boks have done for the banking sector and the digitalisation of government services.

Data Spaces are a direct offshoot of the Danish government's digitalisation partnership, presented on 1 October 2021. In November, the Danish Energy Association and Energinet presented a proposal to serve as the basis for a number of initiatives aimed at maturing thoughts and ideas across stakeholders.



A POWERFUL
TEAM
FOR A BETTER WORLD



Thomas Egebo
President and CEO of Energinet

HIDDEN POTENTIAL OF HYDROGEN

Green hydrogen produced using wind and solar power will be key to our society achieving an efficient green transition in three vital areas. One of them is well-known by now. The other two areas may be less known, but will nevertheless play a major role for us at Energinet and in the daily lives of all Danes.

Thomas Egebo, President and CEO of Energinet, looks at what is happening and the hidden potential of hydrogen. >>

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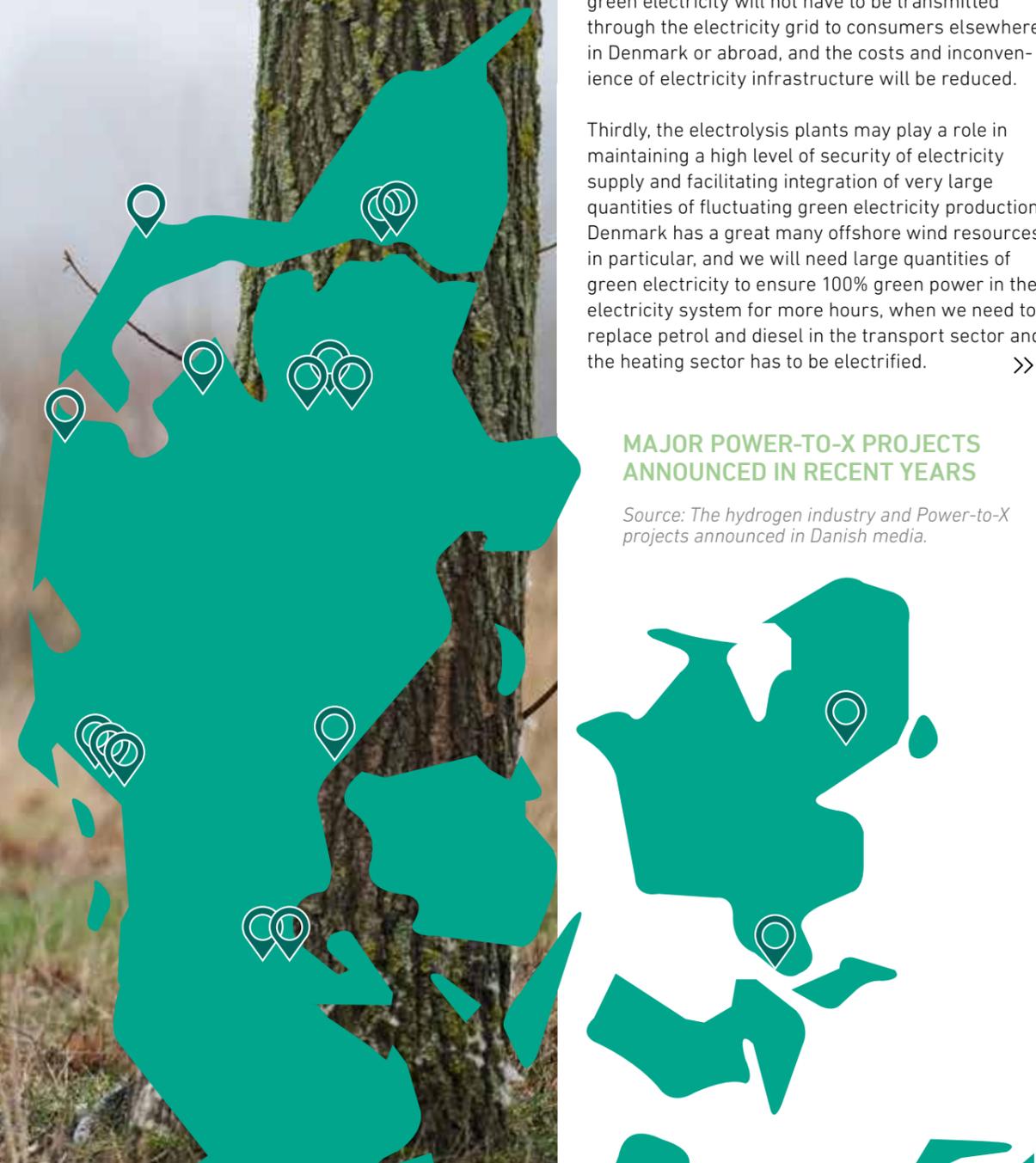
The first and well-known potential is hydrogen's key role in allowing shipping, aviation and parts of industry to become green. These are sectors that may not be able to sail, fly or produce using electricity or batteries – they need potent fuels in large quantities, and hydrogen – or other green fuels made using hydrogen – can provide this.

Secondly, the electrolysis plants that convert wind and solar power into hydrogen can also reduce the need to expand the electricity grid, if the electricity consumption is placed in proximity to wind turbines and solar cells. This means that a proportion of the green electricity will not have to be transmitted through the electricity grid to consumers elsewhere in Denmark or abroad, and the costs and inconvenience of electricity infrastructure will be reduced.

Thirdly, the electrolysis plants may play a role in maintaining a high level of security of electricity supply and facilitating integration of very large quantities of fluctuating green electricity production. Denmark has a great many offshore wind resources in particular, and we will need large quantities of green electricity to ensure 100% green power in the electricity system for more hours, when we need to replace petrol and diesel in the transport sector and the heating sector has to be electrified. >>

MAJOR POWER-TO-X PROJECTS ANNOUNCED IN RECENT YEARS

Source: The hydrogen industry and Power-to-X projects announced in Danish media.



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The electrolysis plants may also come to play an important role in helping ensure that the electricity system is not overloaded, and that we do not experience power outages. The electricity system needs a balance between consumption and generation at all times. This means someone must always be ready behind the scenes to quickly make an adjustment if a fault or unexpected event occurs, such as a short circuit in the electricity system leading to a connection dropping out, or a wind front arriving slightly later than expected.

HYDROGEN COLLABORATION IS CRUCIAL

Energinet performs cohesive, holistic planning for the electricity and gas systems. Hydrogen is playing an increasingly important role in this regard. Energinet is therefore working across the organisation to identify and support synergies between hydrogen and the rest of the energy system. But we cannot succeed alone. Collaboration with several players in Denmark and abroad is playing a vital role.

- Innovation and new partnerships, for example with Danfoss, where we are investigating how electrolysis plants can provide valuable flexibility services to the electricity system.
- We are working towards a common European vision for hydrogen infrastructure in the European Hydrogen Backbone initiative.
- The Energy Origin project makes it possible to document the source of electricity hour by hour. Energy Origin will add value to green hydrogen.
- Gas Storage Denmark is working with several partners in the Green Hydrogen Hub project to make it possible to store hydrogen produced from wind and solar power. The project is working with long-term and short-term underground storage. This will allow hydrogen, combined with the storage options, to further contribute to balancing the electricity system.
- Modernisation of the electricity tariff design to make it cheaper to become a flexible hydrogen producer.
- Energinet's capacity map indicates good locations for electrolysis plants in relation to the electricity grid. See www.kapacitetskort.dk

For decades, conventional power stations have been the key providers of the necessary flexibility for the electricity system, but as more power stations are shut down and an increasing amount of fluctuating generation from wind and solar power is integrated, the way the electricity system is balanced will fundamentally change. Consumption must now be increasingly adapted to fluctuating generation, and the electrolysis plants can become important providers, while also profiting from helping to balance the electricity system.

New green industry adventure

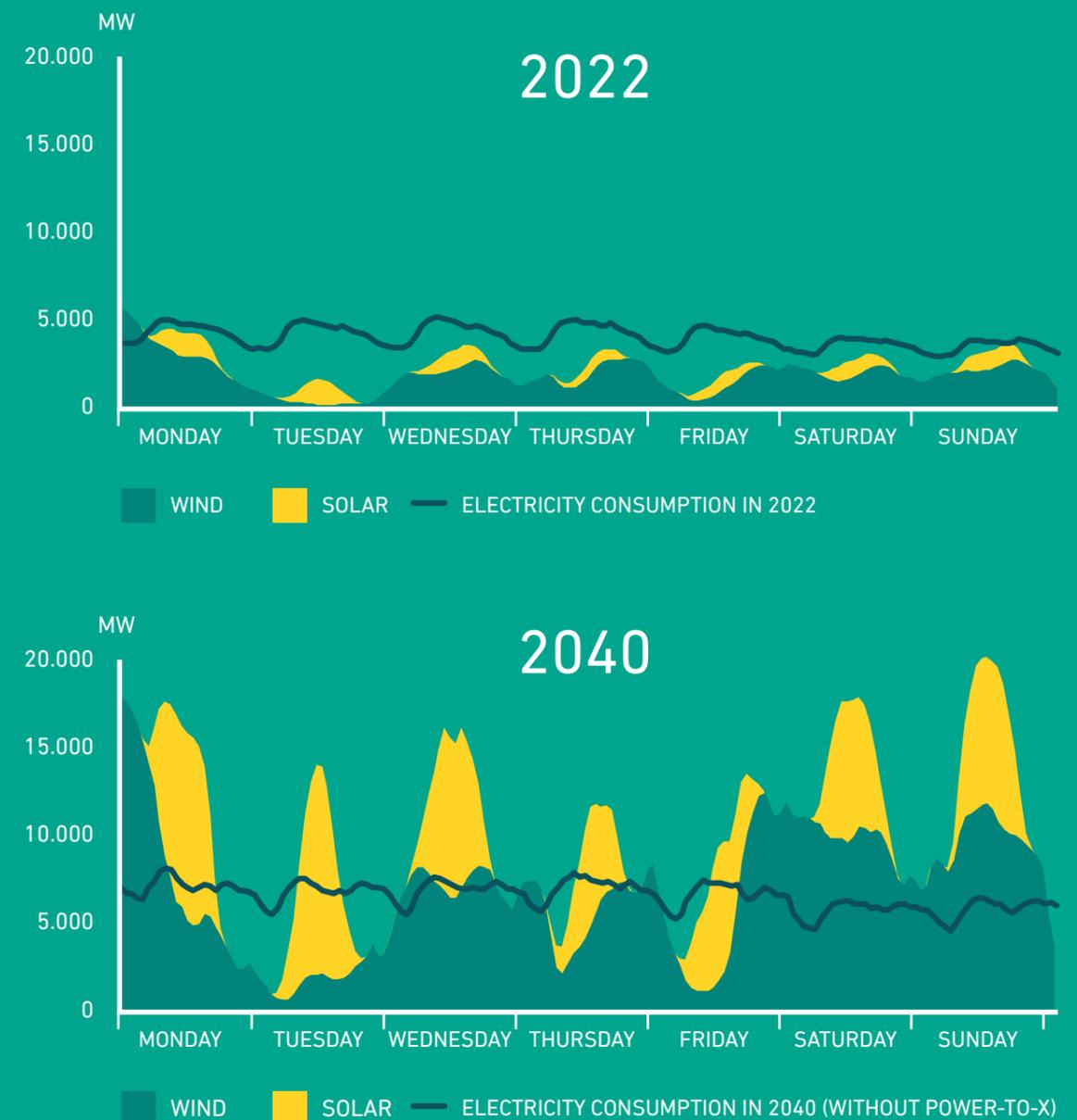
Given the large solar and wind resources available, Denmark is well positioned for a new industry adventure involving green fuels. In our dialogue with the many new hydrogen players, we sense that there is great interest in establishing electrolysis plants. Test systems must be designed for full-scale plants, and billions must be invested in new electrolysis plants. In addition to a large green potential, there is also a huge commercial potential for Danish companies. It is not just Denmark that has its eyes fixed on green hydrogen. Neighbouring countries, such as Germany, want to convert much of their industry from coal, oil and gas to hydrogen. Hydrogen they want to partially source from Denmark. It is one of our key roles as transmission system operator to help realise both the green and the commercial potential.

Energinet is in constant dialogue with market players from Denmark and abroad, and they are expressing interest in Danish hydrogen infrastructure – even before 2030. They particularly see great potential in hydrogen exports to Germany. Energinet, together with German partners, is already looking into the possibility of building a hydrogen pipeline between Denmark and Germany. Preliminary studies have shown there is potential for establishing a hydrogen link to Germany, based partly on re-use of existing gas pipelines. Such a connection can ensure that Danish hydrogen players create a green new Danish export success story, which helps make the rest of Europe carbon neutral.

But hydrogen infrastructure is not only important for supporting a green new Danish industry adventure. It may also prove vital to fully realising the hidden potential of hydrogen. Electrolysis plants can reduce the need to expand the electricity grid and contribute to a green and secure electricity supply. In this context, hydrogen infrastructure can provide the critical flexibility that ensures that Denmark can realise the enormous potential electrolysis plants have for contributing to an efficient green transition.

MAJOR FLUCTUATIONS IN 2040

Fluctuations in wind and solar energy production will increase dramatically up until 2040. New technologies are needed to integrate and balance the large quantities of green electricity. Electrolysis plants, which convert renewable energy into hydrogen*, have the potential to contribute to the flexibility we need in order to utilise the extensive solar and wind resources we have in Denmark.



*POWER-TO-X converts renewable energy into hydrogen and other climate-friendly fuels. This is done using electrolysis – a process whereby water is split into hydrogen and oxygen using green electricity.

Source: The Danish Energy Agency's Analysis Assumptions for Energinet



CONSTRUCTION BOOM IN THE POWER GRID



Henrik Riis
Director, Energinet Electricity Transmission

More electricity is passing through Energinet's over 8337 kilometres of electricity grid every day. By 2030, the quantity will be considerably larger – and will flow to consumers from a large number of photovoltaic cells and wind turbines scattered across Denmark. We will need this green electricity in the future as we electrify everything that can run on electricity. This will be essential in order to achieve the climate target of a 70% reduction in greenhouse gases by 2030.

The green transition of our energy consumption is already well underway. Henrik Riis, Director of Energinet Electricity Transmission and head of Energinet's plant management, is in no doubt that we are facing a period of great changes in our electricity consumption, that will happen at a rapid pace.

"We're replacing our petrol vehicles with electric vehicles like never before, households, businesses and district heating companies are buying heat pumps, and regions and municipalities are increasingly focusing on green transport. There will be an almost insatiable demand for electricity in the future, particularly for the production of the liquid green fuels needed to convert aeroplanes, ships and heavy industry."

More wind turbines and solar cells will be installed

At the other end of the power grid, an increasing number of producers are ready to deliver the enormous quantities of renewable energy required. This is due to rising demand and the fact that the costs of producing renewable energy have plummeted. Lower costs also mean that plants are generally getting larger, and Energinet has seen a clear increase in the number of plant owners who want a direct connection to the electricity transmission grid. Solar energy has been in particular focus in recent years. There is widespread interest in installing new PV power plants throughout Denmark. The volume of solar energy has doubled over the past five years, and is expected to be multiplied over the next five years.

Henrik Riis notes that the massive and rapid growth in the number of new PV power plants to be connected to the power grid is placing great demands on Energinet: "We need to speed up the implementation of our construction projects. But we must also ensure that the power grid is expanded in the most cost-effective way. >>

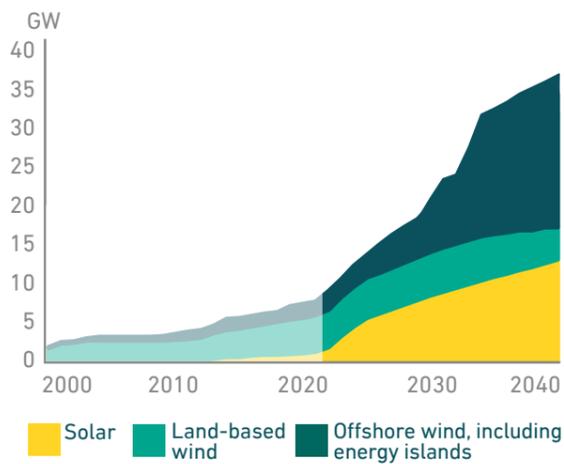
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We have a strong focus on both aspects – through dialogue and new ways of working.”

While solar energy is currently seeing rapid growth, offshore wind turbines will remain the key contributors to the enormous quantities of green electricity

GROWTH IN SOLAR AND WIND POWER



Power grid capacity requirements if the interest reported by renewable energy producers materialises.

Source: The Danish Energy Agency's Analysis Assumptions for Energinet

needed to supply large-scale consumers such as data centres and Power-to-X plants. And Denmark's inexhaustible wind energy resources can also make a significant contribution to the European green transition.

Henrik Riis adds: "The wind potential and favourable seabed conditions in the North Sea and Baltic Sea place Denmark in a unique position to export and generally exchange large amounts of energy with our neighbouring countries. This helps makes market players keen to invest."

The Ørsted energy company is a leading global offshore wind power developer, and is ready to harvest even more wind power in Denmark and throughout the world. Ulrik Stridbæk, Ørsted's Head of Energy Economics, has been observing developments for many years. However, he has not been involved in the entire journey from 1991, when Ørsted built the world's first offshore wind farm in Denmark, to today, where the energy company can supply electricity to more than 900,000 Danish households.

"The offshore wind sector has seen incredible development and is now a fully mature technology which is competitive with other forms of energy. This is also why we have seen governments worldwide focus on offshore wind power since 2018 – to replace phased out coal-fired power stations and for new capacity. Simply because it is the right thing to do, for the climate and economically. Offshore wind also has some derived, but important, benefits that

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governments value. It creates a lot of local jobs and makes countries less dependent on energy imports."

A strong infrastructure will be key

The rapid development in both consumption and production is just what we need to achieve the climate goals set. The need for speed was further heightened in February due to the serious situation in Ukraine, which is affecting the entire European energy sector and society in general.

But there can be no green transition without good infrastructure, geared to linking supply and demand.

Henrik Riis acknowledges that the major interest and many new plants already in the pipeline will put the power grid under great pressure. Much of the existing power grid is also due to be replaced.

"There is a huge task ahead of us. To draw a parallel with another area of infrastructure – our motorways, which carry thousands of motorists every day – it would be equivalent to doubling the traffic on the E45 without expanding the carriageway or building new roads to alleviate the problem. This is the scenario we are facing right now. And we need to not simply avoid this situation – we must stay ahead of it. There is therefore an urgent need to expand the energy infrastructure."

At the same time, the current energy motorways are nearing the end of their service life and reinvestment

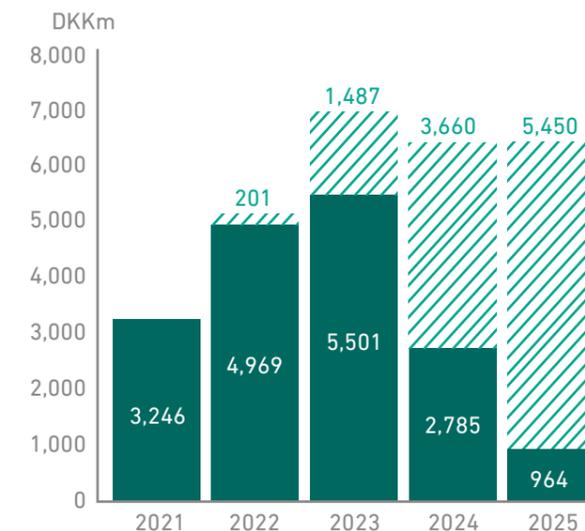
is necessary in order to keep traffic flowing safely without delays. Much of the Danish power grid was built in the 1960s and 1970s, when consumption increased dramatically. More than five decades later, this means we have a power grid which is nearing retirement age. Old power lines and substations have to be refurbished or completely replaced. This is a comprehensive task in itself, and means that the amount of plant requiring reinvestment will more than double by 2023.

European infrastructure must be expanded

Ørsted has built more than 25 offshore wind farms worldwide. But their ambitions do not stop there. The company has plans for much more offshore wind power, but notes that infrastructure is key to whether there is a good business case. And this includes infrastructure across national borders.

Ulrik Stridbæk adds: "No man is an island. If we are to succeed in decarbonising Europe by 2050, we must ensure that the grids have sufficient capacity, both in Denmark and the rest of Europe – and that they work together. In its strategy for renewable energy, the European Commission notes that two-thirds of the EUR 800 billion to be invested in attaining 300 GW of offshore wind power by 2050 will have to be invested in the European power grids. This shows how important it is to Europe's green transition that the need for investments in the grids is not overlooked, but is given high priority on the political agenda."

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SCOPE OF INVESTMENT TOWARDS 2025

Planned projects
 Projects in progress

2021: Actual figures for 2021
 2022-2025: Forecast 2022

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GREEN TRANSITION PLACES HEAVY DEMANDS ON GRID COMPANIES

While Energinet is responsible for the energy system 'motorways' – the transmission grid, the Danish grid companies are responsible for the distribution grid, which transmits the power to home owners and businesses. The grid companies will also face a major challenge when much more electricity has to be transmitted through an ageing distribution grid. This is in part because many wind turbines and solar cells will supply their electricity directly to the distribution grid. This can create major challenges if there is no matching consumption – or if the power grid does not have enough capacity to transmit power out of the area.

Huge construction scope demands a new approach

The massive new investments and reinvestments in the existing electricity grid and a doubling of Danish consumption within the next few years will mean that the plant management department will have to work hard at Energinet. But far more than that will be required.

Henrik Riis: "We must work in completely new ways in our plant management to avoid infrastructure causing congestion for the green transition. We are therefore currently developing our approach to projects, so that we increase the speed and reduce project throughput times. We have intensified our collaboration with renewable energy producers, so that we better understand each other's needs, opportunities and limitations."

Collaboration across the value chain is one of the core elements of an initiative we call 'Developer in the

green transition' at Energinet. Henrik Riis adds: "Close dialogue with both RE producers and suppliers has led to very valuable input, for example on how we can together exploit the opportunities of digitalising the collaboration."

Another key building block in the new approach to construction projects is the establishment of new partnership models with suppliers, who build Energinet's standard facilities and modules to order and install them as turnkey systems. This is similar to a construction company that builds houses selecting certain models as standard homes, so that the company can meet demand and build more houses more quickly.

"In other words, we are working more closely with customers and suppliers to develop solutions together, while exploiting the potential of data and digitalisation," notes Henrik Riis.



FOCUS ON CITIZENS AND LANDOWNERS AS WE REBUILD AND BUILD MORE

Pylons, power lines and high-voltage substations will be necessary as we use more and more power, but they clutter the landscape, and neighbours to these infrastructure projects are quite understandably not enthusiastic. We therefore already have a strong focus on involving affected landowners and citizens as early in the process as possible. Read more about our construction projects and dialogue with citizens at www.energinet.dk/anlaeg-og-projekter.

We are also researching how we can place as much of our electricity grid as possible underground, so that it causes the least possible disruption to citizens and the environment. Read more at www.en.energinet.dk/Infrastructure-Projects

DATA AND DRONES TO OPTIMISE THE POWER GRID, WHILE WE RENOVATE

Our power grid must be renovated gradually, in part to ensure security of supply. We use data and drones to optimise and extend the service life of our electrical plant.

Drones to report faults

In future, drones will inspect Energinet's 4,500 km cable network – and report faults back to Energinet. Energinet currently inspects the grid by walking beneath the cables – and in January, February and March, when there are no leaves on the trees, inspection is performed using helicopters. By using flying drones to inspect the grid, we can achieve significant financial savings and get a better overview of the health of the cable network. We are also changing over from a manual to a data-based approach, and reducing our carbon footprint. The Drones4Energy project from SDU is behind the new drone platform.

Data prolongs the service life of electrical plant

Many of the substations and power lines you can see around the Danish landscape are reaching retirement age and need to be replaced. This is a comprehensive task, and requires that Energinet is able to create an overview of the health of the various plant elements, so that the most needy can be prioritised first. We can also proactively maintain the substations that still have a few years of service left in a timely manner. This requires knowledge about each plant element. Energinet is therefore installing additional digital measuring equipment on our plant throughout Denmark. Data is sent through wired and wireless networks to Energinet's data platform, which analyses the input and makes us more aware (over time) of the condition of our plant.





A NATURAL DILEMMA

Marian Kaagh
Vice President, Energinet Electricity Transmission

Energinet has to establish much more energy infrastructure in Denmark at a high pace in order to supply green electricity and gas for the green transition. How can we strike the right balance between efficient and extensive expansion and environmental considerations? There is no simple, clear answer to this question. We asked Marian Kaagh, Vice President in Energinet, to shed light on some of the dilemmas – and possibilities.

Finding protected animal species during construction work can delay the green transition and make it more expensive. Can you see any solutions to this issue?

If we look at the dilemma of creating a better climate and still taking care of the environment, we can look more generally at how we protect and create better conditions for animal species. Instead of focusing on how we can protect them exactly where we find them, we could create better conditions by providing substitute biotopes for the protected species elsewhere.

Slow regulatory processing in Denmark (and Europe) could prevent us from meeting our climate goals in time. What can we do to meet this challenge?

In order to succeed in the green transition of our energy system, it is important that there is good cooperation between the authorities that need to grant the various permits. We need to look at how we can simplify the processes and thereby reduce the case processing time. This problem is far from limited to Denmark – renewable energy producers are generally dependent on fast regulatory processing in any country. Again, there is a fine balance between European and Danish legislation that aims to protect our environmental interests – and the need to meet the climate goals in time.

We will see more and larger installations in the landscape. Can we do anything to adapt the many new facilities to the environment?

We certainly can, and we already have a major focus on this today. For example, we are constructing a new converter substation at Revsing near Vejen for the first electricity connection between Denmark and the UK – Viking Link. The preliminary archaeological studies found traces of Vikings here. This is very interesting, and we decided to visualise the local historical finds on the building there. Once the facility is complete, a lake and paths will be established, so that citizens can walk around an exciting landscape with both technical installations and natural scenery.

It takes a lot of resources to operate and expand energy infrastructure at a rapid pace. What is Energinet doing to ensure that it is done as sustainably as possible?

Many of our facilities involve extensive consumption of raw materials. We therefore have a strong focus on the value chain of components, eg how materials can be recycled when they can no longer be used. We also have a strong focus on motivating our contractors and suppliers to work sustainably. However, we face several paradoxes here also: Many of the technical components we use cannot be purchased in Denmark. Some, for example, have to be sourced from Italy. If we want to speed up the green transition, it is quickest to transport such components to Denmark by truck, but from an environmental perspective it is better to transport them by ship.

GREEN KNOWLEDGE SHARED WITH THE WORLD



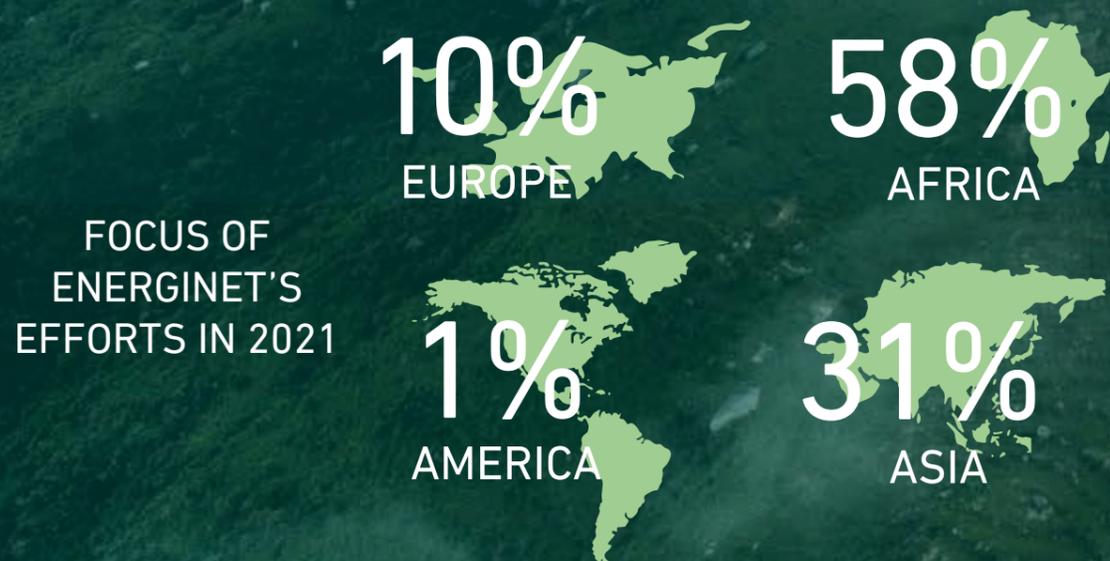
25 projects were completed in 2021 in 19 countries, primarily for the Danish Energy Agency



DENMARK EMITS 0.1 PER CENT OF GLOBAL CO₂ EMISSIONS



THE COUNTRIES WE PARTNER WITH EMIT MORE THAN 60 PER CENT OF GLOBAL CO₂ EMISSIONS



THE WORLD LOOKS TO DANISH EXPERIENCE

- INTEGRATING RENEWABLE ENERGY IN THE ELECTRICITY SYSTEM
- CONNECTING OFFSHORE WIND POWER
- DIGITAL SOLUTIONS
- GREEN GASES

In Denmark, 50% of electricity consumption is met by solar and wind energy, and our ambitious climate goals support even greener electricity consumption towards 2030. Our success in integrating photovoltaic cells and wind turbines into the electricity system means that the world is looking to Denmark for inspiration and specific knowledge for a global green transition.

Energinet is sharing its experience and solutions outside Denmark through Energinet Associated Activities. This primarily takes place through Denmark's green energy partnerships, together with the Danish Energy Agency's Centre for Global Consultancy. The contributions range from webinars to specific consultancy services – on topics such as electricity market development, long-term grid planning and connecting offshore wind power to the power grid.

"We want to disseminate the knowledge we have gained in Denmark over the past 30 years, to advance the global green transition. But Energinet also gets something in return. We will learn more ourselves and gain an international outlook. Each time an employee participates in Associated Activities, we gain new perspectives," says Peter Markussen, Director of Energinet's Associated Activities.

Denmark emitted 26 million tonnes of CO₂ in 2020. This is only a very small proportion of the global emissions of around 33 billion tonnes. The International Energy Agency estimates there is still a need for measures to reduce emissions by 20 billion tonnes in order to achieve the UN's aim of global climate neutrality in 2050.

It is deemed that half of these must come from the green transition in the electricity and heating sectors. There is therefore growing demand for Denmark's and Energinet's experience, and Energinet expects Associated Activities will increase in the coming years. >>

“
 We want to disseminate the knowledge we have gained in Denmark over the past 30 years, to advance the global transition
”

Peter Markussen
 Director of Energinet's Associated Activities



COLOMBIA

FOCUS ON OFFSHORE WIND POWER

The Danish Energy Agency initiated collaboration with Colombia in 2021, focusing on the establishment of offshore wind energy and integration into the electricity system. Digitalisation is a key part of developments in Colombia, and this also applies to the transition in the energy sector, to create transparency and trust and make data available for innovative new solutions. Energinet has presented its experience with the establishment and operation of DataHub, collaboration with users on new business models and development of the regulatory framework.

Colombia is one of the world's largest exporters of coal and has CO₂ emissions of 75 million tonnes. The goal is to reduce CO₂ emissions by 50% by 2030, and to expand wind and solar power by 4 GW by 2030 (equal to 25% of current electricity generation capacity).



■ Countries in which Energinet participated in projects in 2021

BIG PLANS FOR SOLAR AND WIND POWER

India has ambitious plans for renewable energy. The goal is 350 GW of new solar and wind capacity by 2030, a fourfold increase compared to today. In comparison, Denmark's new energy islands will supply 5 GW during the same period.

Energinet is taking part in the Danish Energy Agency's partnership programme with India, and contributing knowledge on how to efficiently integrate renewable energy into the power grid. This includes operation of the regional electricity system with an increasing share of wind and solar power, and development of the existing electricity market so it can handle fluctuating generation dependent on the weather. Finally, Energinet is contributing its experience in prioritising the expansion of the electricity transmission grid, based on the joint European grid planning. These efforts are contributing to reducing the growth in CO₂ emissions in India, which rise by approx. 100 million tonnes each year.



INDIA



SOUTH AFRICA

FAR BETWEEN PRODUCTION AND CONSUMPTION

South Africa faces the same challenge as Energinet: There can be great distances between locations where renewable energy is produced and locations with high consumption. Planning and expansion of the transmission grid are vital in order to reduce the shutdown of wind and solar power generation and ensure they contribute to security of supply.

More than 20 (online) workshops have been held by Energinet employees in cooperation with the Danish Energy Agency, the Danish Energy Association and Eskom (the South African TSO). They have presented our knowledge related to grid planning, and there have been up to 120 participants from Eskom and the South African energy authorities. The project is financed by the Danish Energy Agency. South Africa's CO₂ emissions are approx. 430 million tonnes a year, and most electricity production is based on coal. The goal is to increase the share of renewable energy from around 10% in 2018 to 40% in 2030.

DENMARK TO STORE CO₂ UNDERGROUND

Capturing CO₂ from Danish chimneys and storing it underground will be an important tool in achieving Denmark's ambitious climate goals. Energinet's gas storage facility in Stenlille could become an important stepping stone towards the goal.



In the coming years, Stenlille – a small town between Sorø and Holbæk – may play a key role in the battle to achieve the Danish climate goal. Denmark has a goal of reducing its CO₂ emissions by 70% by 2030, and one of the government's tools will be to store CO₂ underground.

Gas Storage Denmark (GSD), a subsidiary of Energinet, has an underground gas storage facility in the area near Stenlille. Studies must now show whether an underground location just outside Stenlille can also be used to store CO₂.

"The subterranean geology in Stenlille is the best understood in Denmark, as we have operated a gas storage facility there for 30 years. We know exactly what we are dealing with down there, and the probability is very high that we can store CO₂ quickly, easily and safely," says Adam Elbæk, CEO of GSD.

He sees CO₂ storage at Stenlille as a stepping stone which can help speed up progress on reducing CO₂ in the air over Denmark. The parties behind the political climate agreement want to be able to store 0.4 million tonnes of CO₂ underground already in 2025, with the volume increasing towards 2030. It is estimated

that 2.5 million tonnes can be stored underground at Stenlille.

Rapid start

The capacity at Stenlille is not enough to address the CO₂ challenge in the long term. However, it means Energinet can offer Denmark a rapid start on CO₂ storage, until it is possible to expand and use larger storage facilities, for example in the North Sea. There may also be other underground locations in Denmark where Energinet can presumably contribute based on its knowledge from Stenlille.

"If we act now, we can be storing CO₂ underground within a few years. We can do this because we are already on site, and we have skilled people and facilities that we can develop and make available," says Adam Elbæk.

"The most important thing about getting started on storage quickly is that we can create a platform that allows emitters to accelerate the development and scaling of carbon capture technologies from chimneys and anywhere else CO₂ will be captured. It's only once we succeed in making these things work across the board that we will achieve the climate effect we seek. We therefore have a strong focus in the Stenlille

Large, special-purpose vehicles could be seen at Stenlille between Sorø and Holbæk in February 2022, and local residents experienced occasional tremors in the ground. Seismic investigations aim to confirm the assumption that it is possible to store CO₂ approx. 1,500 metres underground

project on lifting the entire value chain through what we do, in close cooperation with the emitters, authorities and others."

Broader perspective

Seismic measurements were performed close to the gas storage facility between Sorø and Holbæk in early 2022. These measurements will determine whether the area is suitable for CO₂ storage. Based on the results, Energinet's owner, the Danish Ministry of Climate, Energy and Utilities, will decide whether Energinet should proceed with the storage plans.

Adam Elbæk predicts that CO₂ stores may eventually come to play another important role: "In a future where the use of fossil fuels has been phased out, it is likely that we will need carbon for the production of things like plastic or modern fuels. Such a storage facility could be part of a production chain, where we store CO₂ with the possibility of later retrieval. The facility would then change from being an end station in a closed value chain, to a sector coupling component. It could couple the industrial and energy sectors together in a long-term and sustainable way," he says, "that's the broader perspective."

FACTS

CO₂ storage is also called Carbon Capture and Storage (CCS). The technique is already in use in other countries, such as Norway. The Danish government has asked Energinet/Gas Storage Denmark to investigate the possibility of CCS in Stenlille.

The seismic studies are being conducted by Uppsala University and GEUS. GEUS (Geological Survey of Denmark and Greenland) is an independent research and consultancy institution under the Danish Ministry of Climate, Energy and Utilities.

The CO₂ to be stored is to be captured from large emitters, such as industry and waste plants. CO₂ is a non-combustible gas which is compressed and pumped underground for storage.

GEUS estimates that up to 22 billion tonnes of CO₂ could be stored underground in Denmark – or 500-1000 years of total Danish emissions at current levels.

Suitable underground locations will be carefully selected to ensure that the CO₂ does not start seeping out again.

SUSTAINABILITY ALSO POINTS INWARD

Denmark's goal of having a climate-neutral society by 2050 is a crucial factor in Energinet's work of operating and developing the electricity and gas systems. The increasing quantities of green energy from solar and wind power and biogas must be integrated into the systems, and viewed together with the potential offered by green new energy sources – and at a rapid pace. In this way, sustainability has become the key focus of Energinet's core task of securing the energy supply for Danes.

But the major focus on sustainability also points inward. Expanding and operating energy infrastructure requires a great deal of resources, and Energinet also impacts the climate through its business operations and many construction activities. Some of the big items in Energinet's climate accounts are transmission losses in the electricity transmission grid and emissions of SF₆ gas from power plants and methane from gas facilities, and we are consciously working to reduce them all.

Methane in focus

Reducing methane emissions is receiving increasing European and global focus as a means to achieving the Paris Agreement goal of limiting the temperature increase to 1.5° C. Methane is a very potent climate gas, and any reduction in emissions will have a positive impact in the fight against global warming.

Energinet therefore set ambitious new interim milestones in late 2021 for reducing methane emissions from our plants, to ensure a rapid impact. In 2025, our goal is to reduce Energinet's total methane emissions by 45% compared to 2019. We are aiming for a 60% reduction in the gas transmission grid by 2030, relative to a larger asset pool, and 70% in our two gas storage facilities.

One of our most important tools in the fight against emissions is to increase and digitalise monitoring, so we can quickly locate and repair leaks at joints in pipes and installations. We also see great potential in reducing the number of blow-offs in connection with planned maintenance. When plant maintenance is done, the pipes are emptied of gas through a blow-off, to make it safe to work. Using compressors makes it possible to move the gas away from the part of the plant to be maintained, allowing us to avoid many of the blow-offs in future.



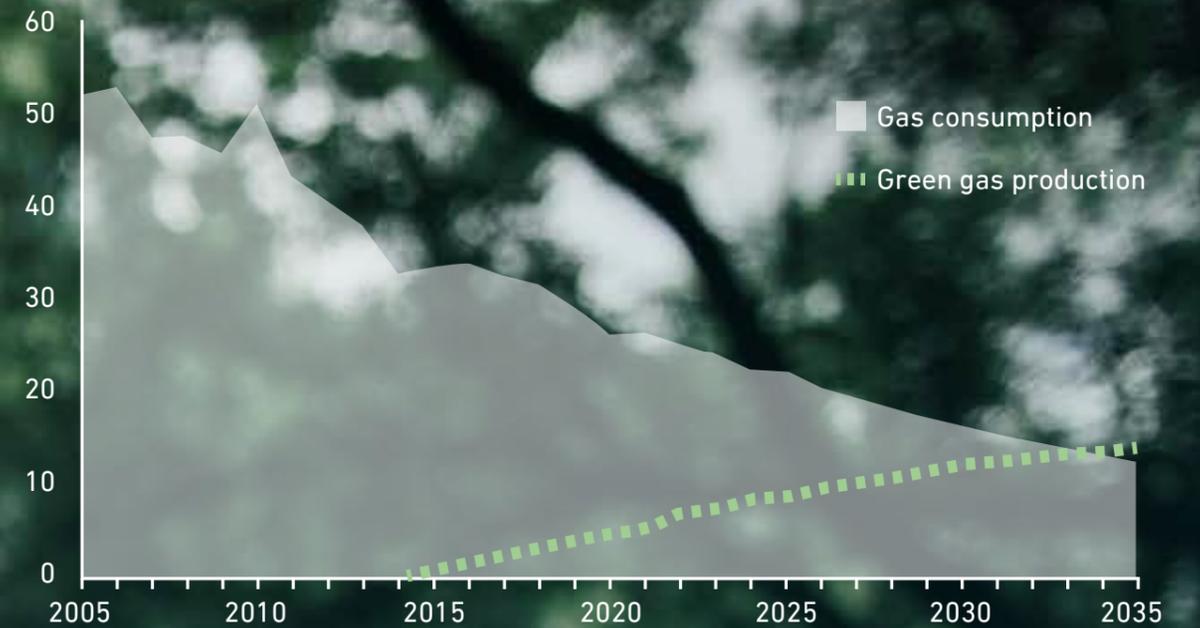
METHANE'S CLIMATE FOOTPRINT

Methane is a greenhouse gas that is much more potent than CO₂, but has a shorter climate impact. Methane is broken down and disappears from the atmosphere within 8-12 years, while CO₂ can remain there for hundreds of years. The climate footprint for gases is generally calculated for a 100-year period. Methane is considered to be 28 times more harmful than CO₂ over this time frame.

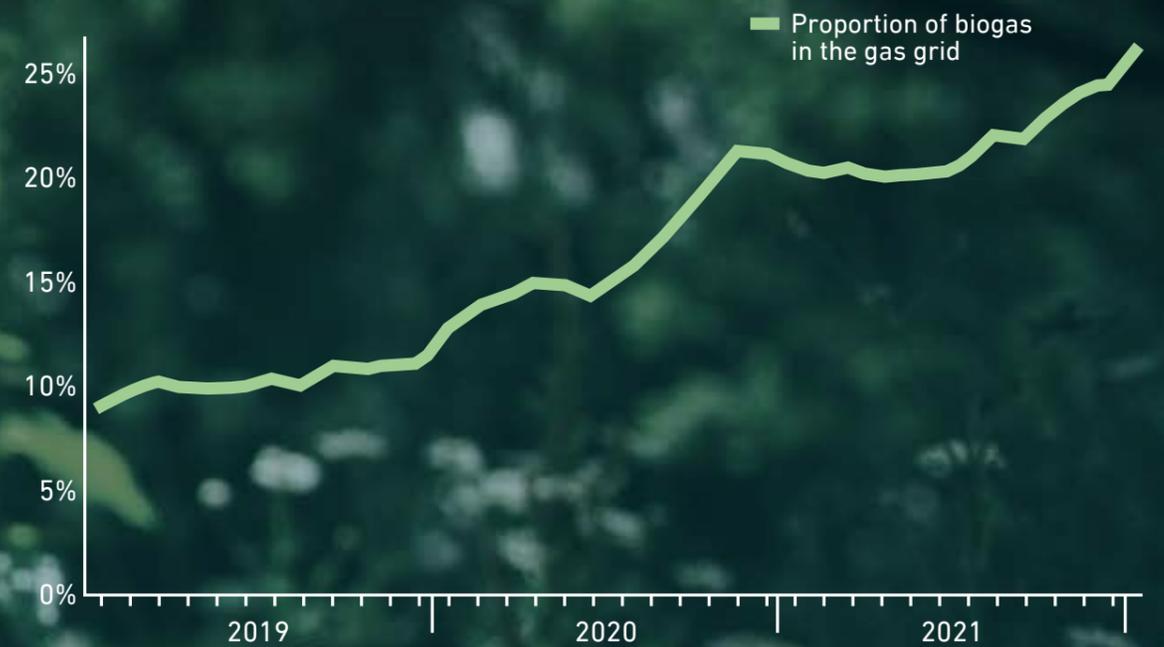
However, if you look at the climate effect over a 20-year period, methane is 86 times more harmful than CO₂. Calculated in this way, methane emissions account for around 4.5% of Energinet's total climate footprint.

GAS GETS GREEN

The proportion of biogas in the Danish gas system is increasing at record speed. Green gas accounted for 21 per cent of Danish gas consumption in 2021. The green transition of the gas system has great potential for contributing to Denmark's climate goals and independence from gas imports. But methane emissions from gas pipelines and facilities have the same climate impact, whether or not the gas is green. Energinet therefore continues to focus on limiting its own emissions.



Historical data are based on energy statistics prepared by the Danish Energy Agency. Projections are based on data from the Danish Energy Agency's Analysis Assumptions for Energinet.



A FLEXIBLE WORKPLACE

Although COVID-19 appears to have been tamed for now, Energinet is continuing to offer its employees a home workstation – and a great deal of flexibility.

We call it the 'flexible workplace', and it essentially means that each employee has a very high degree of freedom to organise their own working life, taking into account their tasks and the workplace community. The vision is for a flexible workplace to lead to greater well-being and better results.

Meet three employees at Energinet and hear how they view a flexible workplace and how they use it.



CHRISTIAN ADELHARDT
Business Developer

It's important to me to work somewhere that accepts that you have to have balance in your private life in order to be able to perform at work. I have fairly young children, so it's important to have the flexibility to make family life work. If I leave early to pick up my children, I sit down at night and catch up on what I need to. I am thrilled with the three-way balance the flexible workplace offers. I can physically attend the workplace and get energy from being in a vibrant company. I can work at home, attend online meetings or have peace for the contemplation that my tasks also require. And the flexible workplace also means I can keep my whole family dynamic working.



ANDREAS ELLINGSGAARD BAASTRUP
Senior Consultant

I faced an extraordinary life situation when my daughter became seriously ill last year. It was extremely difficult, and required exceptional work planning in order for me to juggle everything. If it had been a traditional workplace, I would have had to leave, which would not have been good for either Energinet or myself. I want to fulfil my work duties. But doing so involves much more than just being in the office in Erritsø from 8.00-16.00, Monday to Friday. So Energinet's entire flexible workplace framework makes it possible for me and my manager to arrange the work around difficult life circumstances.



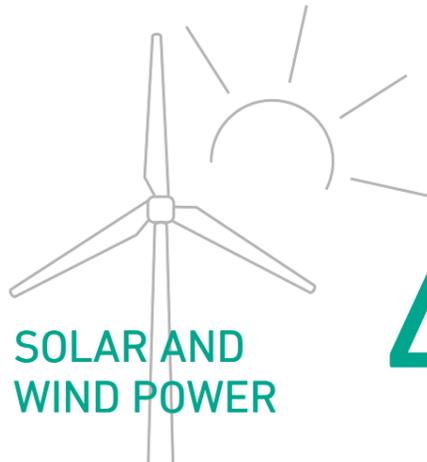
CHARLOTTE LUND
Project Manager

I initially saw obstacles to project cooperation – perhaps coloured by the fact that we primarily worked at home and lacked the informal communication which is important to project cooperation. But it has gradually reached a point where it works, even though it requires more planning to take the project needs into consideration while also ensuring flexibility for each individual.

The flexible workplace is easier to handle in large projects, where many participants are allocated full-time, and flexibility must primarily be balanced in relation to the project and department. It is more complex in cases where people are allocated to several projects, all of which require physical attendance.

However, as a project manager, I feel the advantage of the flexible workplace outweighs the greater need for coordination.

2021 IN FIGURES

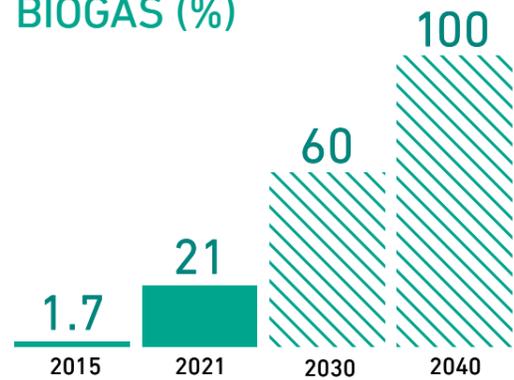


SOLAR AND WIND POWER

47.3%
2015: 40%

In 2025, about 70% of our electricity consumption is expected to be met by solar and wind power.

BIOGAS (%)



HIGH SECURITY OF SUPPLY FOR ELECTRICITY

42 sec.

WITHOUT POWER

Energinet's power grid was again providing world class security of supply in 2021.

SAME ELECTRICITY PRICE AS ABROAD

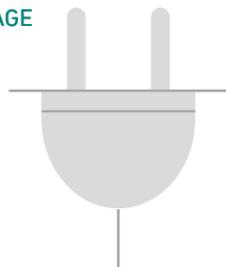
MEASURED AS PERCENTAGE OF HOURS

West Denmark:

94%

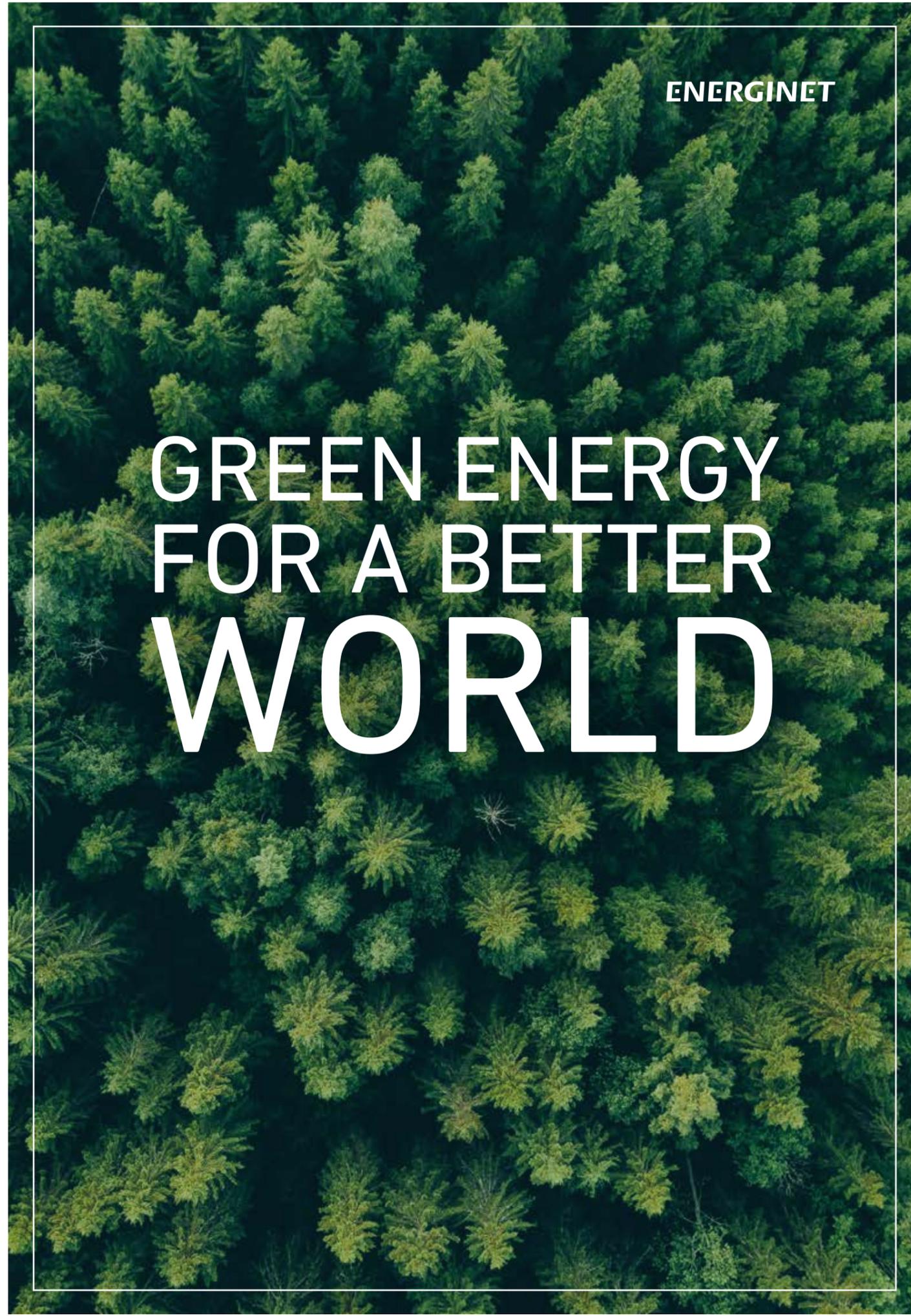
East Denmark:

94%

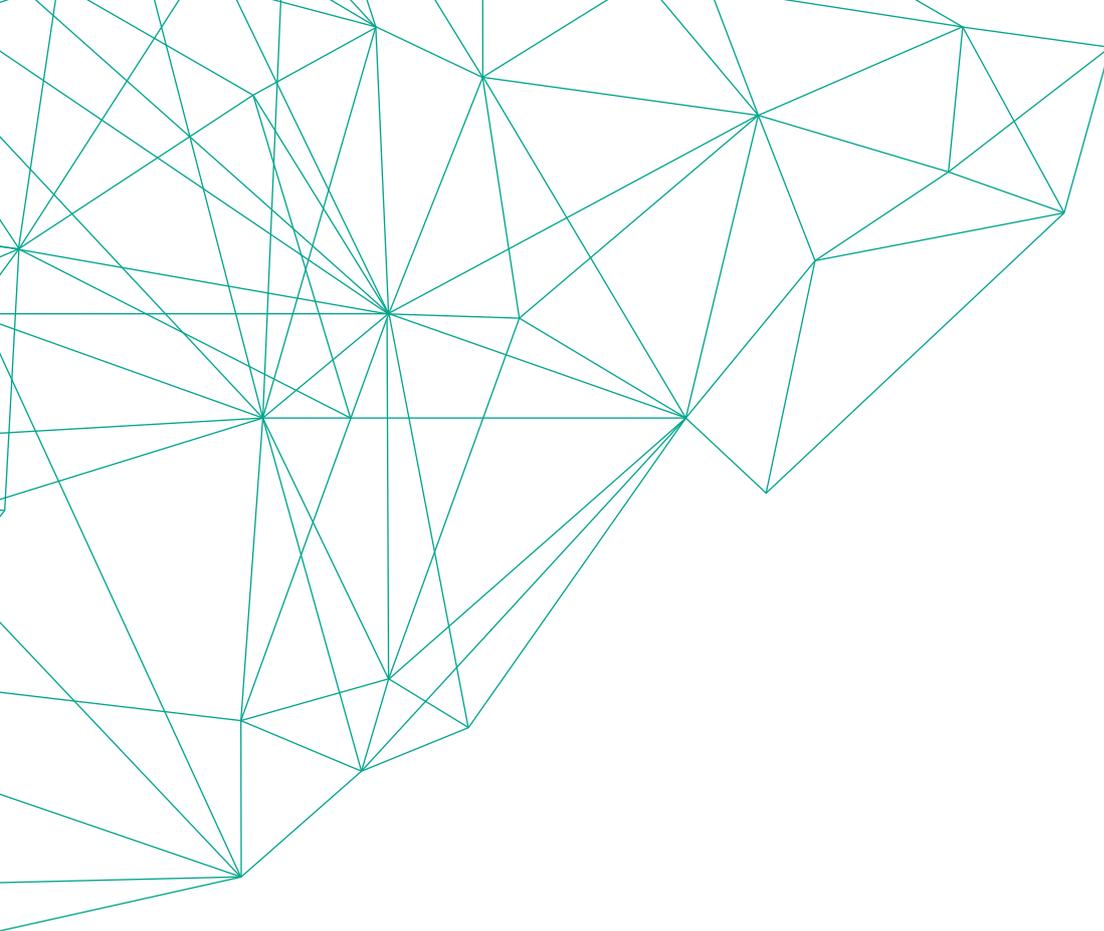


FIXED ASSET INVESTMENTS

DKK billions



GREEN ENERGY FOR A BETTER WORLD



ENERGINET

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Energinet is an independent public enterprise owned by the Danish Ministry of Climate, Energy and Utilities.

We are working towards a green transition of the energy systems, so that citizens and businesses can use renewable energy for everything, with a high level of security of supply and at an affordable price.