



ANNUAL
MAGAZINE
2024

ENERGINET

WHEN GREEN TRANSITION COMES CLOSE TO HOME

5 BARRIERS TO GREEN TRANSITION

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ANNUAL MAGAZINE 2024

Energinet's annual magazine 2024 provides an update on Energinet's activities, and the opportunities and challenges the company is facing.

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Editorial work concluded on
20 March 2024

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GREEN ENERGY ON TIME

Energinet has to deliver green energy on time. We have to ensure high security of supply and affordable energy. This is a big responsibility that we are proud to shoulder. But it is also a difficult task that has only become harder in recent years. There are many challenges as we seek to realise our green ambitions. In this magazine, we present five of the biggest barriers to the green transition right now.

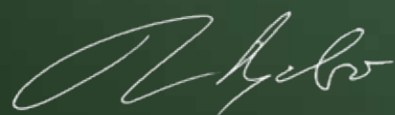
The electricity grid has to be rapidly expanded to handle the huge growth in consumption. To keep up with this growth, Energinet has to reinforce or expand 3,000-4,000 km of electricity transmission grid over the coming years. We have to do this in an overheated market, where the components necessary for the green transition have become much more expensive and have much longer delivery times.

A larger power grid and more large high-voltage substations will also mean that the green transition inevitably becomes more visible in the Danish landscape. We therefore need to get citizens on board with the green journey. Cooperation is key. Not only in relation to citizens, but also among all those working with the green transition – municipalities, market players, authorities etc. An electricity system based on 100% renewable energy also places great demands on balancing the grid.

While the challenges are many, we cannot just sit idly by. There is no instruction manual for the green transition. We are in the process of writing it. I, along with everyone at Energinet, am determined to address these difficult challenges. We must think outside the box, and excel at the things only Energinet can provide.

It is a huge responsibility, but I believe that we have the skills and dedication to reach our goal. Fortunately, we also cannot and should not do it alone. We need strong and trusting relationships with citizens, society and market players.

I am proud to be part of a company that has such an important social mission.



Thomas Egebo
President and CEO of Energinet



BARRIER 1 OF 5:
PACE IS TOO SLOW

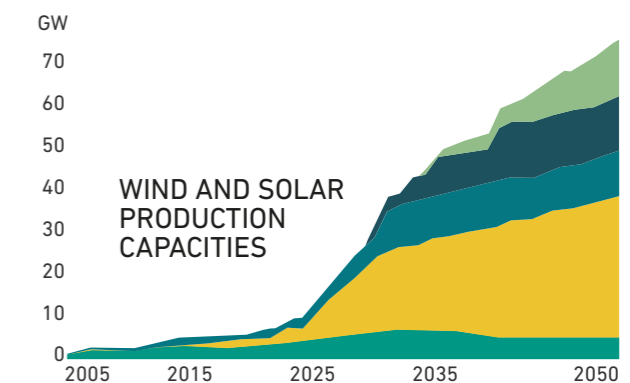
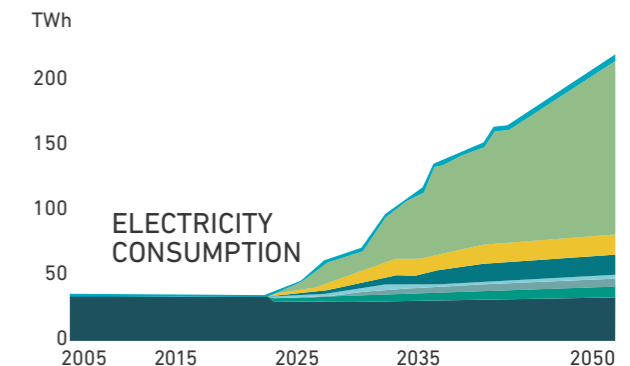
POWER GRID AT RISK OF BECOMING GREEN SHOWSTOPPER

The power grid has already reached its upper limit today in many parts of Denmark – there is no room for more wind and solar power until high-voltage substations and connections have been expanded. Expanding the electricity grid often takes longer than establishing new green electricity generation. The expansion needs to be accelerated to avoid the power grid becoming an even bigger showstopper.

Take a glance at the two graphs. They sum up the challenge.

Danish electricity consumption will explode – and is expected to double before 2030. The growth in solar cells and wind turbines will be even faster – with production to almost triple by 2030.

“In order to handle this extreme growth, we need to expand the electricity grid in time. There is otherwise a risk that cables and power lines will become showstoppers for the green transition. That would mean that some of the new green power is unable to move around Denmark and reach the many consumers who need it for electric heat pumps, electric vehicles or as energy for industry,” says Bjarne Brendstrup, Senior Director, Grid Development at Energinet. >>



Source: The Danish Energy Agency's Analysis assumptions for Energinet 2023

>> BARRIER 1 OF 5: PACE IS TOO SLOW

Future electricity will typically be generated at sea or in parts of Denmark which have no electricity grid to transmit the electricity away and no consumption to absorb the new production.

In many ways, the power grid needs to be turned upside down. And when we erect pylons and lay underground cables, it is not enough to do things the old way. For example, the decision was made in 2015 to build the future 170-km interconnection from Holstebro to the German border, but construction only began in November 2023.

When the first section enters service in 2025, the 400 kV connection will have taken ten years to realise.

Concerned citizens, protests over overhead lines, the desire for a 'second opinion' by policy makers, environmental constraints that were tightened along the way, and finding protected river pearl mussels (which later turned out not to be river pearl mussels) are all factors that explain why the project has dragged on so long.

But we do not have this much time available when more than 3,000-4,000 km of electricity transmission grid and 70 high-voltage substations have to be reinforced or built in the coming years to keep up with the rapid development.

We need better case administration, faster environmental approval and shorter grid connection times, and processes need to be far more streamlined in order to meet the Folketing's ambitious 2030 goal.

Efforts are being made everywhere to speed things up. Energy farms must be built, so that more green electricity generation can be pooled and the electricity grid expanded faster. Financial incentives have been put in place for new solar cell farms to be located in parts of Denmark that have available grid capacity, so they can be connected quickly, while also reducing the need to expand the electricity grid. The government's national energy crisis team, NEKST, has proposed a number of improvements, and so on.

Many market players are also making changes. For example, Energinet has reduced its case administration time by approx. 50% for screening and designating connection points for new electricity producers – at a time when many more cases are being processed. Major

It's not enough to make minor adjustments. We need to make radical changes

construction projects have to be outsourced in order to streamline expansion of the electricity grid. We are also building new high-voltage substations with higher capacity than current knowledge dictates – knowing this adds to the cost – in the belief that the extra capacity may be needed before long.

However, there are already places around the country where the electricity grid has reached its upper limit. There is no room for new green electricity generation until high-voltage substations are expanded and larger connections are established. There is a risk that the limitations of the power grid will become an even bigger showstopper if expansion is not accelerated.

Marian Kaagh, Vice President with responsibility for the environmental aspects of Energinet's plant, believes that environmental approvals for new electrical installations need to be looked at.

"For example, we're arguing that green energy and environmental considerations are in conflict, but that nature may have to give way to a greater extent at the sites where we erect pylons or build high-voltage substations. If we're instead allowed to create large contiguous areas of forest and wild nature, build lakes, or



Bjarne Brendstrup
Director,
Grid development,
Energinet

Marian Kaagh
Vice President
Environment and Support,
Energinet

plant windbreaks, then nature will win overall – just not at the locations of the new installations," says Marian Kaagh.

She also notes that Energinet will begin discussions with municipalities and other parties about upcoming plants at an earlier stage.

"We will also be knocking on the door at some municipal technical departments or homes of citizens who may be affected, earlier than we do today. Perhaps even before we know whether an electrical installation will be realised or how large it will be. We might end up in situations where we first say that a new plant will be 40 hectares in size, but it ends up being twice as big. This can lead to better and faster planning, but also to greater uncertainty and worry. But this is one of the many absolutely necessary steps towards ensuring that we get the expansion moving faster," she says, noting that future electrical installations must be designed to be more flexible, so they can be expanded faster when new needs arise.

Not only do we need to build a record amount of electricity grid in record speed. The situation is constantly evolving – new solar farms, hydrogen projects, battery systems, etc. are constantly being added. The plans we had on the drawing board a year ago are already proving to be inadequate. New infrastructure will be dependent on other new projects that we may not know of yet, or have accommodated.

"This makes the task even more complex. All of us – authorities, developers, decision makers and electricity grid companies – must therefore make even more effort to talk to each other and eliminate barriers and long administrative processes. But it's not enough to make minor adjustments. We need to make radical changes, such as completely eliminating procedures or doing things in new and smarter ways, otherwise there is a risk our common electricity infrastructure will put a brake on the green transition," says Marian Kaagh. <<



BARRIER 1 OF 5: PACE IS TOO SLOW



4 QUESTIONS FOR BETTER ENERGY

The energy crisis and Russia's war in Ukraine accelerated the green energy expansion in 2022. Solar cells and onshore wind turbines need to be quadrupled and offshore wind power increased fivefold by 2030. The electricity grid has to be expanded to accommodate this. Better Energy has built many solar farms and has even more on the way.

What has been your experience so far with accelerating the green energy expansion and connecting the many new plants to the grid?

"The current investment deficit in the electricity grid is a well-known issue which will require historically large investment by all grid companies to address. The renewable energy expansion will ultimately never be faster than the grid expansion. For example, there are around 4 GW of solar projects that already have local plan approval in Denmark and are just waiting for grid connection. This illustrates the scale of the problem. Fortunately, there has been almost exponential growth in grid expansion in recent years. Energinet has also launched a pilot project with temporary grid connections, allowing some farms to be connected before grid expansion makes permanent grid connection



Peter Bjerregaard,
Vice President Regulatory
Affairs, Better Energy



IT'S MORE
A MATTER
OF MULTIPLE
MUNDANE
PROBLEMS

possible. This will mean we get green electrons into the electricity grid faster, and that's why we are here."

What has been the biggest problem so far?

"It's hard to identify a single problem, it's more a matter of multiple mundane problems. Together, these probably constitute the biggest problem. It's often quite mundane problems that slow the pace of expansion. Prestige projects and new activities often tend to distract the focus. New regulation or state-owned energy farms are not necessarily what is needed to speed things up. A lot can be done within the current framework.

I am also concerned that the technical, legal and economic spheres are moving too far apart. There is a strong need to work more closely together across these spheres and keep the big picture in view. Failure to work together can lead to unclear processes and rules. For example, there is so much uncertainty about the technical rules for batteries at present that it is not possible to make investment decisions. This is a clear problem that could most likely have been resolved if more actors had been involved in the process.

Looking ahead, there are more problems on the horizon. One is how to maximise renewable energy integration as quickly as possible. We need a fast-track scheme, to allow Energinet to create a new queue for connecting large RE projects to the grid. Maximising our renewable energy as quickly as possible will require such a fast-track scheme. The selection criteria will, of course, have to be objective and reasonable. For example, requirements might include minimum production capacity of 200 MW, the possibility of providing ancillary services and support from the local municipality. Environmental considerations such as groundwater protection and nature restoration measures could also be taken into account. The aim should be to ensure better prioritisation and planning of large energy farms with a high degree of planning certainty."

If you look inwards – what should Better Energy be doing differently to accelerate the expansion of green electricity generation?

"We need to do even more to build bridges between the specialists who work at the various market players – TSOs*, DSOs**, municipalities, developers, research institutions, authorities, suppliers etc. The situation is better in some specialist areas than in others. The technical area is among the weakest links, even though most people acknowledge that the green transition

is also a technical challenge. However, the technical area lacks leadership focus, and the sector needs far greater cooperation. Building competencies and system understanding throughout the value chain through closer cooperation is essential. All players have an obligation to take responsibility for the energy system transition. We very much want to contribute to better bridge-building and facilitation, and already do so in many forums. As a small extra contribution to our joint efforts, we will initiate a series of network meetings for electricity grid specialists across the various actors in 2024."

What are your three wishes as to what politicians, authorities, electricity grid owners and other actors should do differently in the future?

"Firstly, the energy sector deserves calm and clarity. Every time tariffs, renewable energy schemes or technical rules are changed, this creates uncertainty and slows the green transition. My first wish is therefore that decision-makers at all levels try to draw on outside input and pressure-test ideas, so that decisions are qualified and they find durable solutions rather than short-term fixes. Of course, decisions are rarely better than the foundation on which they are made.

My second wish is that the Folketing opens up the possibility of selling electricity from energy farms to immediate neighbours. The national energy crisis team (NEKST) has also recommended this measure, as it is one of the best – and unfortunately unexploited – ways to promote local support. This may seem like a modest wish, but it would make a big difference. The municipalities are very keen to see this.

My third wish is that we start planning towards the energy system we want to see in 10-15 years' time. Although the electricity grid is currently a bottleneck, I think that as more renewable energy projects are connected to the grid, we will see a green snowball effect within a few years. Since it is easier to move electricity consumption than generation, we should already be doing everything in our power to create increased demand-side response and a more flexible tariff structure. Energinet has just introduced a transmission loss tariff that is partially dependent on spot price. This is a clear step in the right direction, but we could focus even more on developing solutions to operate the electricity system flexibly and make greater use of spot price-dependent tariffs to increase electricity consumption when electricity is green and vice versa." <<

*TSO: Transmission System Operator. In Denmark, the TSO (Energinet) is responsible for operating and developing the backbone of the Danish electricity and gas supply (and also hydrogen in the future).
**DSOs: Distribution System Operators. The Danish electricity grid companies and Evida own the local electricity and gas distribution grids.

>> BARRIER 1 OF 5: PACE IS TOO SLOW



Photo: Danish Ministry of Climate, Energy and Utilities, Adam Rieper

Kristina Lee, Corporate Vice President, Novo Nordisk, heads the government's NEKST 'Faster expansion of the electricity grid' working group. The national energy crisis team is tasked with making recommendations and finding solutions to ensure that the electricity grid does not slow the green transition and development.

Is it 'money and resources', 'rules and frameworks' or 'lack of will and old habits' that are the biggest barriers to accelerating expansion of the electricity grid?

It's certainly not a lack of will. On the contrary, I see sincere and very strong support for the green transition from government officials, TSOs, DSOs, politicians and companies and among the population. It is rather old habits, lack of transparency and sequential case management that stand in the way.

What is the biggest barrier to rapid and timely expansion of the electricity grid you have identified?

There is no single barrier. The issue is how we're going to manage the biggest change in the Danish electricity system ever seen. After being stable for 20 years, Denmark's electricity consumption is going to double by 2030 and increase fivefold by 2050. And the majority will be generated based on wind and sunshine.

We are not simply aiming to change a cog. We are facing a real paradigm shift. Over the last hundred years, expansion of the electricity grid has been in the hands of a small group of experts. They have served us well, and that is partly the reason for Denmark's high security of supply.

But the challenge we now face is so great, complex and urgent that we cannot address it using the methods we have used thus far.

The changes will also mean that far more players and non-experts will be affected by the grid expansion – in relation to making land available, interruptible supply, identification of needs etc. The crucial question is how we collectively move towards a new regime – among customers, producers, TSOs, DSOs, civil servants and ordinary citizens.

Where in particular do you see that the process of expanding the electricity grid can be streamlined?

To date (March 2024, ed.) the NEKST working group has only held two meetings, so we are just getting started. However, I can see several areas where the processes can be optimised. Firstly, I see a potential in creating more parallel project management. There are currently too many processes that hold each other up.

Secondly, there is a need for better information on what grid connection requires of customers. Customers often lack knowledge about the processes. They encounter a system that is highly engineered. But the information material is not easy to understand and the many technical options can make it difficult for customers to navigate the system.

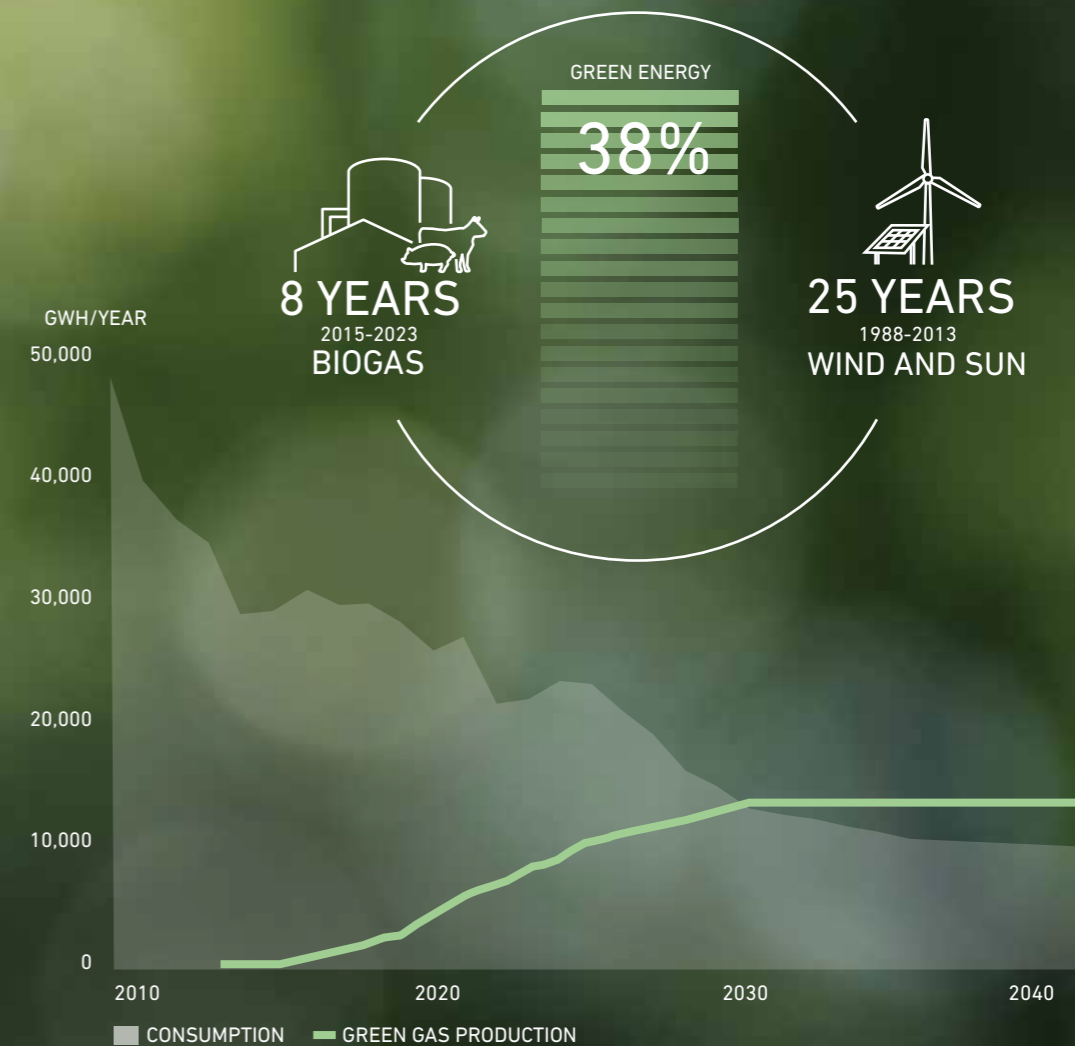
Finally, I see potential in closer dialogue between stakeholders. 'Grid on time' (seven initiatives from grid companies and Energinet to accelerate grid expansion, ed.) has already had many good impacts. But it is still too difficult for Energinet to predict where customers will expand, and this calls for closer dialogue between major customers and TSOs. <<



GREEN SHOWCASE IS BEING OVERTAKEN BY ROCKETING BIOGAS

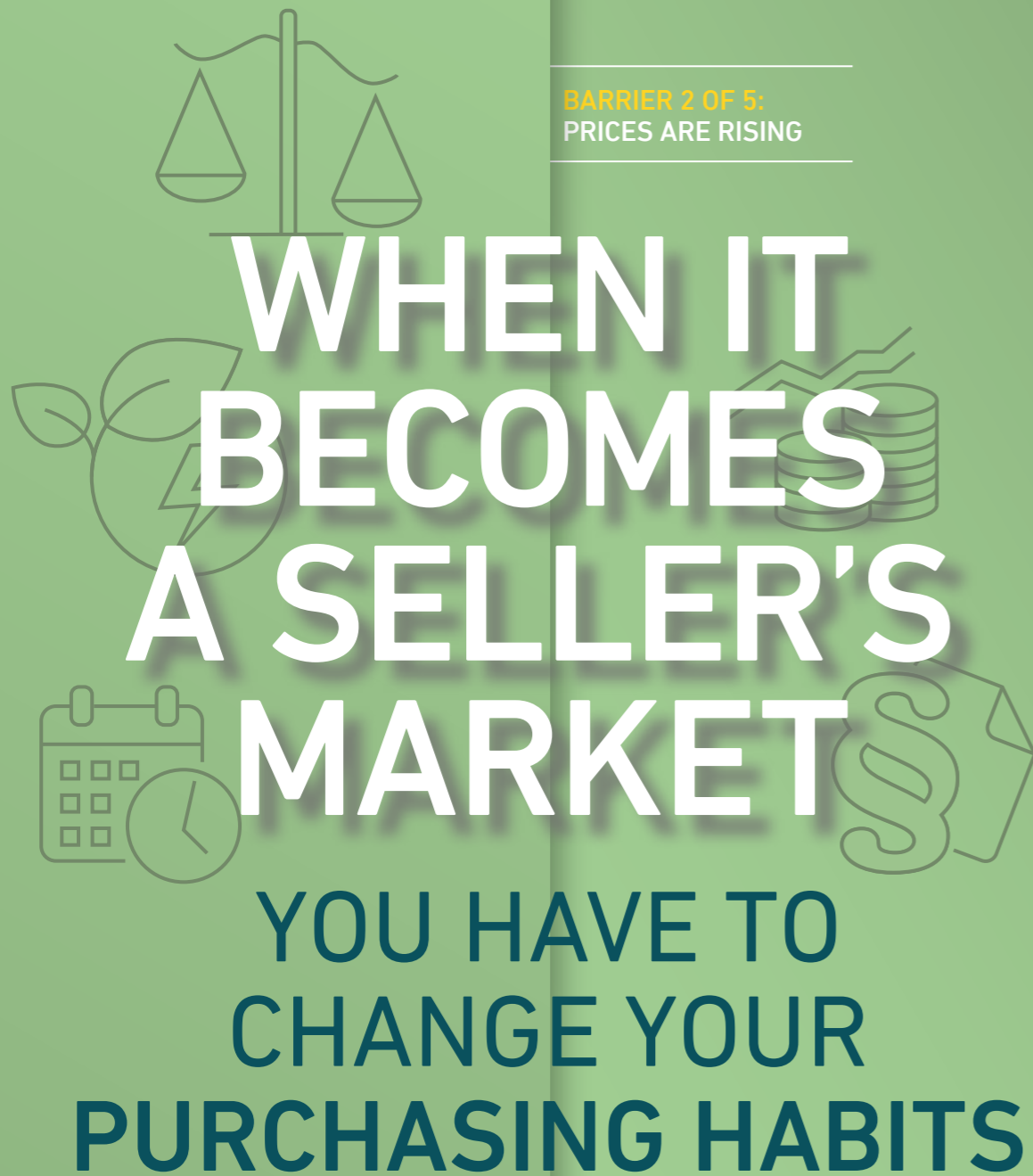
While a few provisos need to be borne in mind, biogas is in the process of overtaking Denmark's major green success story on the inside lane. Green gas has achieved in 8 years what it took solar and wind power 25 years to achieve.

Green gas is thus rapidly on its way to breaking the solar and especially the wind record for which Denmark is renowned. Of course electricity consumption is rising while gas consumption is significantly declining, which gives green gas a major boost in the comparisons. And the green power is not only sourced from wind and sun, but also biomass and even from biogas, so our electricity is actually greener than simply the harnessed wind and sunshine. But despite all this, gas is skyrocketing gas in a greener direction.



Source: The Danish Energy Agency's Analysis assumptions for Energinet 2023

**BARRIER 2 OF 5:
PRICES ARE RISING**



WHEN IT BECOMES A SELLER'S MARKET YOU HAVE TO CHANGE YOUR PURCHASING HABITS

Energinet need lots of components, cables and other materials to expand the energy infrastructure. But the rest of the world needs these too. This has led to global competition for resources – and significantly higher prices and longer delivery times. In order to meet policy goals and demands for the green transition and security of supply, Energinet is therefore radically changing its construction project procurement practices.

Just a few years ago, it was quite easy to get hold of equipment for Energinet's construction projects. The market was in balance.

It was almost like going to shop in a well-stocked supermarket on a quiet Wednesday morning: The shelves were packed with everything you could wish for, prices were reasonable and there was never a queue at the checkout. And if an occasional rare item happened to be sold out, you could always go into a neighbouring supermarket and buy it.

But 2021 is a long time ago in the global market for components for the energy sector.

Since then, we have seen Russia invade Ukraine and an energy crisis. A general global insecurity. A growing desire in many countries to achieve geopolitical energy independence. A growing political drive for a rapid green transition. An ambitious climate plan in the USA, with billions in government subsidies for the green transition.

Together, these factors have led to a dramatic increase in global demand that suppliers of cables, converters, transformers and other components do not have the capacity to meet. This has quickly resulted in sharply rising prices and longer delivery times.

The perfect storm

In other words, an extremely unfortunate set of circumstances that Kristian Snog Folmann calls the 'perfect storm'.

He is Director of Procurement at Energinet:

"In the 12 years I have worked with procurement, I have never seen a market tip so much: We used to be able to place high demands on suppliers. The reverse is now the case," he says.

Such a 'perfect storm' is not pleasant when it impacts the supply chains of Energinet and other TSOs.

But sheltering from the storm and waiting for it to pass is not an option, as Energinet has a tight schedule.

Denmark will consume almost three times as much electricity already in 2030 when we have to convert our fossil fuel consumption to renewable energy. Energinet must also maintain the general security of supply through adequate and future-proof grid expansion at the same time.

This requires major expansion of our power grid, with new and larger pylons, more overhead lines, new underground cables and pipes and new high-voltage substations.

So Kristian Snog Folmann – and the rest of Energinet – have to manoeuvre through the storm in the best possible way. Energinet has therefore changed its procurement strategy for future construction projects.

Market was in balance

If we turn the clock back a few years again, the market for energy sector components was well balanced:

Energinet had a large number of framework agreements with a range of suppliers, and purchases were made under separate contracts tailored to each project. Energinet also had no purchase obligation, and could freely choose whether to make use of the agreement. Suppliers had no

obligation to deliver to Energinet either. In a balanced market, this system worked well: The suppliers had ample capacity to handle the orders, and prices and delivery times were stable. Energinet could expect, for example, to have a transformer installed at a substation about one year after the contract was signed.

But the 'perfect storm' has completely disrupted that balance. It has actually turned it upside down.

Now it is suppliers who can pick and choose among many projects and purchasing enquiries from a range of interested buyers. If a buyer has specialised requirements and wants tailored solutions that are difficult and risky for the supplier, it is highly likely that the items will be sold to someone else. Buyers also have to accept that the delivery time may have quadrupled. >>

“ We used to be able to place high demands on suppliers. The reverse is now the case “

>> BARRIER 2 OF 5: PRICES ARE RISING

This would be much the same as if our supermarket suddenly only had one kind of toothpaste on its shelves – and even demanded that we pay EUR 7.00 in advance, for a tube that we could not take home until the day after tomorrow. And it would not help to go into the supermarket next door, because it would have just as many customers queuing for toothpaste.

It is important to Energinet to get its 'toothpaste'. Ideally several tubes and already tomorrow.

Energinet is therefore adjusting its procurement strategy for construction projects in four ways:



#1 PROCURE EARLIER

The earlier in a process that Energinet commits to making a purchase, the more likely it is that a supplier can allocate some of its limited capacity to manufacture and deliver at the desired time. However, to date Energinet has had to wait for final approval from the Danish Minister for Climate, Energy and Utilities for each project (section 4 approval) before the final agreement with a supplier could be signed.

Energinet has thereby been in a worse position than the TSOs of neighbouring countries, such as TenneT in the Netherlands, 50Hertz in Germany and Statnett in Norway. They are able to commit to a purchase early in the planning process.

However, this barrier will disappear in spring 2024, opening up new opportunities. In dialogue with the Danish Energy Agency, it has been clarified that

“... the suppliers will obviously follow the money. We have to adapt to the market.”

Energinet may commit to a purchase before section 4 approval – if the construction projects are covered by Energinet's Long-Term Development Plan (LUP).

This means that Energinet's procurement will no longer be based on specific projects, but on a procurement forecast encompassing Energinet's entire project portfolio.



#2 PROCURE TO INVENTORY

In future, Energinet will establish project inventory, especially for components with market bottlenecks. In part as backup inventory, where some of the most critical components will be kept on hand in the event of damage or delays in a project. And in part as a buffer where a supplier can deliver a component on time even if Energinet's project has been held up due to a delayed environmental approval or the like.

Building up inventory is also part of the move away from the framework agreements of the past with no purchase or supply obligations. In the example of the delayed environmental approval, this could have meant that Energinet was not obligated to buy and pay for the component that the supplier had produced in a carefully planned production slot.

“Not having an obligation to purchase in advance is something suppliers will longer accept. Energinet has a good name among suppliers and they like working with us. But they also want money on the table. Given that 50Hertz, TenneT or Belgian Elia – unlike Energinet – are ready to put billions on the table, the suppliers will obviously follow the money. We have to adapt to the market,” as Kristian Snog Folmann puts it.



#3 PROCURE MORE STANDARD ITEMS

In a sellers' market, it is important that Energinet is an attractive customer that suppliers want to do business with. And it is easier for suppliers to deliver the same product to many customers rather than deliver tailored solutions.

Energinet is therefore moving away from requiring custom solutions.

“We will buy more 'standard products' instead, and rely on standard market solutions and practices,” says Kristian Snog Folmann.

Kristian Snog Folmann sees the transition to more standard products as a crucial factor in securing the supply of key components for Energinet in the current market. But he is aware that this involves some risks:

“The more detailed an agreement is, the more certain we can be that all factors have been taken into account. But we have to accept a greater risk of minor imprecision when building our plants on the construction sites if we want to be able to source our components and deliver efficiently in relation to our plant portfolio,” he says.



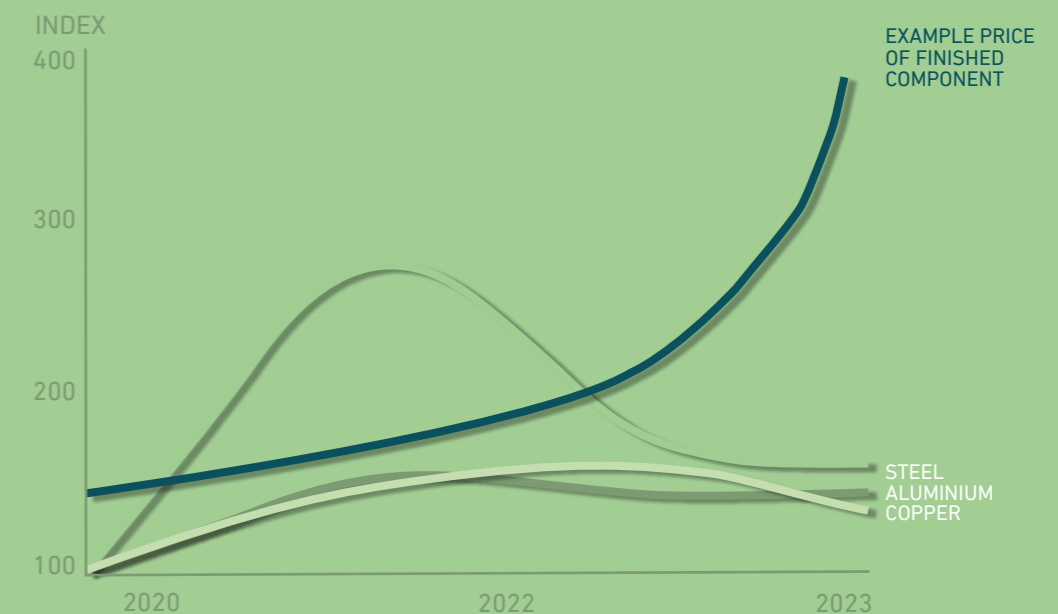
#4 PROCURE GLOBALLY

Energinet has traditionally purchased from European suppliers.

But it is the European suppliers in particular that have become more expensive and are struggling to keep up with demand. So the bottleneck effect is greatest in Europe. Energinet will therefore look further afield in the future when purchasing, for example to the Far East.

“This involves various risks, for example if it is difficult to do business with new partners that we don't know very well. We don't want to have to interrupt a project that is in progress due to collaboration issues that

COMMODITY PRICES ARE RISING – PRICES OF FINISHED COMPONENTS ARE RISING EVEN MORE



Steel, aluminium and copper are the key commodities used to manufacture components for the energy sector. As the chart shows, after large fluctuations in steel prices, global prices stabilised at a level in 2023 that was 40-50% higher than in 2020. But prices for finished components often skyrocket, as the darkest curve illustrates. The explanation for this lies in the nature of market mechanisms, in a situation with huge demand and limited supply.

Source: The London Metal Exchange, Nordea Bank time series and Energinet

» BARRIER 2 OF 5: PRICES ARE RISING

force us to find other suppliers. Our work with critical infrastructure also has a focus on ensuring a high level of cyber and information security. This means that we are extra careful when purchasing from countries that do not have as high a level of security as in the EU. But a cable is just a piece of wire, and we can buy that anywhere. I believe we can achieve a short-term gain by drawing on fast, extra capacity in the Far East," says Kristian Snog Folmann.

Overall, however, Kristian Snog Folmann believes that an approach to the market similar to that of other European TSOs will benefit Energinet. Where through

more proactive purchasing and efforts to 'open the market', Energinet is better able to procure the components it needs – on time and at an acceptable price.

"Our new procurement strategy may not solve all our challenges right now with our supply chains, but it takes us a long way in the right direction. In particular, purchasing further in advance – and standard components rather than tailored ones – can make a big difference for us," he says.



Kristian Snog Folmann,
Director, Procurement,
Energinet

” In the 12 years I have worked with procurement, I have never seen a market tip so much... “

2023 GREEN RECORDS

ELECTRICITY SYSTEM

The share of green electricity has never been higher, and solar production set a new record



of time electricity generation from wind and solar power exceeded consumption

70%

of electricity was came from wind and solar sources in May, July and October

GAS SYSTEM

Despite more normal gas prices, Denmark maintained its low gas consumption from 2022



more than 50% of gas consumption has been met by biogas

76

 TWh

gas was exported to Poland via Baltic Pipe. This is almost four times Denmark's consumption



Nicolaj Nørgaard Peulicke
Vice President
Innovation, Energinet

THE FUTURE ENERGY SYSTEM IS DIGITAL

Most of us associate our electricity and gas supplies with the power lines, pylons and pipelines that criss-cross Denmark. Physical infrastructure also plays a major role in Energinet's task of ensuring that Danes have access to energy anytime, anywhere. What is less visible – but just as important – is the large amount of data that provides the digital foundation for the future green energy system. Data that only serves a purpose when it is brought into play by capable IT employees and artificial intelligence.

"We have to be extremely good at using data as we address our key challenges. It enables us to make better decisions and optimise the way we use our resources. But it requires us to be constantly inquisitive. We therefore continually experiment with the innovative use of modern technology, and expand our digital capabilities by investing in our IT platforms. We also have a strong focus on setting our data free, so others can use it for the benefit of the green transition," says Nicolaj Nørgaard Peulicke, Group Vice President of Innovation at Energinet.

Digital pioneering demands innovation and strong skills

In other words, the energy system – and Energinet – are undergoing a comprehensive digital journey. One of the key elements is to establish a strong and secure IT platform capable of handling the extensive data from offshore wind farms, gas storage facilities, international connections, power stations, solar cells, biogas plants and onshore wind turbines. Data that is combined with weather forecasts for sunshine and wind, and predictions about electricity and gas consumption in Denmark and abroad. This will give Energinet's staff in its control centres for electricity and gas a solid basis for making informed decisions, minute by minute, around the clock. So they can quickly find alternative solutions to secure electricity supplies when the forecast windy weather does not materialise.

"Balancing and digitalising the green transition is a complex but exciting and unique task, and fortunately there are many skilled IT specialists, IT project managers and software developers who want to be involved," says Nicolaj Nørgaard Peulicke. "Overall, we have succeeded in establishing a strong IT organisation that works with a wide range of tasks, where each member contributes based on their special experience and competencies. The result is a diverse and innovative environment, where people get to address exciting challenges using the latest technology. In fact, almost a quarter of Energinet's over 2,300 employees are specialists in IT and innovation."

Artificial intelligence and robots

Regarding technology, there is a group of specialists in Energinet's innovation department who focus on whether and how the latest technologies can help automate and streamline tasks throughout Energinet.

"We constantly explore the possibilities, for example in the use of artificial intelligence. We tested intelligent chatbots widely in Energinet during the second half of 2023. That is, intelligent computer programs employees can ask for advice. There are really many applications where technology can create great value and help with daily work tasks. We are therefore planning a rollout to all employees. Physical robots are also of interest. For example, they can extend the reach of our automatic data collection – including in places where it is not safe for our employees to be." <<

HOW WE WORK

Energinet develops digital and technological solutions as part of its core contribution to achieving both its own and Denmark's goals for the future green transition. Innovation is therefore a fully integrated part of Energinet's IT organisation. This helps us maximise the value we achieve each day by linking innovation, data and IT development together. Around 500 employees currently work with this based on agile principles and in close cooperation with Energinet's core business. This approach helps to strengthen development and innovation in the use of IT and security across Energinet.



TAKE PART IN THE GREEN TRANSITION

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AI HELPS PREDICT THE WEATHER

Drifting clouds and wind fronts will become increasing challenges to security of supply in a green energy system where power is sourced from many more PV power plants and wind turbines across the country. The movements of clouds are difficult to predict and cause large fluctuations in energy production minute by minute. This makes it a difficult task for Energinet's control centre staff to maintain a stable power supply.

We are therefore currently investigating solutions based on artificial intelligence that can give the control centre better insight into the impacts of wandering clouds on electricity generation from solar cells. This involves getting better data from DMI, new AI models, satellite images and ground-to-sky cameras that monitor the movement of clouds.





It is about 89 cm tall and remembers everything you teach it. It hardly ever makes mistakes, but is still quite new to the job and has a lot to learn. As do the Energinet employees who have to work out what it can do and train it to be better.

The robots are here. Mobile artificial intelligence has long since made inroads into a number of sectors, including the energy sector, where it has shown huge potential when we need to do things faster, smarter and safer for humans.

This is also the conclusion at Energinet when we test and investigate the potential for combining robotics with artificial intelligence (AI). And this is where the robot dog comes in. It is the focus of a wide range of interesting new opportunities that can not only automate and digitalise processes and achieve savings, but also lead the way in relation to employee safety.

Greater safety offshore

Energinet's offshore facilities are some of the places where we are testing the robot dog's abilities. It can improve safety for our employees here by acting as our eyes and ears – when things are going well and also

when problems arise. One example is when there is a lot of wind and thus high production at the wind farms. The plants sometimes break down at such times, making it necessary to send employees out by helicopter or boat. At the most difficult and dangerous time, when the wind is strong. At such times we can send the robot dog out to inspect both indoor and outdoor areas, so we get an overview of how serious the situation is before we send people out – and can thus plan our activities accordingly.

Fortunately however, things operate as expected out at the stations most of the time. The robot can then perform other tasks such as statutory routine inspections of helidecks and high-voltage components and perimeter checks, and it can even act as an intelligent scarecrow. This alone can save us millions per plant each year.

The robots can be remote-controlled manually from shore, but they can also work autonomously using artificial intelligence, so we do not have to have a constant connection to them.

Digital twins

Another facility at which we have unleashed the robot dog is our largest substation, Fraugde, east of Odense. One of the things we are testing here is the robot dog's

ability to help us create and maintain digital twins of the substations via automated 3D scans. It has proven to be highly competent at this.

Without the robot's help, the same task would involve about five days' work for three people for a large substation. This is typically done by a supplier making 3D models by manually placing a tripod-mounted scanner at various locations, while a colleague ensures that the 3D drawings are geographically correct using GPS measurements. For safety reasons, a station operator must also always be present. Using the robot dog we can automate this process and create a very precise digital 3D version of the substation using advanced software.

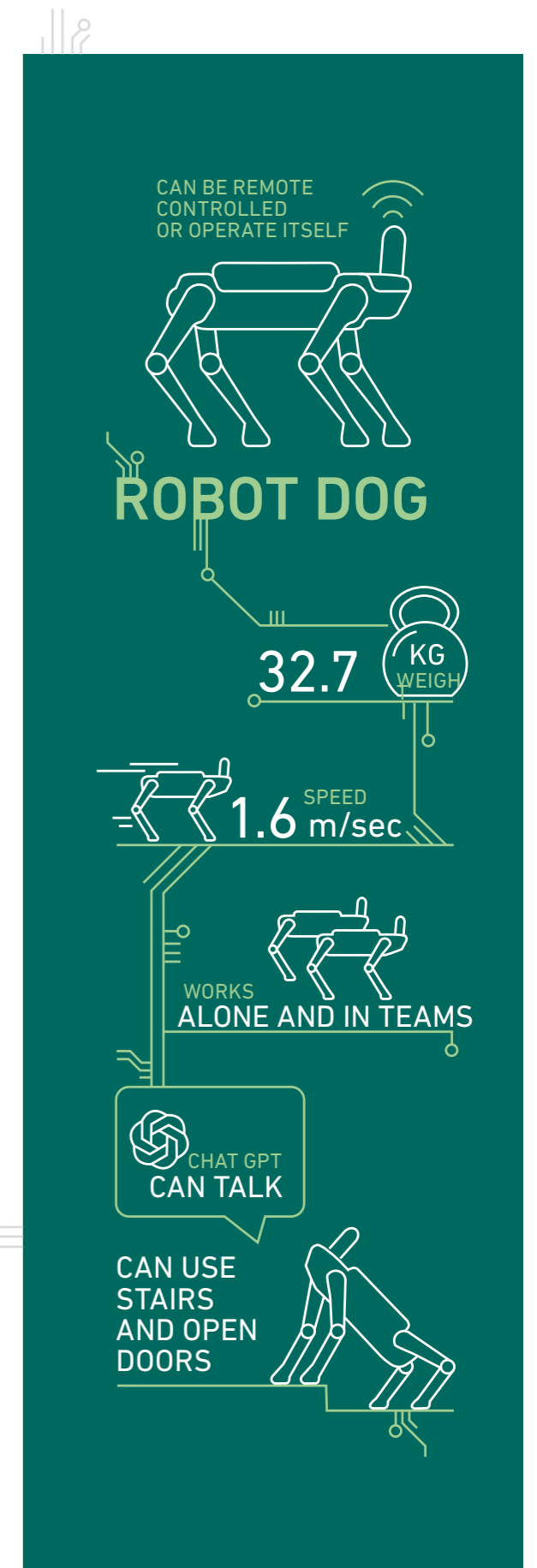
A dog with both talent and limitations

Robot dogs thus show great potential for Energinet. They can automate inspections, conduct 3D scans and keep birds in check. They can also serve as our eyes and ears in the plants, making the work safer for our employees.

However, the dogs also have their limitations. With a total of 220 stations we have a large and diverse plant portfolio, which encompasses vital indoor and outdoor components, as well as stairs, doors, electrical cabinets, handles, buttons and displays. Our plants are designed to be managed by humans, and this can often entail challenges even for advanced four-legged robots. For example, they can climb stairs and map components, but they cannot open a heavy door or replace a relay. We are therefore already investigating the potential of the next generation of robots – the humanoid robots that are currently seeing rapid development in USA. <<

WHAT IS A DIGITAL TWIN?

A digital twin is a virtual copy of a physical system, such as a substation. The digital twin monitors and improves operation of the plant. This includes finding and fixing problems, planning maintenance and generally keeping everything running smoothly. You can compare it to a computer game, where you can test and understand the system safely and easily.



BARRIER 3 OF 5:
IT IMPACTS THE LANDSCAPE

NEIGHBOUR: WE HAVE BEEN PUT ON HOLD

Sara Sikkersq Jensen and her family are neighbours to the converter substation in Revsing. The announcement of large new plants in the area concerns her. The family would like to be able to choose whether to stay, or make a new life somewhere else.

Sara Sikkersq Jensen lives with her husband Per and their two children, aged eight and nine, close to Energinet's converter substation in Revsing. The couple moved in in 2014 and renovated the rural property and built facilities for horses.

The barn roof needs to be replaced, but that is not going to happen now. The couple have suspended any further renovations.

"We won't be putting any more money into it than we already have, because it's a bad investment," says Sara Sikkersq Jensen.

Since 2014, a lot has happened in Revsing – a rural area north of Vejen in South Jutland. Energinet has built a large converter substation less than 700 metres from the family's property.

"We bought here with the intention of staying. It's a nice secluded area – slightly rural but close to the freeway and town. We didn't know anything about the project when we moved in. We were told about it two years later, and it has been ongoing ever since. It would have been nice to know that when we bought it. We would definitely have chosen to buy somewhere else," says Sara Sikkersq Jensen.

Two new plants

The converter substation is one thing. It has already been built, and Sara Sikkersq Jensen feels that construction took place with good communication from Energinet and the construction site management.

However, the neighbours in the area have now been informed that Energinet has plans for two large new plants and to reroute high-voltage power lines.

"There is no point trying to fight it. It has to go somewhere, and it makes a lot of sense to place it here in relation to the cables and infrastructure already in place. We can get it moved 100 metres at most. So we would rather seek constructive dialogue," says Sara Sikkersq Jensen. >>

» BARRIER 3 OF 5: IT IMPACTS THE LANDSCAPE

Start over somewhere else

Her greatest concern is that living so close to the power lines will be bad for her family's health. They would prefer to sell the property and start over somewhere else. But they fear a loss of value if they sell now. Their investments were planned over a 30-year horizon, not 10 years. Given that she and her husband need to be careful with their finances, they would like to see the neighbours of the new facilities receive buy-out offers or compensation for the loss of value on their properties already now.

"For such a large expansion, one could say that any residents within 2,000 metres can choose for themselves – whether to stay or leave. This would involve 20 properties at most, and they don't cost 10 million kroner apiece out here. It would be small change in relation to this large project. It's sad you have to wait until it's all finished before you can talk about it."

Green energy is positive

Sara Sikkersq Jensen is not opposed to the green transition in any way.

"Green energy is only positive. It would be crazy to be against it. This is extremely good for our society and good business for Denmark. But should 20 households be bound to their properties because our society needs a green transition? It is totally unreasonable to not take care of the people who are impacted when you make such a large investment in our country and infrastructure. That our lives should be put on hold.

We hoped that when we reached 2024 there would be a resolution and we could find out where we stood. Now we have a new deadline, sometime in 2030 or 2032 or 2034, depending on how things go with permits and construction. All of a sudden, we've been tied up for 16-18 years. I don't think that's fair." <<



PLANS FOR TWO LARGE PLANTS IN REVSING

The converter substation in Revsing was built for the Viking Link connection to the UK, which became operational in December 2023. The converter substation converts electricity for Viking Link from alternating to direct current and vice versa, so it can be transmitted between Denmark and the UK. The building is 24 metres high and has 15,500 square metres of floor space. Including the outdoor areas, the current substation occupies 19.5 hectares of land.

Energinet has informed neighbours that there are plans for two more large plants in Revsing. One is a

high-voltage substation, to allow the electricity grid to handle much more green power in the future. The other is a converter substation to connect the North Sea Energy Island to the Danish electricity grid. The energy island is awaiting a decision by policy makers.

The plans also include rerouting overhead lines. Energinet is working with a total gross area of around 145 hectares. The two plants, including a reservoir, vegetation etc., will be located within this area. The final area of land required and the exact locations of the two plants have not yet been decided.

The converter substation in Revsing was built for the Viking Link connection between Denmark and the UK. The outer walls are decorated with patterns inspired by Viking art.

THE COMPENSATION FRAMEWORK FOR NEIGHBOURS

Energinet's options for compensating neighbours fall within a fixed framework.

Neighbours to Energinet's substations can be offered compensation for loss of value if the legal tolerable limit is deemed to have been exceeded. Whether the tolerable limit has been exceeded is generally decided by the assessing authorities (expropriation and valuation commission) or the courts.

Neighbours close to newly established overhead lines are offered compensation for the reduced value of the dwelling. If a 400 kV overhead line is established within 80 metres of a home, Energinet offers to take it over.

"I totally understand the concerns neighbours to our plants may have about possible future inconvenience or a reduction in the value of their home. I also understand that people can be very sad to see a large facility built in their neighbourhood. However, we have to operate within the framework the legislation allows in relation to any compensation to neighbours," says Marian Kaagh, Vice President for Environment and Support at Energinet.

The government and a number of political parties agreed in December 2023 to look at the rules for compensation to neighbours in order to advance the green transition.

THE GREEN TRANSITION NEEDS SPACE – BUT IT HAS TO GO SOMEWHERE

Frank Schmidt-Hansen, Mayor of Vejen Municipality, is ready to shoulder some of the social responsibility for the green transition. Large plants can benefit development in his municipality, but he thinks others also need to carry their share for the cause.

Energinet's newest and largest converter substation is located in Revsing in Vejen Municipality. It dominates the landscape.

The converter substation is also unlikely to stand alone, as Energinet plans to build two more – very large – plants alongside it. To benefit the green transition. But perhaps not to the liking of its neighbours.

Frank Schmidt-Hansen, Mayor of Vejen Municipality, is fully on-side about his municipality being an energy hub. A hub for large electricity interconnections and the future hydrogen infrastructure in Denmark. In other words, a hub for the green transition.

"The city council agrees that we have a social responsibility. If a rural municipality like Vejen cannot find land for wind turbines, solar cells and even Energinet's technical plant, it will be hard to find it anywhere in Denmark. It has to go somewhere," says Frank Schmidt-Hansen. >>



» BARRIER 3 OF 5: IT IMPACTS THE LANDSCAPE

“ I CAN CERTAINLY
PUT MYSELF IN
THEIR SHOES ”



Actively involved in planning

Vejen Municipality therefore chooses to be actively involved in the planning together with Energinet. For example regarding the location and design of the plants. The mayor feels they have done well in adapting the converter substation to the landscape in Revsing. And he praises Energinet for informing neighbours about the planned new plants at an early stage, so they did end up reading about it in the newspaper:

“Energinet is good at early involvement and openness about the process. Good communication and dialogue will take you far. The affected citizens have also acknowledged this. They would have liked it to be somewhere else, but once the decision had been made, it was good that someone listened to their wishes and eliminated some of the inconvenience. But the citizens clearly feel they are being unreasonably impacted when Energinet now returns and wants to build more plants. I can certainly put myself in their shoes.”

Consideration for citizens

For Frank Schmidt-Hansen, consideration for citizens is the biggest challenge in the green transition. He notes that the citizens in Revsing do not know whether they will be compensated for becoming neighbours to large, technical plants.

“It’s a dilemma that a small group of local citizens get all the inconvenience for what the larger population will benefit from in the long term. Energinet’s compensation does not match the market. Viking Link has cost DKK 13 billion in total. If it were possible for Energinet to spend a little more of these billions on neighbour compensation, it could help calm nerves in the Revsing area. It would still be a tiny fraction of the total investment,” he says.

The mayor makes a comparison with the project developers who have been approaching municipalities and citizens in recent years for space to build solar farms etc.

“The compensation offered by a solar farm developer makes citizens able to live with the sight and the inconvenience. But Energinet is not authorised to do that,” he says.

Vejen as an energy hub

However, Frank Schmidt-Hansen sees advantages and opportunities in making Vejen into an energy hub.

“It’s an opportunity we need to seize. Apart from during the establishment phase, Energinet’s plant holds no jobs for us, but given that the plant is there, we are looking at whether we can attract green, energy-intensive companies.” The mayor mentions the example of protein factories or ‘vertical farming’, where crop production is indoors and in multiple layers.

The Vejen mayor also sees a clear benefit in utilising the surplus heat from Energinet’s plant in the district heating system. As of March 2024, it has still not been possible to get this in place.

“It’s a travesty. The way our society is now, we can’t afford to have heat just dissipating into thin air, but there are regulatory factors, such as price caps, preventing it.”

Long time horizons

He also wants to see Energinet’s ability to compensate neighbours improved:

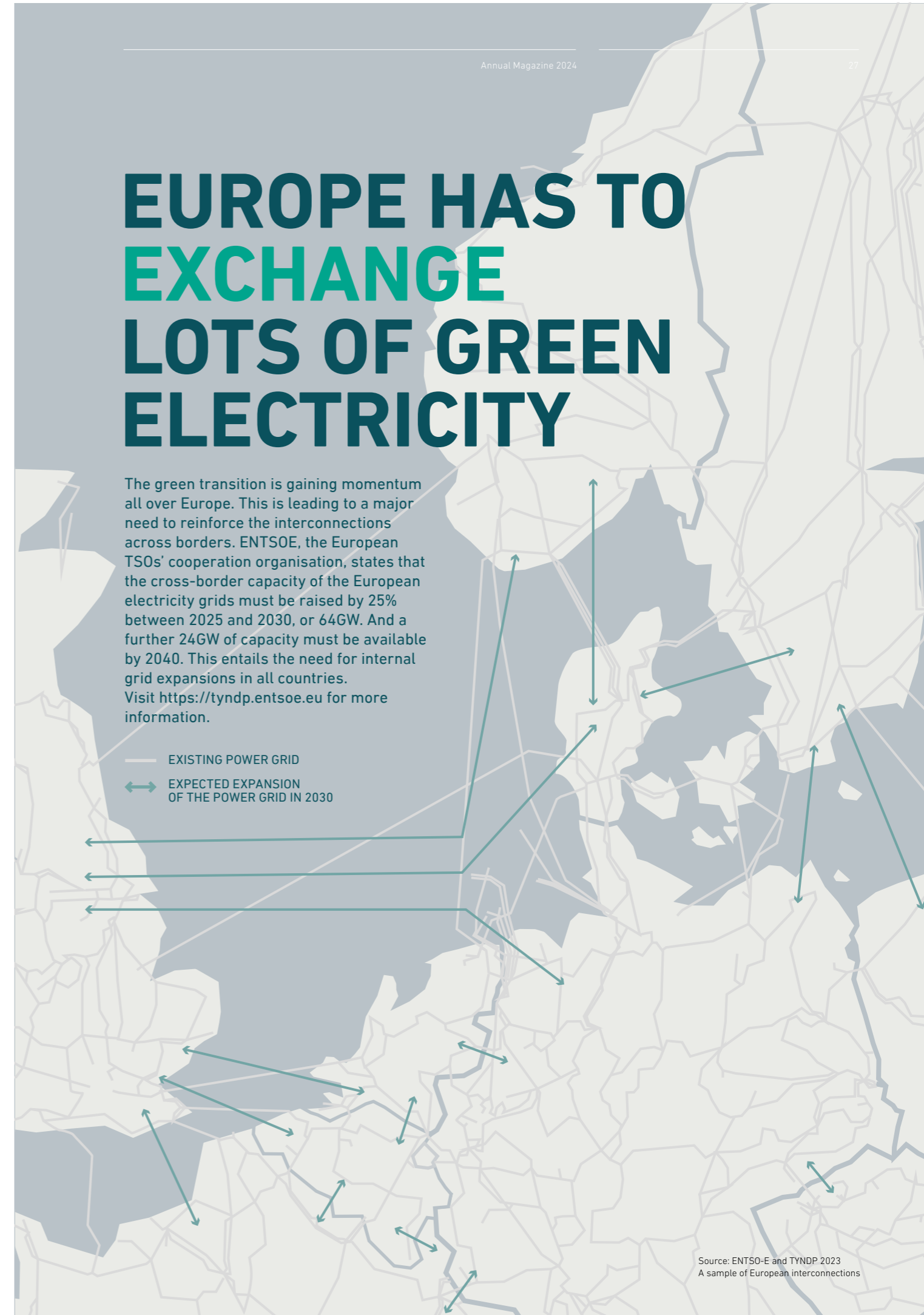
“Energinet works with long time horizons. There are citizens who can end up being tied up for a long time, and Energinet does not buy up properties like the Danish Road Directorate does.”

“It’s the municipalities – me as mayor and our city council – who have to take responsibility in relation to our citizens. We are ready to do that if there are also others who will stand with us and say that this is a joint responsibility.” <<

EUROPE HAS TO EXCHANGE LOTS OF GREEN ELECTRICITY

The green transition is gaining momentum all over Europe. This is leading to a major need to reinforce the interconnections across borders. ENTSOE, the European TSOs’ cooperation organisation, states that the cross-border capacity of the European electricity grids must be raised by 25% between 2025 and 2030, or 64GW. And a further 24GW of capacity must be available by 2040. This entails the need for internal grid expansions in all countries. Visit <https://tyndp.entsoe.eu> for more information.

— EXISTING POWER GRID
↔ EXPECTED EXPANSION OF THE POWER GRID IN 2030





**BARRIER 4 OF 5:
IT REQUIRES MORE COOPERATION**

THE GREEN TRANSITION STARTS AND ENDS LOCALLY

Christina Føns
Technical and
Environmental Director,
Middelfart Municipality

The idea for a new solar farm may well come from a desk and an energy company somewhere else in the country. But in reality, the green transition starts and ends locally – with the municipalities and citizens who have to make land available, grant permits and integrate it into the local community as a new element. If the local communities are not on side, there is a risk that it will neither start nor end well. Instead of success, the projects may experience stagnation or even be halted.

Denmark's municipalities play a key role when wind and solar power and electricity grids are to be expanded – and thus also when the green transition needs to be accelerated.

Christina Føns is Technical and Environmental Director in Middelfart Municipality and a member of the working group in NEKST (the national energy crisis team) for more rapid expansion of the electricity grid. She sees several elements as central to the pace of the green transition: cooperation across borders, closer dialogue with local communities, awareness of major differences from region to region, a more proactive expansion by electricity grid companies and project developers, and professionalisation among all players.

What role do the municipalities play in the green transition? How can you contribute?

“When we talk about the need to accelerate the green transition, cooperation with citizens is a key element. The transition must therefore be largely effected locally in the municipalities. They know their citizens, who are very different from region to region – so the challenges must also be approached very differently. The maturity of each city council also varies greatly. Some have been working on green projects for years and have extensive experience with NIMBY (Not In My BackYard, ed.), others have less experience.

And when you ask how we can contribute, the municipalities have a rather unique position as a kind of local facilitator for the green transition. We can create a space that all involved parties can step into – citizens, local interest organisations, municipalities, and of course the companies that want to establish green projects in a given area. It's important that people listen in this forum – and find the best possible solution together. Even if it means moving the solar farm a few hundred metres.”

What do municipalities need in order to be able to take even greater responsibility in the green transition?

“The green transition has not always been on municipal agendas, but it very much is now. One of the interesting

things about the movement is that municipalities have never actually been assigned a specific new task in relation to implementing the green transition. But they have taken up the challenge and come up with tasks in each their own way, which they address very differently. Examples of this are DK2020 plans, strategic energy plans, resource plans, and capacity forecasts for electricity consumption and generation. The government has also established a mobile task force for renewable energy, which offers a lot of good help and advice.

Despite this, I believe it would be a good idea to assign the municipalities a role and an overall framework. It would be very natural for them to get involved, as they know the local actors and citizens best of all.”

What do you see as the biggest obstacles to realising green projects?

“If you get off to a bad start with citizen dialogue it can mean that the protests spread – in some cases far beyond the municipality. Then the project drags on and it can be difficult to implement it. Things can also go wrong if there is a lack of facts or failure to contextualise solution options in the dialogue. If you fail to present and make clear the real facts and solution options in connection with establishing a given project, there is a risk it will drown in noise from the outside world, making it difficult to maintain a good solution-oriented dialogue among stakeholders.” >>



“THE GREEN
TRANSITION HAS NOT
ALWAYS BEEN ON
MUNICIPAL AGENDAS,
BUT IT VERY MUCH IS
NOW”

» Barrier 4 OF 5: IT REQUIRES MORE COOPERATION

How do you see the collaboration on where to place green facilities on the Danish map?

"If we start from a helicopter view, the fight for space is one of the big challenges. Denmark is a small country, and about two-thirds of our land is being used for agriculture. This leaves little room for green projects on land when there also has to be room for biodiversity, forests, infrastructure, housing and much more. It's a complex political debate involving many stakeholders with ties stretching all the way to the EU.

But the problem requires that we also cooperate at municipal level to utilise the few available areas wisely. That we manage to exploit every possible synergy across municipalities, so we do not position our renewable energy plant too randomly as a society.

The good news is that positive collaboration has already been established across neighbouring municipalities in many places in Denmark. These have joined forces in 'business regions' or other intermunicipal partnerships. One example is the Triangle Region, where we also collaborate on Power-to-X projects. These are typically far too cost-intensive for a municipality to handle alone."

It is no secret that the power grid is struggling to keep up with the current development. How do you see municipal cooperation with us as the infrastructure owners? Are there things we can do better?

"It's just as frequently the power grid that stands in the way of expansion as it is the citizens. And if the power grid is not to fall completely behind in relation to the green transition, all players will have to think more proactively about grid expansion than they have done to date. I'm aware that huge investments are involved, but it takes many years from when the decision is made until the cables are laid.

Dialogue is also extremely important here, and good initiatives are under way. What makes it difficult is that development is happening incredibly fast. Some municipalities, like Kalundborg, have many projects underway on both the consumption and production side, and it can be difficult to see how things will unfold just a few months ahead. They update their capacity overview every quarter! Development is less rapid in other areas.

Finally, it is important that all market players – from developers to grid companies and municipalities – become more professional in the joint dialogue, because it takes time, resources and expert knowledge to drive the green transition together.

Energinet's long-term development plan gives the municipalities some overall knowledge about where there is a need to build, but the relationships and the exchange of insight and knowledge between us and Energinet are what really count." <<



|| WHAT MAKES IT DIFFICULT IS THAT DEVELOPMENT IS HAPPENING INCREDIBLY FAST ||





GREEN HYDROGEN FOR EXPORT

To exploit the great potential for renewable energy in the North Sea and on land, analyses point to large volumes of hydrogen production in 2030 and beyond. The first project is Danish Backbone West – a hydrogen pipeline in Jutland connecting with Germany and with access to underground storage.





The entire value chain – from the production of renewable energy and electrolysis to pipelines for hydrogen transport, hydrogen storage and consumers at the other end of the pipe – has to be built from the ground up.

Energinet has been tasked with investigating the possibilities for establishing large-scale hydrogen pipeline infrastructure and hydrogen system operation in Denmark.

 Hydrogen is a gas consisting of two hydrogen atoms, H₂

 Hydrogen is one of the most widely used elements in industry for the production of chemicals, ammonia and artificial fertilisers

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-  Electricity hub
-  Electrolysis plant
-  Hydrogen storage
-  Energy island



Barrier 5 OF 5:
POWER SYSTEM LOSES BALANCE

JØRGEN MAKES MONEY BALANCING THE GREEN POWER SYSTEM

The phone rings and vibrates. There are constantly people at the other end trying to get hold of Jørgen. Jørgen K. Andersen is clearly a busy man, even though he has reached retirement age. But the 76-year-old workhorse has absolutely no intention of slowing down.

"I'm well, so why not keep going. I have no health problems. The doctor says I'm like a 14-year-old, so I might as well work one more year," he says with a twinkle in his eye.

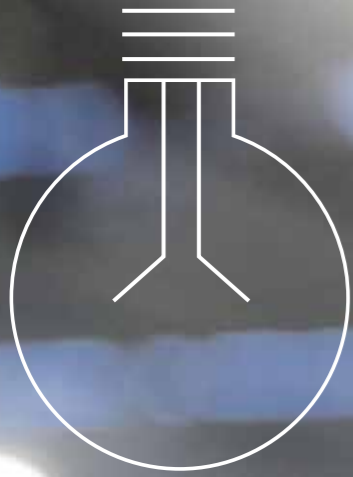
They say you cannot teach an old dog new tricks. Those who say this, clearly do not know Jørgen. In 2012, he handed over the operation and ownership of his plant nursery to his daughter and son. Since then, he has been responsible for product development, among other

tasks. He wanted to draw on his experience to think innovatively. And there has been plenty of that.

Jørgen's father started Thoruplund Gartneri, close to Odense, in 1946. Back then, the 1,500 square metres were used to grow outdoor greenery and cut flowers. Jørgen joined the team in 1974 and had great ambitions. So production was reorganised, and the volume has increased dramatically:

"We now have 45,000 square metres. 17,000 square metres of rented space and large-scale production in Vietnam on 20,000 square metres and in Turkey on 15,000 square metres. We actually have 100 men working in Vietnam right now. There are high temperatures and plenty of sun. The good Lord takes care of everything."

In Denmark, the good Lord cannot take care of everything. Many large greenhouses are needed here, >>



and grow lights are installed in these. And such devices consume a lot of power. So much so that this accounted for a very large share of the budget during the supply crisis flowing from the war in Ukraine. The nursery took on new habits after that. And some new ideas. Can we perhaps make money by adjusting our consumption? Can we make money by turning off our lights when asked to?

Ancillary services for the sake of country and wallet

Many years in the horticultural industry have given Jørgen solid insight into the electricity grid. Every time the nursery had to expand production, they were very aware of the challenges their consumption presented.

"I already knew a lot about the electricity system. Each time we expanded the nursery, we were told that it is difficult to get enough power to us. So we're very aware that there are big challenges."

But even with this knowledge, Jørgen Andersen would never have started providing ancillary services if he had not received help from an old horticultural industry acquaintance. This acquaintance, Thomas Offer Madsen, now owns and runs Greenario Energy, which helps companies like Jørgen's to earn a little extra income by providing ancillary services – while also helping to balance an increasingly green electricity grid. There are a number of such companies that help people like Jørgen to get started in providing ancillary services.

"We would never have begun providing ancillary services if there hadn't been an intermediary to help us get started. This requires some technical expertise. We wouldn't have gotten underway without Thomas."

But Thoruplund got started, even though it wasn't easy. The nursery has now made the transition from being a challenge for the electricity grid, to being part of the solution in balancing it. It generates extra income at the same time:

"We do it for two reasons. We want to help address the challenges the grid is facing. But we don't just do it to be good citizens. We also expect to earn some money from it. And we hope and believe that we will."

Thoruplund Gartneri has already begun to see – after six months – that earnings are, in Jørgen's words, 'quite reasonable'. And while Jørgen sometimes notices that the lights go out in the greenhouses, it is not something that hinders production or disrupts the daily work.

Why it is important that more people do what Jørgen is doing

Our electricity grid is distributing more and more green power throughout Denmark, which is very good. But it does not come without challenges. Both wind and solar energy are 'fluctuating energy sources'. They only generate power when the wind is blowing or the sun is shining. There is still a need to supply power to Danish electricity consumers at other times.

And this is where Jørgen and others play a role. Their flexible consumption helps to stabilise the power grid and facilitate a more rapid green transition.

Ancillary services to the power grid through demand-side response means that consumers adjust their electricity consumption in response to Energinet's needs. When there is too little power in the grid, they reduce their consumption to help balance it, and when there is too much they can increase their consumption. This helps to maintain a stable power supply and prevent the power grid from becoming overloaded.

But more players are needed in this market. There are many reasons for this. In part because of the weather-dependent generation already mentioned, but also because there are fewer and fewer conventional power stations as a result of the green transition, and these have historically provided most of the ancillary services. Electricity consumption has also been strongly rising in recent years, and this trend will only accelerate in the future. We are therefore in the situation right now where the need for ancillary services is increasing, but there are not enough players providing them.

"We need more people like Jørgen who think about how flexible they can be, and make that flexibility available to the electricity system. This will allow us to balance the system and continue to maintain a high security of supply," says Kia Marie Jerichau, Director of Flexibility and Balancing at Energinet.

Modest first-mover

It is no easy task to get Jørgen to sing his own praises. Boasting, as he calls it, does not come naturally to him. It takes some insistence before he will admit that exploring new trends is probably inherent in his nature and part of the plant nursery's DNA.

Thoruplund is also the first plant nursery to provide ancillary services to Energinet.

"It's in our nature. We are never at the trailing end. We monitor the new trends, and when they are certain, we strike. We have done this with robots, for example. We were also one of the first nurseries to build Dutch-style greenhouses. And we were among the first to start outsourcing production." >>



WHAT ARE ANCILLARY SERVICES?

Ancillary services are a collection of products Energinet purchases to ensure electricity generation and consumption match at all times of the day. It is impossible to precisely predict and plan electricity generation and consumption, and ancillary services are used to fill any gaps that arise as a result. If Energinet did not have ancillary services available to it, the power grid would become overloaded and damaged, leading to disconnection of consumption in the worst case.



DO YOU WANT TO PROVIDE ANCILLARY SERVICES?

Find out more at:
en.energinet.dk/ancillary

or contact us at electricitymarket@energinet.dk

>> Barrier 5 OF 5: POWER SYSTEM LOSES BALANCE

Jørgen goes on to list more examples. One of which is that the nursery investigated the possibility of having its own solar farm. And while it does not sound so innovative today, Jørgen and Thoruplund were also among the first to invest in their own coal-fired boiler in the 80s.

It is therefore also a natural extension of Jørgen's work as a horticulturist to embrace ancillary services. Jørgen's children, twins Bodil and Jacob, also want ancillary services to be part of the company's ESG reporting:

"We expect to use it in our communication. It will also be part of our ESG reporting. It's in the spirit of the times that things are moving in this direction, and that is also why we got started with ancillary services. It's about staying at the leading edge."

The decision to start providing ancillary services was not an idea that arose very suddenly. It was the result of many conversations and, above all, required thorough preparation.

Do your homework

Just as the decision was not spontaneous or sudden, it has also taken a lot of preparation to get started. New systems have been installed and a number of power cables have been run to allow the grow lights in Thoruplund to turn on and off automatically.

Jørgen has also read extensively on the subject and had many chats with Thomas Offer Madsen, among others.

"It's important to familiarise yourself with it thoroughly before making the decision to get started with ancillary services. After that, the technical side and control system is very important. We received some help from Greenario, but otherwise we have used our own common sense. You have to do your groundwork thoroughly, so you know what you're getting into."

And the thorough groundwork seems to be bearing fruit for Jørgen and Thoruplund. In his own modest words, the bottom line for providing ancillary services 'looks reasonable'. Not that this surprises Jørgen. Things are going much as he predicted. The only thing that has surprised him is that the lights are turned off a little more often than he had expected. The innovative Funen resident sees it as a pleasant win-win situation that being a good citizen helps balance the electricity grid while generating new income for the company. <<



Barrier 5 OF 5: POWER SYSTEM LOSES BALANCE

CHEAP HEAT AND THE GREEN TRANSITION GO HAND IN HAND

In Sønder Felding, they provide ancillary services for the sake of their customers. To make their heating as cheap as possible. The fact that it also contributes to realising the green transition is a nice bonus.

Last year, Operations Manager Tonny Dam Jensen and the rest of the small team at Sønder Felding Varmeværk won the annual district heating award from the Danish District Heating Association.

One of the reasons they did so was because they electrified large parts of the heating plant and provided ancillary services to Energinet. It is an award that Tonny Dam Jensen is proud of, but with humility.

"We're very proud of the award, but I don't feel we've done anything markedly different from our other capable colleagues."

They expanded the heating plant in Sønder Felding in 2022. In simple terms, they expanded by adding a large heat pump that allows them to produce more heat than their customers can actually use, making it possible to store the energy in a large storage tank. This allows the heating plant to provide ancillary services to Energinet – and ensure cheap heat for its customers.

Expansion provided new opportunities

When Tonny Dam Jensen and the team at Sønder Felding Varmeværk decided to expand, they had done their homework. They believed there was money to be made.

"We knew what we wanted when we expanded. We just didn't know all the fancy words like sector coupling, ancillary services, or what exactly the FCR market was."

Since the expansion, Tonny's work duties have changed markedly. In the old days, he could set the heating price for the whole year because the plant was fired using wood chips. Now he only knows the price two hours

after the heat has been delivered to living rooms in Sønder Felding.

"In many ways, it's a bit like being a share trader. But in addition to supplying cheap heat to our customers, Sønder Felding Varmeværk and other heating plants are making a huge difference for the green transition. We're helping to balance the electricity grid, and we're proud of this." <<

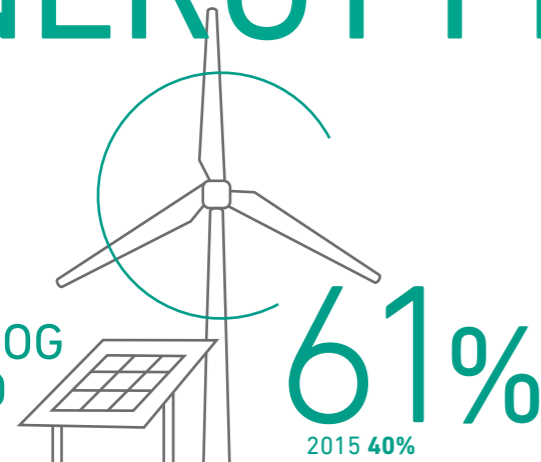


Tonny Dam Jensen
Operations Manager at
Sønder Felding Varmeværk

ENERGY FIGURES

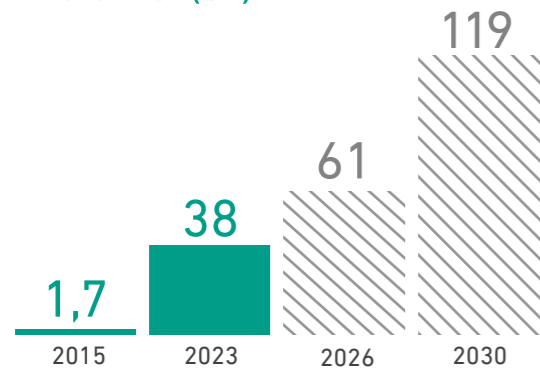
2023

SOL OG
VIND



I 2030 forventes 100% af vores nettoelforbrug at være dækket af sol og vind.

BIOGAS (%)



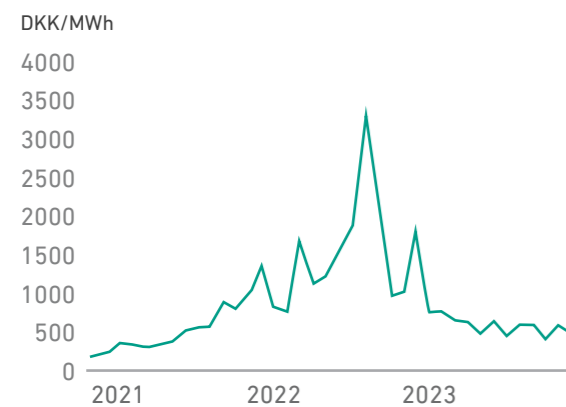
HØJ EL-FORSYNINGSSIKKERHED

64 sek.

UDEN EL

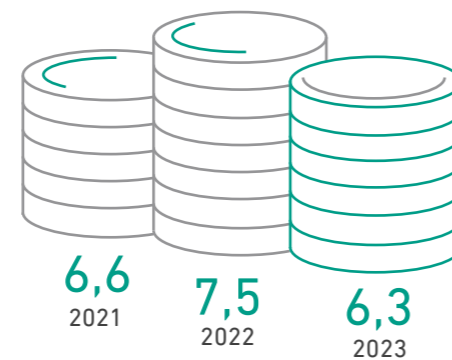
Igen i 2023 var forsyningsikkerheden fra Energinets elnet helt i top

DE DANSKE SPOTPRISER (EL)



ANLÆGS-
INVESTERINGER

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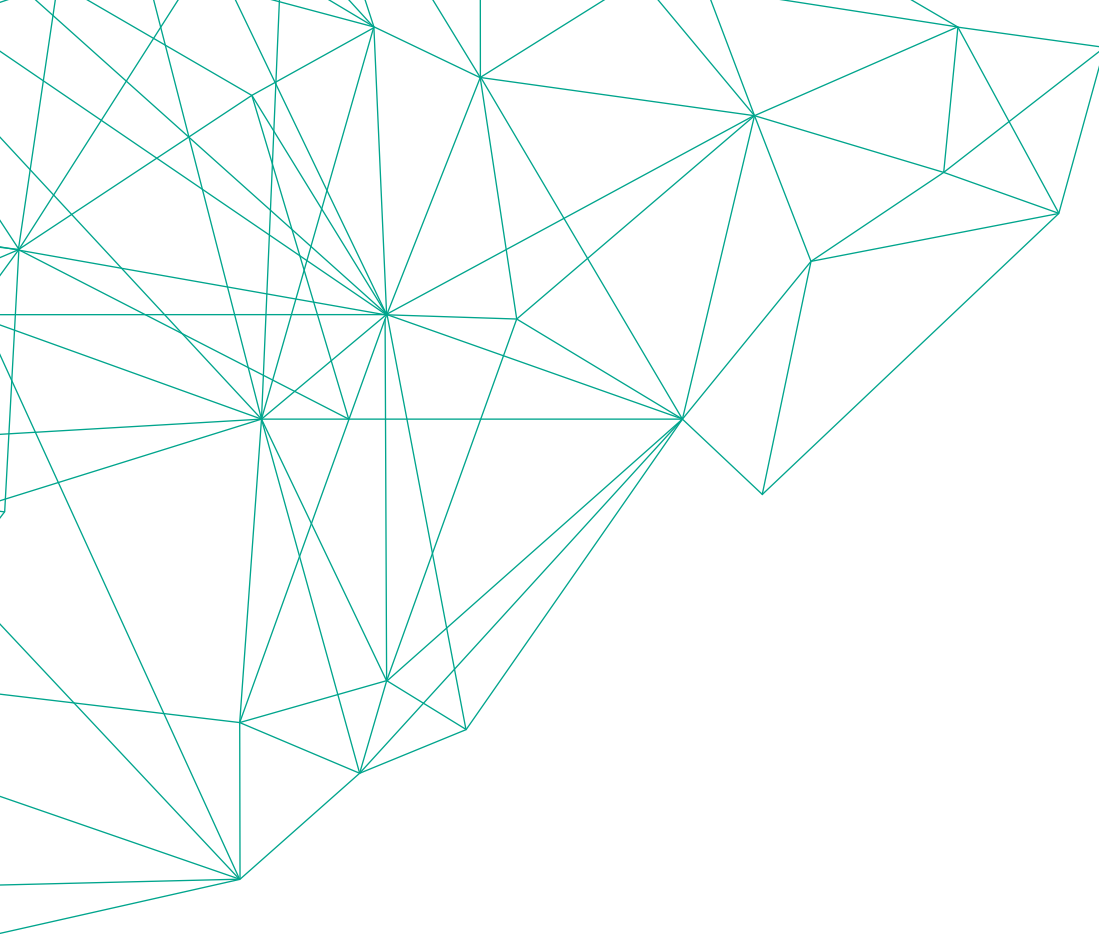
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Energinet is an independent public enterprise owned by the Danish Ministry of Climate, Energy and Utilities. We are working towards a green transition of the energy systems, so that citizens and businesses can use renewable energy for everything, with a high level of security of supply and at an affordable price.