



ENERGINET



STRATEGY

# WINDS OF CHANGE





Now it's all about making use of renewable energy across sectors. To create a world in which global climate change has been slowed down.

*Lars Barfoed, chairman of the board*

The green transition must be accelerated. We need to learn new things and develop new solutions. We must therefore increase our curiosity and risk willingness.

*Thomas Egebo, CEO*



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

Energinet contributes to converting energy systems with the aim of ensuring that citizens and businesses use renewable energy for everything, with a high level of security of supply and at an affordable price. We must create value for society in a broad sense; for citizens, businesses, institutions and civil society.

The energy sector is undergoing a large-scale transformation as a result of national and international agreements to convert to climate-neutral societies.

The scope and speed of the transformation are on a historical scale. Therefore, Energinet does not have a strategy with a specific term, but a dynamic strategy which is applicable at any given time and which is being developed continuously: A focused development strategy.

Energinet's focused development strategy is called Winds of Change. The strategy is a window through which you can see at any given time the issues on which Energinet has a special development focus.

Energinet's development focus is on the new tasks which we find it critical to examine and solve if we are to continue to succeed in performing our role in the green transition.

However, Energinet's strategy does **not provide an overview** of Energinet's obligations, activities and initiatives.

Energinet's ongoing work with security of supply under the green transition continues with undiminished strength and with the use of means for market, grid and system development, both nationally and internationally. Our work is thus governed by objectives based on the Danish State's ownership strategy and by provisions in Danish and European legislation regulating Energinet's activities.

Renewable energy, high level of security of supply and affordability. **Solving the trilemma of energy** is and will always be Energinet's mission or core task. We must create room for renewable energy and maintain a high level of security of supply in ways that are affordable to society. The legislator has set up Energinet to solve this particular task, and this is the area in which we have a special social responsibility.

If we succeed in performing this task, the Danish energy system can inspire the rest of the world. In this way, we contribute to global climate change actions and initiatives through the performance of our core task.

**04**  
ENERGINET'S STRATEGY  
AT A GLANCE

**06**  
VISION: GREEN ENERGY  
FOR A BETTER WORLD

**07**  
APPROACH: A SPEEDIER  
TRANSITION

**08**  
STRATEGY: WINDS OF  
CHANGE

**10**  
VITAL CHALLENGES  
AND PROMISING  
OPPORTUNITIES

**12**  
POTENTIAL 1  
Sector coupling is the key to a  
climate-neutral future

**16**  
POTENTIAL 2  
Danish offshore wind power  
as a unique contribution to  
Europe's green transition

**20**  
POTENTIAL 3  
Rapid development of solar  
and wind power on market  
terms raises demands of new  
approaches

**24**  
POTENTIAL 4  
Collaboration with society  
towards solutions of the future



# ENERGINET'S STRATEGY AT A GLANCE



## SITUATION

The energy sector is undergoing a large-scale transformation as a result of national and international agreements to convert to climate-neutral societies.

The scope and speed of the transformation are on a historical scale. Therefore, Energinet does not have a strategy with a specific term, but a dynamic strategy which is applicable at any time and which is developed continuously to meet the objective: That, over time, citizens and businesses can use renewable energy for everything, with a high level of security of supply and at an affordable price.



## VISION

WHAT DO WE WORK FOR?

Green energy for  
a better world

Every day, we work with designing, maintaining, developing and expanding energy systems that will make it possible to use renewable energy for everything. In Denmark and globally.

Renewable and green energy is one of the most important prerequisites for creating a world in which people can thrive and live good lives without causing damage to future generations or the current populations in the most exposed areas on the globe. A world in which global climate change has been slowed down.

7 AFFORDABLE AND  
CLEAN ENERGY



9 INDUSTRY, INNOVATION  
AND INFRASTRUCTURE



13 CLIMATE  
ACTION



17 PARTNERSHIPS  
FOR THE GOALS



The UN Sustainable Development Goals constitute Energinet's business compass, in terms of both the social mission that we perform and the resources we use for this.





## APPROACH

HOW DO WE WORK?

### A speedier transition

The green transition must be accelerated. This makes stringent demands on Energinet's culture and our way of working. We need to deliver on our tasks more quickly and become better at learning new things.

We must be willing to assume delimited risks in situations in which action is important to pave the way for the green transition, even though the effect is only likely and not certain.

Persistent focus on cooperation, innovation and utilisation of the possibilities offered by digitisation are key elements if we are to succeed in our green transition work.

We are aware of our social responsibility and manage our resources in line with our objective to contribute to a better world in which global climate change is slowed down.



## STRATEGY

WHAT DO WE WORK WITH?

### Winds of Change

Energinet's social mission is to convert the energy system with the aim of ensuring that citizens and businesses use renewable energy for everything, with a high level of security of supply and at an affordable price.

In the coming years, we need to do what we can to support energy consumption which can realise and utilise the enormous offshore wind power resources as well as onshore solar energy and wind power which are now becoming more widely available on market terms. So that we can use renewable energy for everything.

We have to exploit 4 potentials:

- Sector coupling
- Large-scale off-shore wind power
- Solar and wind power on market terms
- Collaboration with society

Energinet's strategy must be seen in the light of political ambitions in Denmark and Europe, including, in particular, the ambitions to ensure 100% renewable energy in the electricity system in 2030 and to achieve a climate-neutral society in 2050.





## VISION

GREEN ENERGY FOR  
A BETTER WORLD

Every day, we work with designing, maintaining, inventing and expanding energy systems that will make it possible to use renewable energy for everything. In Denmark and globally. For a world in which global climate change has been slowed down.

Renewable and green energy is one of the most important prerequisites for creating a world in which people can thrive and live good lives without causing damage to future generations or the current populations in the most exposed areas on the globe.

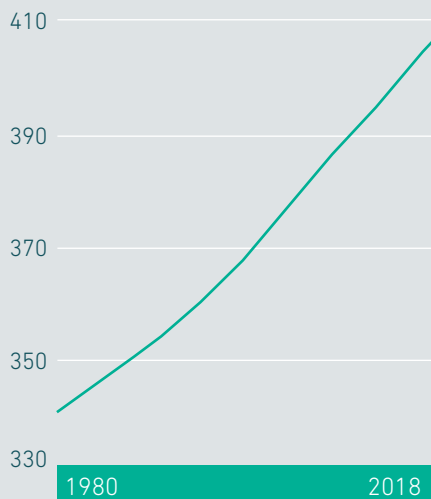
Inexpensive and reliable renewable energy is urgently needed globally. Solutions for integration of renewable energy developed in Denmark are now being used throughout the world. We must continue to lead the way, and Energinet has a vital responsibility for making this possible.

We will therefore create the best green energy system in the world by 2030. We will convert to renewable energy without compromising on the availability of energy at an affordable price and with a high level of security of supply. This is good for the global transition to climate-neutral societies, but it is also good for the Danish economy.

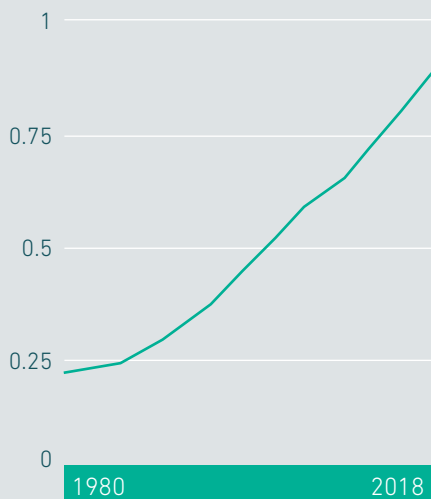


**SUSTAINABLE  
DEVELOPMENT GOAL 13  
CLIMATE ACTION**

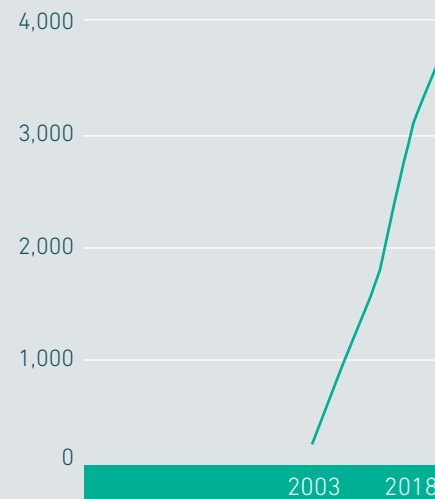
## 4 SIGNS OF RAPID CLIMATE CHANGE

MORE CO<sub>2</sub> CO<sub>2</sub> parts per millionTEMPERATURE IS RISING 

Surface temperature °C

GREENLAND'S ICE IS MELTING 

Melted ice in gigatonnes



Data from a statement about the climate crisis signed by 11,000 scientists from 153 countries and published November, 2019, in Bioscience Magazine.





## APPROACH

# A SPEEDIER TRANSITION

The tasks in the green transition require that we close the gap between idea and reality through extensive partnerships.

The green transition must be accelerated. This increasingly requires that all players in the energy sector and in society in general collaborate on finding the right solutions.

In fact, the right solutions are not the same as they used to be. The first half of the green transition was about creating a basis for mass production of renewable energy on market terms. In the second half, the challenge will be to utilise the energy to ensure cross-sectorial renewable energy consumption. This is a difficult challenge, which must be met rapidly.

Digitisation, new technologies and business models for ensuring the integration of renewable energy in the energy system are high-priority areas in the coming years. Through collaborations as well as knowledge and data sharing, Energinet will support that known and new players in research, energy and end consumption sectors can realise the effects of new digital technologies which are absolutely essential in a transition to climate-neutral societies.

The challenges are colossal and cannot be overestimated. This makes stringent demands on Energinet's culture and our way of working. We know that both managers and employees will need to learn completely new disciplines in the coming years, and that we must be able to develop our culture so that it supports the significantly increased speed and complexity of this task. Curiosity must be an integral part of our mindset.

We will participate in collaborations and partnerships with universities, trade and industry, innovators, consumers, organisations and any relevant

player to meet our social mission. This applies in Denmark as well as internationally.

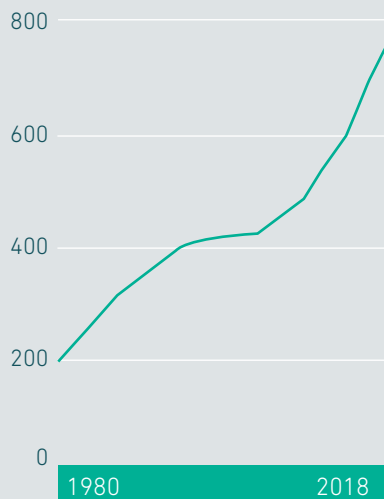
We are curious and listen to our stakeholders to learn new things and see the world from as many perspectives as possible before we make decisions or create new knowledge. We want to challenge our own assumptions and thus actively drive innovation.

We manage our resources in line with our objective to contribute to a better world in which global climate change is slowed down. This means that we work with measures aimed at minimising the environmental impacts of our operations as much as possible.

We also manage our resources in line with efficient operations. This means that we have continuous and systematic focus on efficiency improvements enabling us to perform our social mission with optimal socio-economic effect.

### EXTREME WEATHER

Incidents per. year



17



SUSTAINABLE  
DEVELOPMENT GOAL 17  
PARTNERSHIPS  
FOR ACTION





## STRATEGY

## WINDS OF CHANGE

The transition of the energy system is rapidly entering a new phase – a second half in which Energinet focuses on new opportunities and challenges. The historical context and the ambitious political objectives which form the backdrop for Energinet's strategy are central to understanding the turning point which the strategy represents.

## THE ENERGY SECTOR IN A PARADIGM SHIFT

## THE 1990S

In the 1990s, Danish politicians could enter into broad accords on public sector support for development and expansion of renewable energy, particularly onshore wind power, offshore wind power and solar energy.

## THE 2000S

The 2000s saw the formation of integrated energy markets in Europe, the Nordic region and Denmark. Energinet was set up.

## THE 2010S

In the 2010s, the intended consequences of the broad accord on a greener society reached in the 1990s became increasingly evident. Production with renewable energy sources became good business and began spreading by means of market forces and without subsidies in Denmark and internationally.



## FIRST HALF

The first half was about creating a basis for mass production of renewable energy on market terms.



7  
SUSTAINABLE  
DEVELOPMENT GOAL 7  
SUSTAINABLE  
ENERGY

## 2020 (NOW)

Right now, in 2020, we are envisaging a massive potential expansion of offshore wind power in Danish waters. The potential is 40 GW – at least three times more than even a fully electrified Danish society can consume. This is combined with a concurrent expansion of onshore solar energy and wind power, and onshore RE production is now being diffused on market terms.

## THE 2020S

In the 2020s, it will be necessary to lay down the framework for the next phase of the green transition. The objective will then be to ensure efficient utilisation and integration of renewable energy in all energy consumption parts of society. The challenge will also be to find solutions to storage of green energy and balancing of the electricity system, including increased demand-side response.

## THE 2030S

In 2030, the ambitious political objectives for the green transition and climate actions must be met. The objectives in 2030 require the implementation of extensive transitions now.



## SECOND HALF

The second half is about utilising energy for renewable energy consumption across sectors and throughout society.



# VITAL CHALLENGES AND PROMISING OPPORTUNITIES

Which action areas are particularly relevant in the coming period to enable us to perform our social mission optimally? Which challenges are vital? Which areas offer promising opportunities?

Climate-neutrality before 2050 is on the agenda for the Danish Parliament. It is our task to prepare the energy system for that future.

In the coming period, there are some particularly significant, new challenges and opportunities which can be described as follows in brief:

## **Danish offshore wind power can accelerate the green transition**

Denmark's offshore wind power resources are among the best in the world. In addition, technological and industrial development has made offshore wind power a good business.

In 2040, the Danish electricity consumption, including data centres, electric vehicles, heat pumps and railway electrification, will amount to the equivalent of 13 GW offshore wind power. However, the total potential for offshore wind power is of as much as 40 GW in the Danish part of the North Sea alone.

It is therefore no wonder that precisely offshore wind power constitutes a cornerstone in Danish and European climate and energy policy ambitions.

## **Large renewable energy must be utilised optimally**

One thing is that renewable energy from offshore wind power and from onshore wind power and solar energy is established. But how is this renewable energy to be stored, used and integrated into the energy system?

This can firstly be done by accelerating various types of sector coupling between electricity, green gases and high-value products which can contribute to reducing greenhouse gases from otherwise difficult sectors such as agriculture and heavy goods transport.

Secondly, it can be achieved by working with new ways of utilising large-scale offshore wind power. Surplus offshore wind power, which is not to be used in the Danish energy system, can, to advantage, be exported and contribute to meeting European climate targets in the green transition.

Today, only approx. 20% of the Danish energy consumption is covered by electricity. Electric vehicles and heat pumps are among the elements that will result in a significantly larger percentage of the Danes' future energy consumption having to be covered by electricity.

Regardless of how the future electricity consumption is structured, it is therefore certain that there will be a need for more overhead lines at high-voltage level than today, and they will be visible in the landscapes.

However, out of consideration for citizens and nature, we must minimise as much as possible the number of new extra overhead lines in the future expansion. This is a separate challenge which sector coupling and large-scale offshore wind power also contribute to meeting.

## **Winds of Change offer new opportunities**

On the following pages, we will zoom in on the focus areas we will be working particularly to develop in the coming period to seize the opportunities and meet the challenges described above.

We zoom in on what Energinet can do to ensure that these elements become effective contributions to realising Danish climate targets in ways which can also be copied globally and thus have greater effect than purely national measures.

# 1

## STRATEGY



# WINDS OF CHANGE

The enormous offshore wind resources and the boom in renewable energy on market terms are Denmark's core strengths. These core strengths may result in extensive climate impact reductions in otherwise difficult sectors such as agriculture and transport, concurrently with the transformation to a 100% green energy system. With these Winds of Change follow new opportunities.

# 4

## OPPORTUNITIES

### SECTOR COUPLING

Green gas and conversion of electricity to hydrogen, heating and RE-based fuels will be essential to climate impact reductions in difficult sectors such as agriculture and transport.

### LARGE-SCALE OFFSHORE WIND POWER

The wind power potential in Danish waters is more than three times higher than the electricity consumption in a fully electrified Denmark. New large-scale solutions will be of decisive importance to the Danish contribution to Europe's green transition.

### SOLAR AND WIND POWER ON MARKET TERMS

Production facilities for renewable energy are popping up in higher numbers and at higher speed than expected so far. This is a good and necessary development towards meeting the high climate ambitions. However, new solutions are required if the development is to continue.

### COLLABORATION WITH SOCIETY

The development towards a climate-neutral society will require expansion of extra infrastructure in relation to what we know today. New technological solutions, new considerations and new types of collaborations and partnerships in society will be essential.

# 5

## EFFECTS

### REDUCTION OF CLIMATE GAS EMISSIONS FROM DIFFICULT SECTORS

If we succeed in supporting Power to X as a business, climate gas reductions in, for example, agriculture as well as sea and air transport may be achieved more rapidly.

### ELECTRIFICATION

If we succeed in efficient integration of RE potentials, the electrification of, for example, residential heating, passenger cars and industrial processes will be implemented more rapidly than otherwise.

### FEWER OVERHEAD LINES THAN OTHERWISE

If we succeed in sector coupling across electricity, heating and green gases, the electrification will require fewer extra overhead lines than otherwise.

### ENERGY STORAGE AND BALANCING THE ELECTRICITY SYSTEM

If we succeed in increased flexibility, new forms of energy storage and large-scale offshore wind power solutions, we can integrate 100% renewable energy while maintaining a high level of security of supply.

### CONTRIBUTION TO GLOBAL TRANSITION

If we succeed in supporting the Danish offshore wind power potential and new solutions in the next phase of the green transition, we will contribute more effectively than otherwise in the global fight against climate change.

# 1

## TARGET

CLIMATE-NEUTRAL SOCIETY IN

# 2050





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OPPORTUNITY

1

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2



# SECTOR COUPLING

Green gas and conversion of electricity to hydrogen, heating and RE-based fuels will be essential to climate impact reductions in difficult sectors such as agriculture and transport.

## ENERGINET SEEKS TO:

### 01

Develop market models, integrated infrastructure planning and operating solutions in electricity and gas which support continued electrification of heating and transport, and ensure that market players can establish PtX clusters.

### 02

Play an role as a catalyst across the entire sector coupling area to ensure sufficient progress in relation to conversion and decarbonisation of the energy sector and society.

### 03

Develop gas storage facilities and actively seek out partnerships with a view to supporting a growing PtX market.

### 04

Make our knowledge available for the public debate on sector coupling, enter into a dialogue with energy sector players on both direct and indirect electrification and engage in knowledge partnerships within, for example, passenger transport, aviation, shipping, industry and agriculture.

### 05

Examine the unclarified scenarios for the development of markets and infrastructure related to different potential development paths for hydrogen in Denmark.





## OPPORTUNITY 1: SECTOR COUPLING - THE KEY TO A CLIMATE-NEUTRAL FUTURE

### BACKGROUND

There is an enormous potential for renewable energy on Danish soil and in Danish waters. In Danish waters alone, offshore wind farms can be established which can produce approx. three times as much electricity as the volume needed by a fully electrified Danish society.

In addition to a full electrification of Danish energy consumption, the enormous potential makes it possible to convert power from renewable energy sources into gas, hydrogen and RE fuels – also called Power to X, or the third phase of sector coupling.

In fact, sector coupling in Denmark can be described in three development phases, which do not succeed, but supplement, each other, gradually creating better opportunities for green energy consumption throughout Danish society.

The first phase was the establishment of district heating and decentral CHP plants, which is something which most Danes take for granted. In the first wave, surplus heat from electricity production is utilised, and gas generators can alternately generate electricity and heating for distribution in large residential areas. In Denmark, there is well-established sector coupling between electricity, heating and gas (as well as waste incineration).

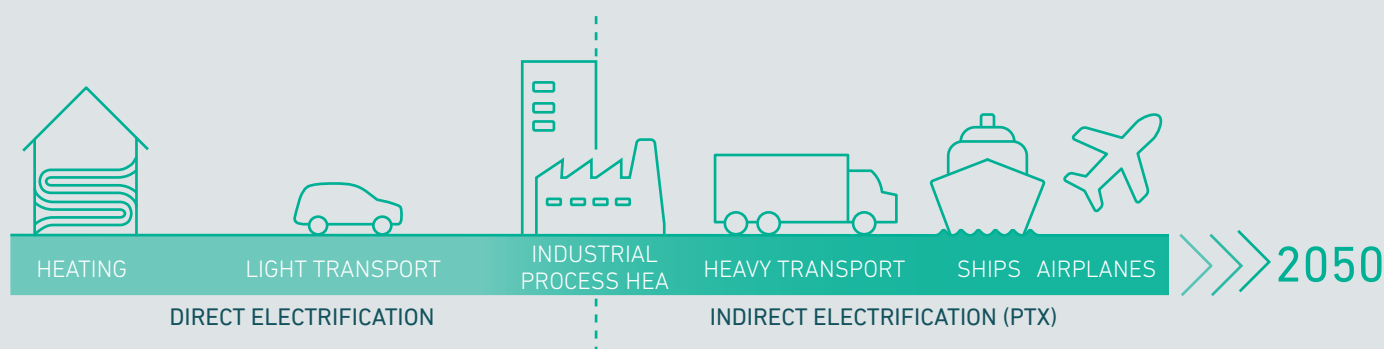
The second phase is direct electrification, which is currently being implemented. Individual heat pumps replace oil-fired

boilers in houses outside the district heating areas, and large electricity-driven heat pumps are gradually established in the district heating sector. In a near future, electric vehicles and electrification of railway services will constitute yet another sector coupling between electricity and transport. The increasing biogas production from, in particular, residual products in the agricultural sector is also part of the second phase of the sector coupling. The direct electrification phase is vital to the green transition right now, and must be strengthened.

The third phase is still only being implemented on a small scale. It is called Power to X and can be characterised as indirect electrification. With Power to X, electrolysis is used to convert electricity from renewable energy production to hydrogen, which can be processed further into green gas or chemically based high-value products such as RE fuels for lorries, aeroplanes and ships.

Together with the heavy increase in Danish biogas production, completely new types of interaction between the electricity and gas systems may thus make significant contributions to reducing greenhouse gases from otherwise difficult sectors such as agriculture and very heavy goods transport.

Energinet is currently developing the gas system for future gas consumption which will be reduced from the current level and which will also be based on green gas. This work is an important element in sector coupling.



### ELECTRIFICATION AND POWER TO X

Denmark's huge RE-potentials can be utilized to electrifications and to indirect electrification via power to X for sectors that cannot run on electricity.

## OPPORTUNITIES

Power to X is a river delta which connects RE resources with the ambitious climate targets

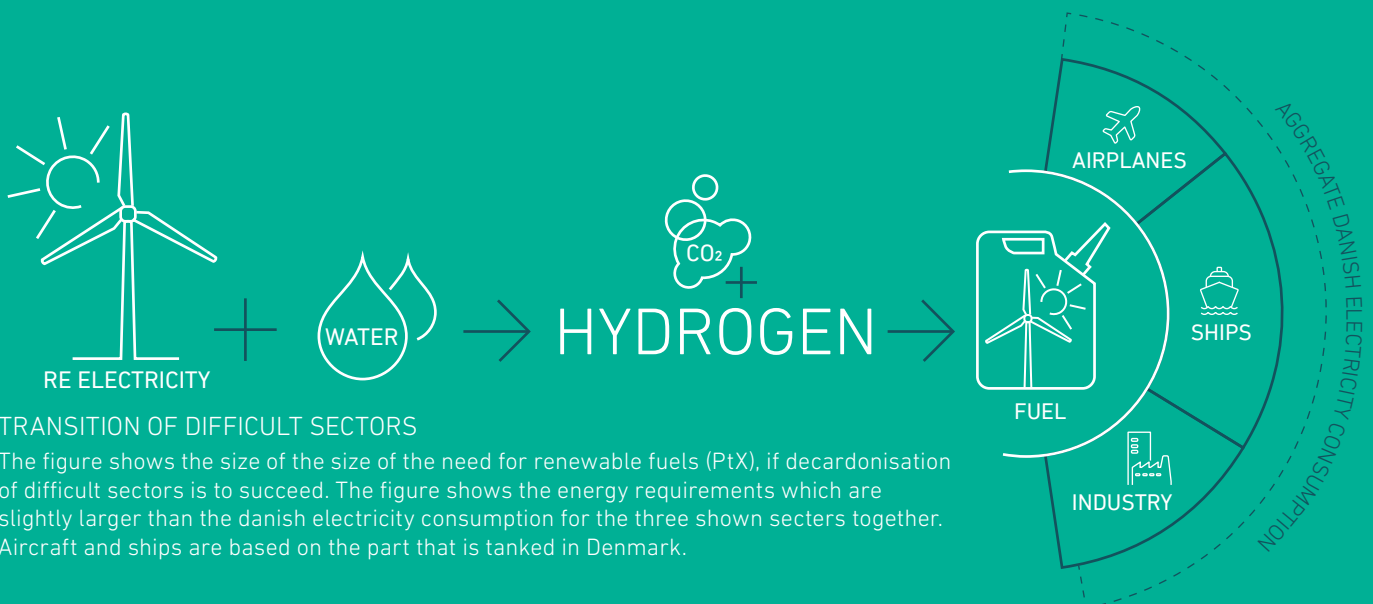
If we imagine figuratively that Danish RE resources are a river of abundant wind power volumes which must be lead to provide different types of end consumption, then Power to X is a river delta with many branches. A river delta in which each single branch of the delta leads valuable green energy to an end consumption which was previously fossil-fuel dependent, but which is now becoming climate neutral.

If we stay with this image, four of the river delta branches can be described as follows:

- Carbon from biogas production can be used, together with hydrogen produced from excess wind turbine power, as green fuel in, for example, lorries and aeroplanes, or the hydrogen can be used to produce ammonia, which can become a climate-neutral fuel in ocean-going sea transport.
- Hydrogen or upgraded biogas can be used for that part of the industry's process heating which currently requires more than 200 degrees of heat and which is therefore technically impossible or far too costly to electrify.

- The gas system and, not least, the gas storage facilities will be able to store electricity which has been converted into hydrogen or gas, thus solving the important and much-discussed challenge of storing enough energy for when the sun is not shining, and the wind is not blowing.
- The success of producing renewable energy at highly competitive prices also means that RE producers and their investors will have an increasing need to hedge the risk of their investment with other elements than the expected electricity price. Production of high-value products such as jet fuel out of surplus wind energy may be part of the answer for investors and thus increase the chances of continued high investor interest in offshore wind farms.

These four 'river delta' branches alone make it clear that the third wave of sector coupling, Power to X, has an enormous potential for meeting many difficult challenges in the green transition, all at once so to speak.



### TRANSITION OF DIFFICULT SECTORS

The figure shows the size of the need for renewable fuels (PtX), if decarbonisation of difficult sectors is to succeed. The figure shows the energy requirements which are slightly larger than the danish electricity consumption for the three shown sectors together. Aircraft and ships are based on the part that is tanked in Denmark.

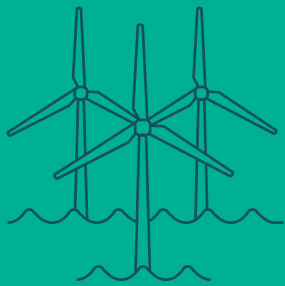




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OPPORTUNITY





# LARGE-SCALE OFFSHORE WIND POWER

The wind power potential in Danish waters is more than three times higher than the electricity consumption in a fully electrified Denmark. New large-scale solutions will be of decisive importance to the Danish contribution to Europe's green transition.

## ENERGINET SEEKS TO:

### 01

Play an active facilitating role in the realisation of the Danish, regional and European ambitions for large-scale offshore wind power

### 02

Support the political ambitions for hybrid solutions and offshore 'energy islands' from which the energy, in the form of electricity or hydrogen, can be distributed to several Northern European countries, thus utilising large-scale offshore wind power and minimising the need for new onshore overhead lines.

### 03

Work actively for a better geographical correlation between production and consumption and, in particular, highlight the positive security of supply effects of offshore wind power on different locations.

### 04

Contribute to the identification, possibly through political initiatives, of favourable landing zones or energy clusters for large-scale offshore wind power from the North Sea, where there is great access to the electricity and gas systems as well as access to storage of hydrogen and other green gases in salt caverns.





## OPPORTUNITY 2: LARGE-SCALE OFFSHORE WIND POWER - A UNIQUE CONTRIBUTION TO EUROPE'S GREEN TRANSITION

### BACKGROUND

Offshore wind farms have become a Danish symbol in the world, where global companies are now erecting and operating more and more offshore wind farms in virtually all regions of the world.

As a result of innovation, political ambitions and a good investment environment, the offshore wind power industry has now been consolidated as a well-established industry which is well on the way to making offshore wind power completely competitive on market terms.

Offshore wind farms are a key example of how technologies which were largely born out of a collective effort to meet

Danish targets on CO<sub>2</sub> reductions will, over time, make it possible to implement climate-improving measures also in other parts of the world and thus achieve a global effect.

The energy consumption in a fully electrified society will constitute approx. 13 GW, while the wind power potential in Danish waters alone is as much as 40 GW.

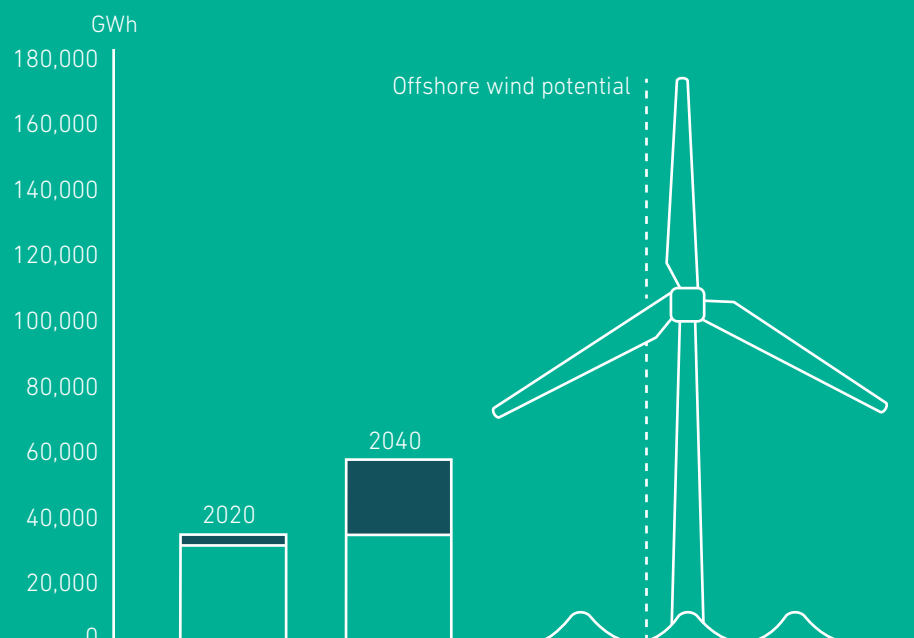
The enormous Danish offshore wind resources can therefore not only be utilised for Danish energy consumption, but can also become a significant contribution to the green transition of European energy supply.

### OFFSHORE WIND POWER AND DANISH ELECTRIFICATION

The offshore wind potential in Danish waters far exceed the need for electricity in a fully electrified Denmark.

New electricity consumption is heatpumps, EV's, datacentres, etc. Classical electricity consumption are the things we are more familiar with: lightning and electrical machines in households, businesses and social institutions.

- Traditional electricity consumption
- New electricity consumption



## OPPORTUNITIES

Implementation of large-scale offshore wind power requires new solutions.

Even though the establishment of offshore wind farms is a well-tested technology and takes place in a well-functioning global industry, it will require significant new solutions if the enormous Danish offshore wind power potential is to be realised at the speed demanded by the political objectives and targets towards 2030 and 2050.

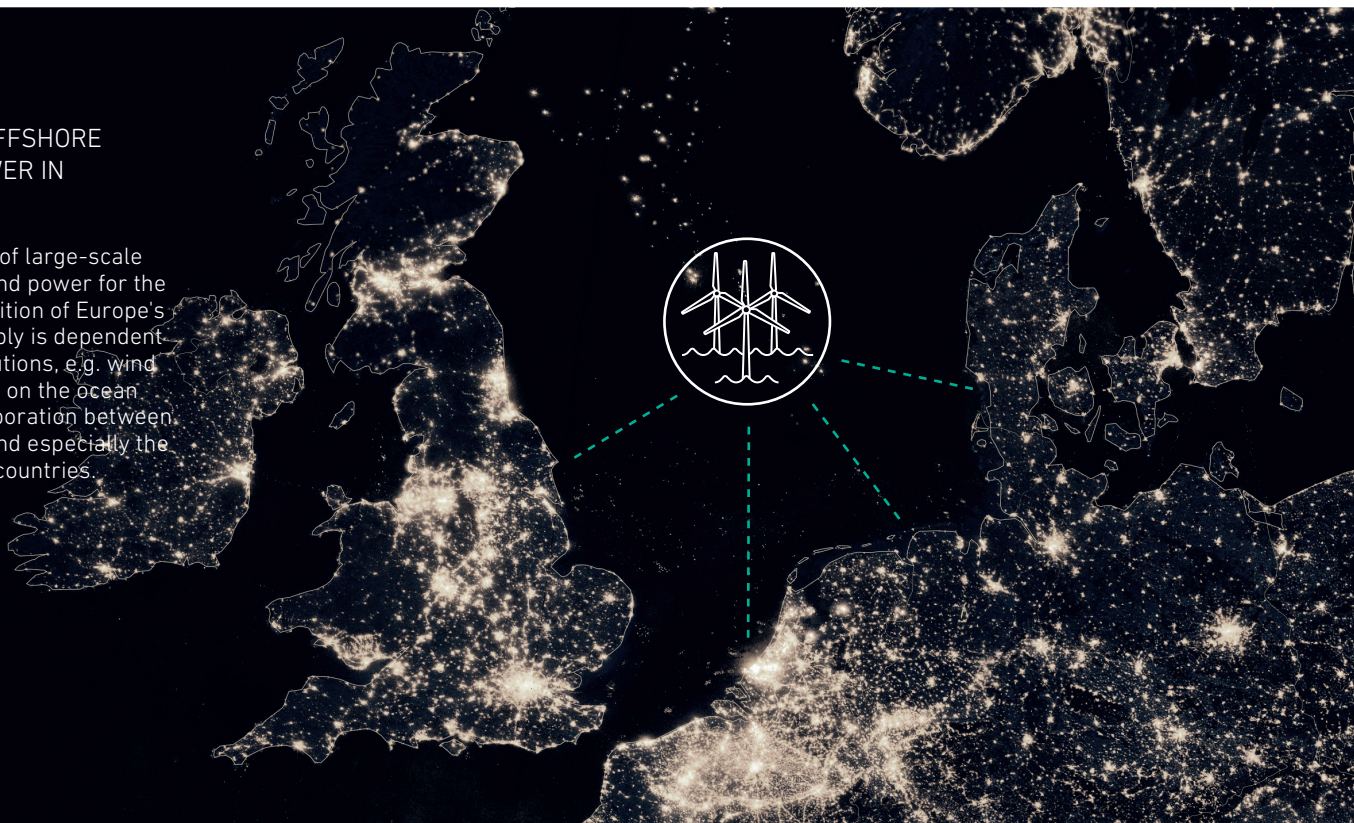
We must not least look at the new solutions in the infrastructure and in the integrated energy systems which are to absorb renewable energy and ensure that it can be sold for more climate-friendly energy consumption across sectors and national borders.

Continued cost reductions combined with solutions which can support the balancing of the onshore electricity grid and solutions which can minimise additional expansions of the electricity grid are the most essential factors in determining whether large-scale offshore wind power can be developed in Denmark.

Large-scale offshore wind power will be one of the most important paths to climate-neutral societies, and many of the triggering factors for whether developers and investors will be attracted to building large-scale offshore wind power facilities must be found in an innovative and holistic energy system.

### DANISH OFFSHORE WIND POWER IN EUROPE

Realization of large-scale offshore wind power for the green transition of Europe's energy supply is dependent on new solutions, e.g. wind power hubs on the ocean and a collaboration between European and especially the North Sea-countries.





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OPPORTUNITY

3

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4



# SOLAR AND WIND POWER ON MARKET TERMS

Production facilities for renewable energy are popping up in higher numbers and at higher speed than expected so far. This is a good and necessary development towards meeting the high climate ambitions. However, new solutions are required if the development is to continue.

## ENERGINET SEEKS TO:

### 01

Strengthen the collaboration with authorities and players to develop stronger incentives for location of new consumption and new production, taking into account the electricity grid capacity.

### 02

Work for higher agility in decision-making processes, so that the expansion of the electricity grid is adjusted to the uncertainty and pace of change connected with renewable energy on market terms.

### 03

Contribute to the development of favourable areas and supporting a framework for energy clusters which can accommodate large-scale offshore wind power and large volumes of renewable energy from onshore facilities, and give impetus to sector coupling.



# OPPORTUNITY 3: SOLAR AND WIND POWER ON MARKET TERMS

## MARKET TERMS

### - NEW APPROACHES

#### BACKGROUND

In parallel with the promising possibilities for offshore wind power, especially in the North Sea, there is ongoing successful development of onshore facilities. A successful development which requires new market solutions and planning approaches if the success is to be converted into more climate-friendly energy consumption and with the best possible socio-economic benefits.

Wind power and, in particular, pv power plants seem to be spreading at a pace that far exceeds our expectations just a few years ago. Solar panels which are installed on commercial terms and without subsidies will accelerate the transition.

This poses a number of challenges which can be said to be closely related to the actual strength of spreading solar

energy and wind power on market terms:

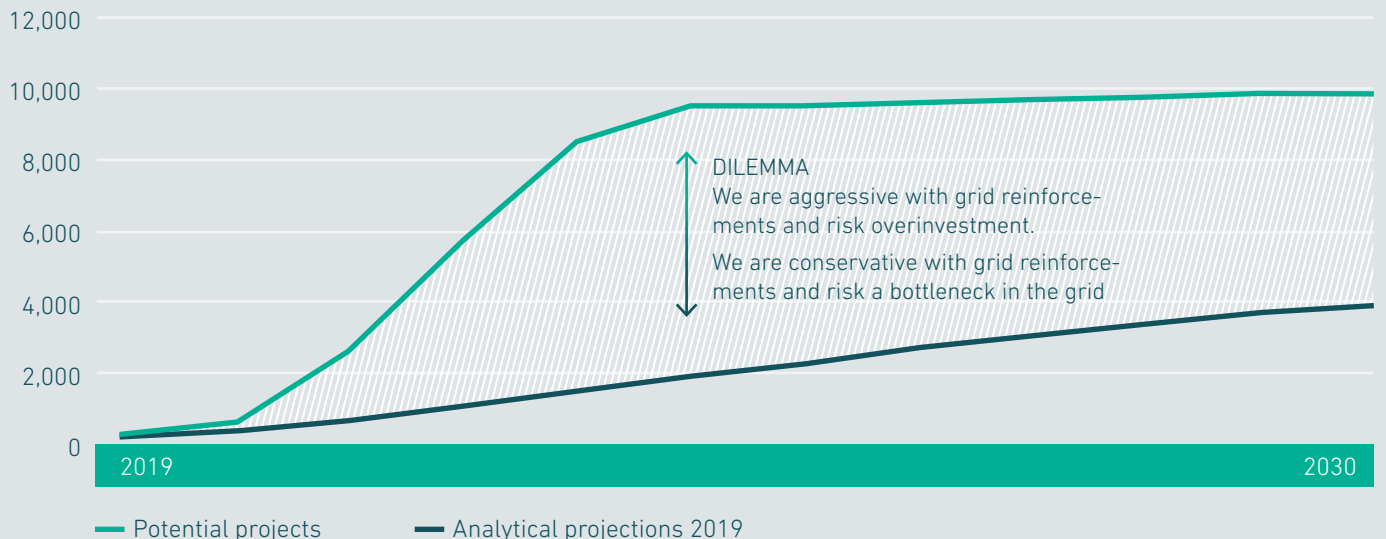
The strength is that the establishment and location of production facilities for renewable energy are not to be planned and financed centrally, but are diffused more rapidly and in line with the commercial incentives which stimulate the activities of RE developers around Denmark.

The challenge is that the market-based establishment of RE facilities takes place unpredictably and without being managed in terms of where it would be beneficial to place RE production facilities in relation to consumption, the electricity grid and the overall energy system in general.

#### DIFFICULT TO PLAN

The figure shows the gap between registered interest in projects from RE-developers in Denmark and the analytic projections that Energinet uses for planning the grid.

Capacity MW





## OPPORTUNITIES

New approaches to energy markets and planning are necessary

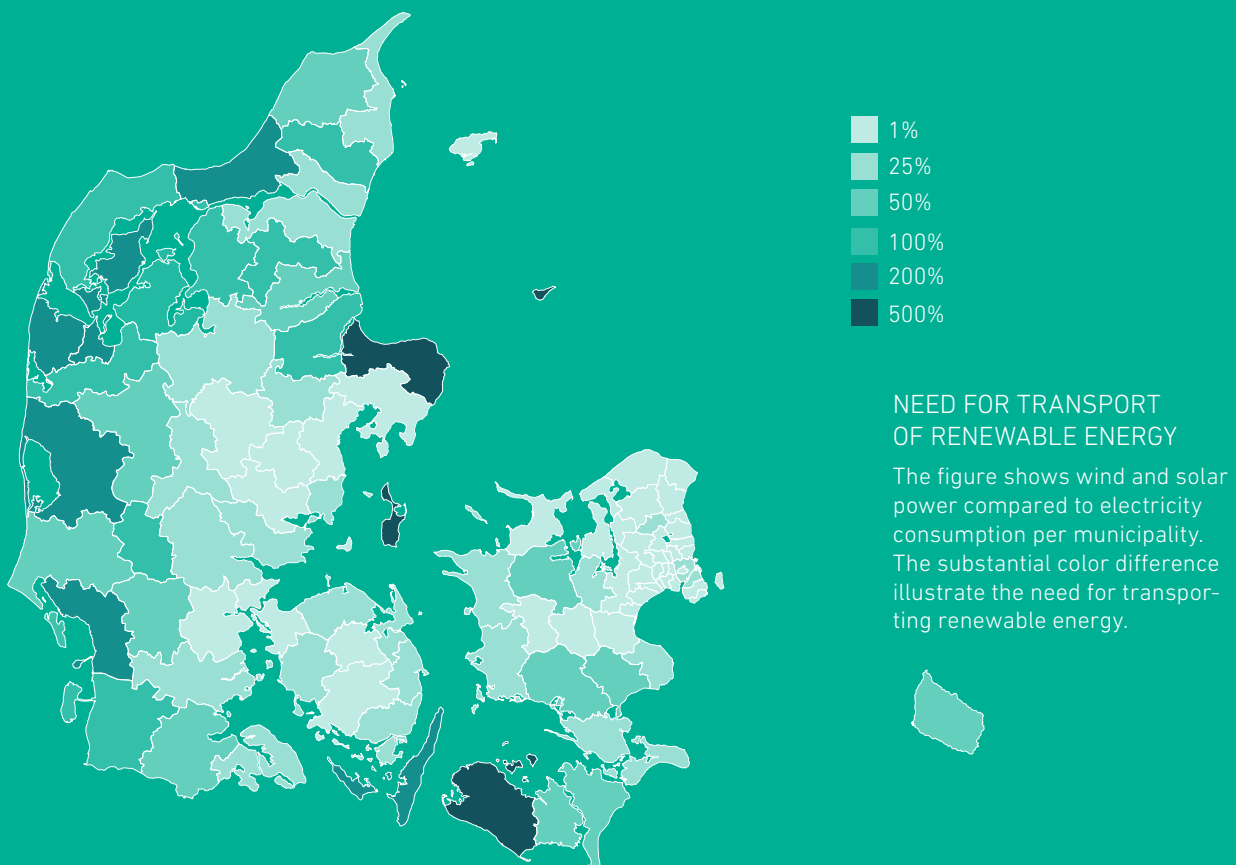
In line with the increasingly rapid and unpredictable expansion of RE facilities, there is a need to find the best ways of meeting the above challenge.

RE investors do not currently need to take into account electricity grid capacity or energy consumption in the local area when deciding on the desired geographical location of the solar panels or onshore wind turbines that are to generate renewable energy.

For example, a developer pays the same costs for locating a photovoltaic cell or a wind turbine close to the place of consumption and a strong electricity grid as for locating

these facilities far from consumption centres in areas in which the grid already handles large volumes of RE electricity. The business potential is the same regardless of the grid capacity, as downward regulation of production as a result of grid restrictions triggers compensation once the plant is connected to the grid.

Energinet works with both physical grid reinforcements and alternatives to this. We can achieve part of the objective based on optimised planning, but it will also be necessary to establish incentives for players and developers to deliver consumption and production flexibility as well as a more expedient geographical location of new RE production and consumption.



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OPPORTUNITY

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## ENERGINET SEEKS TO:

### 01

Involve itself actively and externally in contributing new knowledge to society and with a significant higher prioritisation of research and innovation.

### 02

Work continuously with systematic and persistent efficiency improvement programmes for Energinet's resource use and operations.

### 03

Use as few extra overhead lines as possible in the future expansion of the electricity transmission grid; a multiplication of electricity consumption must not result in a corresponding increase in the number of overhead lines.

### 04

Optimise all possible parameters to increase the capacity of the existing grid.

### 05

Include financial consequences for citizens in the future decision-making basis for construction projects and contribute to the further development of good compensation schemes for affected citizens.

### 06

Strengthen our research into cabling in order to maintain Energinet's position as a global leader in the use of cables and ensure solid evidence for when cabling is possible and when it is not possible.

### 07

Strengthen the dialogue with the outside world on the green transition and increase awareness of the part of the transition for which Energinet is responsible.



# COLLABORATE WITH SOCIETY

The development towards a climate-neutral society will require expansion of extra infrastructure in relation to what we know today. New technological solutions, new considerations and new types of collaborations and partnerships in society will be essential.



## OPPORTUNITY 4: COLLABORATION WITH SOCIETY - THE ENERGY SOLUTIONS OF TOMORROW

### BACKGROUND

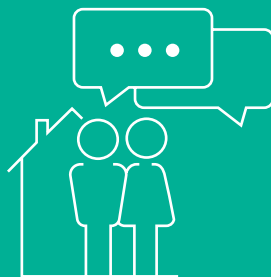
The continued electrification of Danish society will require a significant expansion of the transmission infrastructure for transport of electricity in relation to the current facilities. Regardless of the exact way in which the development will go. Electric vehicles and heat pumps must be supplied with electricity.

However, increased sector coupling and international collaboration on large-scale offshore wind power in the North Sea can contribute to ensuring that there will be fewer extra overhead lines in the Danish landscape in the future than what would otherwise be needed in the green transition of the Danish energy system.

New technologies, new market solutions and digitisation must make it possible to utilise renewable energy optimally

throughout the energy system. In addition, increased focus on research and innovation is key to ensuring Energinet's contribution to the development of the energy solutions of tomorrow. Solutions which are suitable for a significantly more complex and dynamic energy system, the final structure of which no one yet knows.

In the long term, the technological developments may make it possible to place a greater part of the infrastructure underground. However, this is uncertain and cannot solve the entire problem. Visible infrastructure will be part of the green transition, also in future.



#### **A citizens' meeting in 2016:**

*An employee of Energinet talking to concerned citizens about projected overhead lines between Kassø and Frøslev in Denmark.*

## OPPORTUNITIES

The experience with establishment of new overhead lines in recent years has shown that, although there is great support for the green transition, there is increasing opposition to the necessary infrastructure.

This is not surprising, as natural values and people's housing conditions are significant and legitimate concerns which Energinet attaches great importance to including. It is all the more important that we find the best ways of engaging in public participation and ensuring good trade-offs for all legitimate reasons. Without infrastructure, renewable energy cannot be fully utilised, and Denmark and the rest of the world will not achieve the objective of the climate-neutral society. This makes it important that we realise optimally the opportunities for a more wide understanding of the

necessity of the infrastructure in the green transition. This may be achieved by increasing public knowledge of Energinet and our role and by ensuring a closer dialogue with decision-makers and citizens.

As described above, the development of energy solutions which contribute to slowing down climate change and which are also in harmony with our society's and citizens' living conditions will also require significantly increased focus on research, innovation and development. Such significantly increased focus entails costs, risks and increased allocation of resources to these areas. With increased resource consumption follows increased responsibility for efficient use of these resources.





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# GREEN ENERGY FOR A BETTER WORLD

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

**Energinet contributes to** converting energy systems with the aim of ensuring that citizens and businesses use renewable energy for everything, with a high level of security of supply and at an affordable price. We must create value for society in a broad sense; for citizens, businesses, institutions and civil society.

