



16/17

Transporting electricity
and powering society

Connecting across borders

Enabling the transition
from traditional to
renewable power



WE ARE TENNET

When you turn on the lights, do you ever wonder how the electricity is delivered to your home? Or do you sometimes look at the power lines running next to the road, as you drive in the Netherlands and Germany, and ask yourself where they go, where they come from, or who owns them? The answer to both questions is us. TenneT.

When you turn on the lights



41

mln

Number of end users

This is the total population of the Netherlands and approximately 40% of the German population.

We operate the electricity grid for the Netherlands and large parts of Germany. That means we feed electricity into the grid from where it is made – from coal and nuclear power plants, as well as wind, solar and biomass – and carry it over 22,500 kilometres of high-voltage connections to 41 million end users.

We carry electricity across borders, connecting countries and providing the power on which we all depend. You may never have heard of TenneT. That's fine – we'd rather you noticed your electricity is always there for you to use, at the flick of a switch. But if you do want to know a little more about our work, read on.

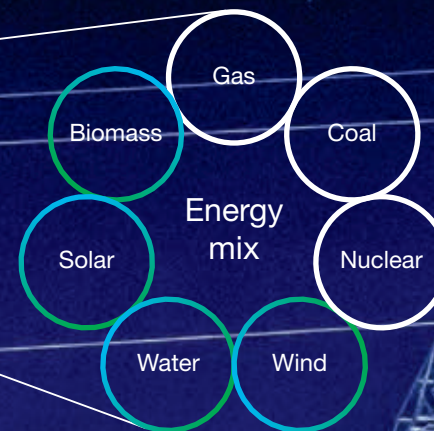
AT A GLANCE

22,573 km

High-voltage lines

Grid area: The Netherlands and a large part of Germany

Long enough to reach more than half way around the world.



99,99999%

Security of supply

834

mIn EUR

Underlying earnings before interest and tax

25

bIn EUR

Investments 2017 – 2027



Twice the cost of constructing the Channel Tunnel, in today's prices.

3,040

Number of employees

HOW IS ELECTRICITY DELIVERED TO OUR HOMES?

The electricity at your fingertips may have been produced hundred of miles out in the North Sea, or at a conventional power station. We carry it from wherever it is generated, across land and sea, and plug it into Dutch and German grids.

OUR WORK IN A NUTSHELL



Maintain, Transport, Connect:

We keep the power on

A key part of our job is to maintain a safe and secure balance between the supply and demand of electricity, making sure that power is at your fingertips, whenever you need it.



We bring power to you

We ensure that electricity is delivered from its various sources to you – the end user. We do this across thousands of kilometres of high-voltage grid and infrastructure, which we maintain and expand to keep the power flowing as efficiently and safely as possible.



We connect across borders

Electricity knows no borders, and we believe North West Europe is better served by an integrated electricity market. Therefore we connect our electricity grid with the countries around us. This way we can establish a single market that guarantees a reliable electricity supply at a fair price.



2022 GERMANY'S GREEN ENERGY VISION

Energiewende is Germany's ambitious changeover to low carbon, renewable energy. The phase-out of Germany's fleet of nuclear reactors, to be completed by 2022, is a key part of the programme.

YOU CAN RELY ON US 24/7

In a more complex energy market,
we will keep you plugged in.

TenneT is Europe's first cross-border grid operator and Germany's largest. We operate, maintain and expand the high-voltage grid in the Netherlands and large parts of Germany. **We are trusted with providing a secure and reliable supply of electricity, today and in the future, 24 hours a day, 365 days a year.**

Dutch Energieakkoord sets out that by 2023 the Netherlands must take 16% of its energy from renewable sources. Critical to this is expanding the share of offshore wind and explains why TenneT is building a high-voltage grid at sea, close to the Dutch coast.

2023
16% DUTCH ENERGY
FROM RENEWABLE
SOURCES

Without us, you could not use your computer, keep your food fresh in the fridge, charge your telephone, heat your house, watch TV, fuel your car, use the ATM, switch on the lights or pay for your groceries. Not to mention go to hospital, or have an operation.

We have worked hard to become one of the best in the world at our job. Our track record means this essential power is available 99.99% of the time. Which we are proud of, because delivering electricity is far more complex than it used to be. On one hand, the world has never been hungrier for power. On the other, we demand power from sustainable and clean sources – such as wind, solar and tidal. Often, this comes from remote areas, such as the wilds of the North Sea. Bringing it onshore and then carrying it vast distances across land is no easy task.

This switch from traditional to renewable power – called the 'energy transition' – is one of the biggest challenges ever faced by grid operators, especially in Germany and the Netherlands, where demand for sustainable power is among the highest in the world. And this isn't the only challenge of our work. In today's complicated energy market, more and

more people are also making their own electricity, with solar panels and wind turbines. We call this new generation of producer-consumers 'prosumers'. Connecting all of these power sources to our grid, bundling the electricity and transporting it reliably across land and sea also calls for new, stronger power lines. That means we need to invest more than ever in the maintenance and expansion of our grid, while devising ever-more ingenious ways to carry power with minimum disturbance to the environment and local communities.

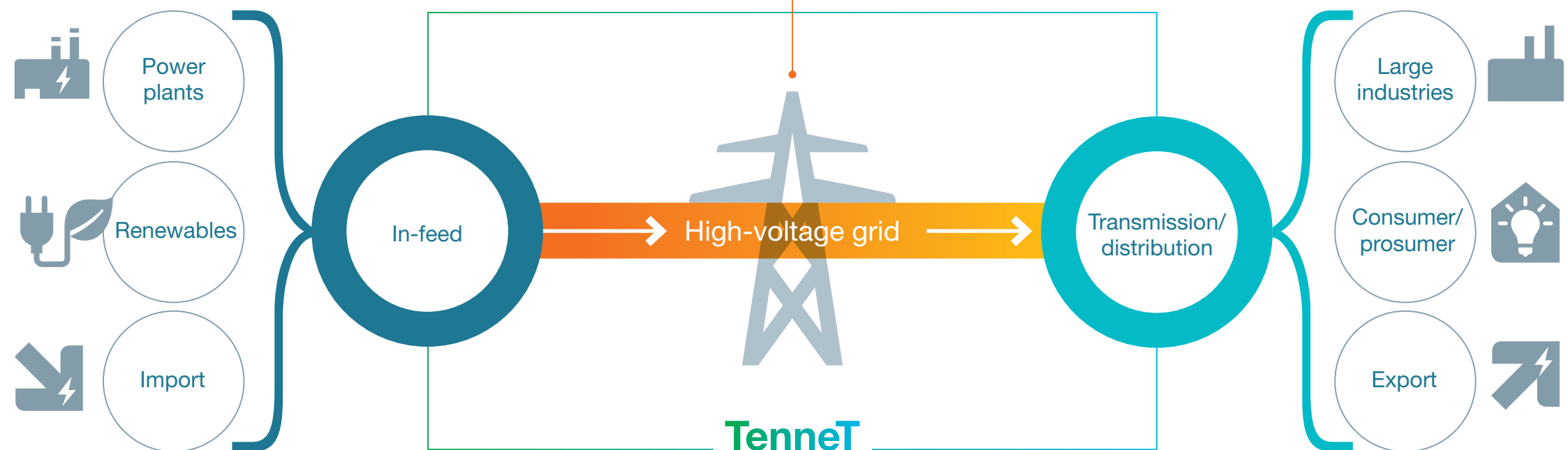
WHAT WOULD HAPPEN IF WE WOULDN'T DO OUR JOB?

Without us, there would be no transport of electricity. No electrical devices would work: your computer, stove, fridge, TV, heating, phone charger – all the things we rely on in modern life.

What we do: TRANSMITTING ELECTRICITY

We deliver electricity

The high-voltage grid is the backbone of the electricity supply system. It is used for the transport of large quantities of electricity over relatively long distances, mostly via high-voltage lines above the ground. Electricity generated at sea is transported via subsea cables and then connected to the high-voltage grid.



WHERE DO YOU BALANCE SUPPLY AND DEMAND?

As electricity is fed into the grid, we need to carefully balance the level of supply with demand. To do this, we have national control centres in the Netherlands and Germany, where supply and demand are monitored and balanced 24/7.

Sources of electricity

The electricity flowing through our grid is generated from both conventional and renewable fast-growing energy sources, including energy from wind, solar and biomass. The offshore wind power is transported to the shore through sub-sea cables, where it is fed into the transmission grid.

Our high-voltage grid

Because wind farms and power plants are often far away from where electricity is used, we need to carry it over large distances without major losses on the way. This is why we transport electricity at 110,000 volts and higher: up to 1,700 times higher than the electricity from your socket.

Managing the grid

The government entrusts us with building and managing the high-voltage electricity system. To do this, we work with many stakeholders: politicians, municipalities, communities, NGOs, regulators, regional operators and many more.

A photograph of three people (two men and one woman) sitting around a wooden table in a kitchen, looking at a large map or blueprint spread out on the table. The kitchen has teal cabinets and a white tiled backsplash. Two large, industrial-style pendant lights hang over the table. The man on the left is wearing a dark jacket over a light blue shirt. The man in the middle is wearing a light green long-sleeved shirt. The woman on the right is wearing a blue denim jacket over a light green top. The map on the table shows a landscape with roads, fields, and some buildings. There are also some smaller documents and a pen on the table.

Our responsibility in **SOCIETY**

We are the company that enables power to be delivered to your home, transporting it across land and sea. This is a big role in society, even if not everyone knows who we are.

Having this role also means we have a big responsibility to society, to behave honestly, openly and fairly to all whose lives we affect. On a daily basis, we do this by talking and – perhaps more importantly – listening to our stakeholders.

This is essential whenever we plan an infrastructure project. Meeting society's needs for power also means inescapable consequences for the natural environment – like installing new power lines, or running underground cables – so we take care to minimise the impact.

From the outset, we engage with everyone affected, listening to their questions and needs. We make information easily available, take concerns very seriously and work hard to minimise any negative consequences of our work.

Ultimately, we are committed to creating a sustainable future for society. But that means more than volts and powerlines and turbines. It is also about talking, listening and doing the right thing.

WHY WE BELIEVE IT'S GOOD TO TALK

Power is a basic need of society. We ensure everyone has the power they require, and also that people have a say in how we bring it to them.

Growth

Wind

Secure

Solar

Data

Link



Randstad high-voltage connection

We are constructing this high-voltage connection to serve the highly urbanised Randstad area in the Netherlands. This produces a large and growing amount of electricity (e.g. at the Velsen and Maasvlakte power plants and also by the horticultural industry) and it is also a major importer of electricity (via a subsea cable between the UK and the Netherlands). As well as serving the future needs of this important area, our Randstad 380kV connection will also help us connect offshore wind farms to the onshore grid, and accommodate growing amounts of solar-generated electricity.



Connecting wind farms in the North Sea

TenneT is working hard to ensure that the growing number of offshore wind farms in the North Sea are connected to the Dutch electricity grid. These include the Borssele wind farm, for which TenneT is building a 1,400 megawatt (MW) connection, consisting of two 700 MW connections. In combination with more new wind farms off the Dutch coast, we are looking at a total of 3,500 MW of new electricity needing to be connected into the grid by 2023. That's about as much as the yearly electricity usage of 3.5 million homes, almost half of all Dutch households.



Linking the Netherlands and Germany

This is our fourth high-voltage connection between the Netherlands and Germany, a 380 kV connection linking 57 km between Doetinchem and Wesel together with the German TSO, Amprion. Cross-border connections like this are an example of how we are actively facilitating an integrated electricity market in North West Europe, helping to ensure a stable, secure and consistent supply of power. As more electricity is generated from sustainable sources, like wind turbines and solar panels, supply can be inconsistent and hard to predict, so it is particularly important that we can quickly meet energy demands by different means.



Enabling 'solar communities' in Germany

As more and more households in Germany install solar panels (also known as photovoltaic PV) to generate their own energy, TenneT is teaming up with the solar battery maker, sonnen, to help integrate them in the grid. Around 6,000 German households with PV systems and sonnen storage batteries have signed up to TenneT and sonnen's pilot project. The idea is to use the solar power stored by the 'PV community' to help balance the variable amounts of electricity flowing into TenneT's grid. Traditionally, this balancing was only performed by traditional power plants, but this way, renewable energy stored in batteries can be used, minimising the waste of this valuable sustainable power.



Collecting weather data with VW

The grid works best when electricity production and consumption are always in balance. The trouble is, wind and solar energy are, by nature, unpredictable and so this balance is more difficult to maintain. To help us predict how much wind and solar energy we can expect, we are working on an innovative pilot project with Volkswagen, in which its vehicles collect weather data from all over Germany. Using rain, light, and sun sensors, the cars collect the weather data and send it to us in real time. We can use it to better predict the productivity of wind and solar power sources and thereby regulate the balance of electricity in the grid.



Building the arteries of Germany's electricity future

Germany's ambitious energy transition requires an infrastructure of high-voltage lines to carry renewable electricity from the north of the country – where it is produced – to the high energy-consuming south. In joint ventures with two other German TSOs, TenneT is working on two critical projects that will build these north-south electricity highways. At almost 700 km, the SuedLink will be the longest power link in Germany, running from Schleswig-Holstein to Bavaria and Baden-Württemberg. The SuedOstLink links Sachsen-Anhalt to Bavaria. Not only ambitious in distance and vision, these lines will also be an engineering feat, with all of the cabling being laid underground.

In the next ten years, we plan to invest over EUR 25 billion in onshore and offshore electricity infrastructure. This extra capacity will help the grid cope better with the influx of renewables and transmit electricity further to where it is needed.

Some of our important PROJECTS

In the Netherlands, we are expanding and upgrading our onshore grid to accommodate larger and more volatile electricity flows. We have multiple critical sites in the grid where work is underway, all of which will help us handle larger and more unpredictable energy flows. As well as this, we are also investing offshore, building a new AC grid in the Dutch sector of the North Sea that will be able to handle 3,450 MW of wind energy – enough to power over 86 million 40 W light bulbs. This is due to be operational by 2023.

In Germany, the onshore high-voltage grid is undergoing considerable expansion to meet the requirements of the Energiewende. As more and more renewable energy is generated, we are installing new or upgraded electricity connections. Over 20 large onshore projects are currently in the planning or implementation phase. We are also working on two first-of-a-kind underground onshore connections that will secure a more reliable energy supply to southern Germany.



We are all getting used to seeing wind turbines in the landscape – both on land and at sea. They are the physical evidence of our society's desire for clean, renewable energy. As more and more wind power flows into the system, we have an important job to ensure the grid is ready for it.



Building a GREENER FUTURE

NORTH SEA HOLDS THE KEY TO ENERGY FUTURE

The North Sea is the focal point for the transition to renewable energy in North West Europe. This is where a large amount of our green energy will be generated and distributed from, with TenneT playing a key role through our North Sea Wind Power Hub project.

As a leading European offshore and onshore electricity grid operator, TenneT has a deep understanding of the complexities involved, and years of experience. Very early on, we recognised that efforts to generate wind power must be carefully integrated to provide a secure supply of electricity. This is especially true when it comes to bringing offshore wind power to the mainland.

Doing this requires close European cooperation and knowledge of cross-border energy markets. Few can match our expertise and capacity for dealing with this challenge. We now have more connectors linking national borders than any other grid operator in Europe. And this is only the start; we have big plans to accommodate even more wind energy flowing in from the North Sea for North West Europe, with our proposed North Sea Wind Power Hub.

This will be a purpose-built offshore island, far into the North Sea, harvesting power generated from the vast number of offshore wind turbines in the area. It will be a focal point for collecting North Sea wind power and then sending it onshore via undersea power cables. When it's ready, the North Sea Wind Power Hub is expected to supply renewable energy to 80 million people in Europe by 2050, providing power for six European countries including the Netherlands and Germany.

As well as investing in innovation, we are also helping to cut the cost of renewable energy for the consumer. In our role as market facilitator, we help the evolving market for renewable energy work more smoothly and efficiently. To help this, we are working with national governments to introduce new legislation and ways of trading energy, helping consumers see the financial, as well as environmental, benefits of green energy.

FUTURE outlook

At TenneT, we are always looking far ahead. The needs of society change quickly, as do energy preferences. To keep the electricity flowing, we have to move fast and always be aware of new challenges, as well as opportunities.

Our role is to harness this power effectively. It's too big a job for us to do alone, or even by individual countries. It needs international co-operation between governments and specialists like TenneT. We all need to work together to make our sustainable energy demands a reality.

A European political declaration of 6 June 2016, on energy cooperation between the North Sea countries, was an important step in this direction.

It marks a starting point for a joint European approach up to 2050, with the North Sea as the focal point for the energy transition. This is where a large amount of our green energy will be generated and distributed from.

Our long-term vision for the North Sea Wind Power Hub will play an important role in this – an island far off shore has the right wind conditions, and, because it lies in relatively shallow water, will be easier to build and connect. And, as more renewable energy flows

into the grid, we are making use of innovative digital technology to ensure we can handle it most efficiently. This is why data and analytics is a core strategic priority for us. Thanks to our efforts, the electricity grid is becoming more digitalised, as we make changes that allow for a more intelligent flow of electricity in the system. At a consumer level, we are involved in some ground-breaking pilots, such as collaboration with VW to collect weather data, which helps us predict the amount of renewable energy entering the grid.

As a grid operator, we feel like we have a very clear role and a big responsibility. We are driven by a burning desire to keep the lights on, ensuring that all of the Netherlands and around 40% of Germany have a reliable, secure and high-quality electricity supply.

This is our mission.

Our MISSION Vision Values



As security is our biggest concern, we feel it's safer and more reliable for our grid to be linked into the wider North West European network. This doesn't only make the supply of power more reliable and stable, but also more cost-effective for you, the consumer. Encouraging this integration of the European market, and facilitating its evolution, is a core part of our **vision**. This is particularly important as more and more renewable energy flows into the grid. It makes the market more complicated to manage and design, requiring more innovation and cross-border collaboration.

As our work is so essential to the smooth-running of society, we hold ourselves to the highest **values** of quality and integrity.

Quality requires the highest standards of safety in everything we do.

Integrity means being open, honest and respectful in the way we serve society, particularly local communities, partners and employees.

Our brand values

The TenneT brand is built on our commitment to be **responsible**, **engaged** and **connected**. This is our promise to the outside world, describing how we serve our stakeholders and how we want them to see us.

TenneT Holding B.V. and TenneT TSO B.V.

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16/17

**Meeting the energy
needs of the future**

Building a greener grid

**Our vision for a
North Sea Wind Power Hub**