



Our performance in 2022

We describe our performance in 2022 in the following six chapters, each describing one of the six outputs/outcomes as mentioned in our value creation model.

Deliver a high security of supply

As the transmission system operator (TSO) for the Netherlands, and a significant part of Germany, TenneT owns and operates over 25,000 kilometres of high-voltage lines and cables. Our clear and critical task is to deliver electricity to nearly 43 million domestic and business users, safely and reliably, 24 hours a day and 365 days a year. This is what we call security of supply.

To do this, we design, build, maintain and operate a high-voltage grid stretching across land and sea. This carries electricity from where it is produced – including an increasing proportion of offshore wind energy – to where it is consumed. We carry it over ground via overhead lines, underground, under the sea and across borders, over our high-voltage grid. With a service level as high as 99.99963%, the availability of our onshore grid is among the highest in the world.

Ensuring that people and businesses in the areas we serve have a secure supply of electricity, meets an important need in society. And as the transition to renewable energy sources and the goal of a sustainable energy future depend on the development of a new energy system, we directly contribute to the realisation of Europe's ambition to be the world's first climate-neutral continent by 2050.

As TenneT, we face an ongoing balancing act in our work: securing the supply of electricity today and tomorrow, driving the energy transition and doing so at an acceptable cost for society. This balance requires co-operation on many levels to tackle all the challenges we face.

As Europe accelerates its clean energy targets, our responsibilities are growing, and the time we have to meet them is shrinking. By 2030 the current ambitions are to

have an energy system capable of supporting a 55% drop in EU carbon emissions, with net zero to be achieved in our German market by 2045.

To achieve this, our energy system is undergoing a development in which the grids - the backbone of the energy system - are being used in a completely different way. Our energy network was once built to meet the demand for energy on a mainly national scale. Now it is changing into a multifunctional hub of electricity supply, demand, storage and an international connector for European cross-border energy trade. To build a system capable of meeting these challenges and supporting Europe's climate targets, we are focused on a grid development strategy to deliver a Target Grid in 2045 (see '[About TenneT – Our Strategy](#)').

The challenges of achieving this goal became even more complex in 2022, with the outbreak of the war in Ukraine. The humanitarian, geopolitical and energy crisis caused by the war has a substantial impact on TenneT's activities, with rapid increases in energy and raw material prices, gas shortages and disrupted supply chains all creating difficult conditions across our sector (see '[Secure supply today](#)' on the next page). A particular impact of the market volatility is seen in our procurement of balancing and ancillary services, including balancing reserves and redispatch, which we use

to balance demand and supply and to ensure the security and quality of electricity supply. Fast-rising gas and electricity prices led to a rapid increase in the costs of these ancillary services during 2022, reaching their highest-ever level. (see '[Safeguard sustainable financial performance and investor ratings](#)').

However, these developments have strengthened the urgency among European governments to reduce energy dependency, with a shared desire to boost energy security and independence. A renewables-based energy system in Europe is the key to achieving this, but, at the same time, all players in the system – TSOs, national governments, regulators and end-users – need to co-operate to reach this goal.

Our performance in 2022

	Performance	Target	Status	Trend
Onshore grid availability	99.99963% 2021: 99.99999% 2020: 99.99995%	99.99962%		Our grid availability onshore had a slight decrease this year, due to interruptions in the 110/150 and 220/380 kV grid in the Netherlands. Despite these interruptions, we did meet our target.
Offshore grid availability	94.08% 2021: 94.09% 2020: 94.03%	95.07%		The offshore grid availability was comparable to last year. Due several interruptions, such as with the NorNed cable, we unfortunately weren't able to meet the target.

Secure supply today

TenneT's most important task as a TSO is to secure the supply of electricity, now and in the future. This requires managing factors such as the changing mix of energy sources – including renewables alongside traditional sources – the integration of new technology and a growing demand for electricity from end-users. Our people, such as in our control centres and in the field, work hard to ensure that we are able to secure this supply of electricity, 24 hours a day.

Their efforts helped us to achieve, once again, a high-level availability of 99.99963% for our onshore grid and for our offshore grid 94.08% of the time. We report our onshore and offshore grid availability separately, as they are technically different. Our offshore connections have less built-in redundancy than our onshore grid. Unfortunately, there were also instances where we faced outages and we needed to respond. The duration of these interruptions however did not have a significant impact on our overall grid availability. An example of this is an incident that occurred between Lelystad and Dronten in the Netherlands. On 2 September a short circuit lasting approximately 4 minutes, caused an outage in Flevoland. This short circuit severely overloaded the assets, resulting in damage to the overhead lines, some of the assets in Lelystad and Dronten-Olsterpad

and the railway infrastructure of ProRail. TenneT is drawing lessons from the events. For instance, efforts are being made to raise even more awareness around switching on installations that may or may not be live. Extra attention is also needed for such switching operations and procedures for this are being tightened.

For our offshore grid, this was also the case with our interconnectors NorNed and COBRA. Our NorNed interconnector was out of service for a few months, initially caused by a cable failure on the Dutch side of the connection. During the cable repair and the root cause analysis severe quality deficiencies at the cable have been revealed, what was leading to further assessments of the cable prior to a possible reenergisation. As a result of the investigation, the 1.5 km onshore cable part has to be replaced because of reaching the end of lifetime. All measures have been taken to substitute this cable part as soon as possible, expected in Q2 2024. Additionally, we have taken several measures in order to reenergise NorNed whilst making sure to stress the onshore cable part as little as possible. Our interconnector COBRA failed in November 2022. The failure was located on the Danish Island Fano. The failure was repaired in 28 days, as a result of good teamwork between EnergiNet, Prysmian and TenneT.

In 2022, several external factors intensified the challenge of maintaining security of supply. In particular, the war in Ukraine caused upheaval in the energy markets. A prime example of co-operation was seen during 2022 when ENTSO-E synchronised the power systems of Ukraine and Moldova with the continental European network. This emergency work, soon after the commencement of the war in Ukraine, was completed in a matter of just over two weeks in March 2022. Previously Ukraine was connected to the Russian power system, therefore it was essential to bring it into the European system as soon as possible. TenneT is proud to have been involved in this synchronisation.

The shortage of gas resulting from the war in Ukraine forced several countries to turn to alternative power supplies to secure their load. For example, the Dutch government decided to temporarily re-direct some generation demand to coal-fired plants, so that it could focus on stocking up gas supplies for the winter. The same applied for Germany, where the German government initiated a programme to bring conventional power plants from their current reserve status back to the energy market. Also the last three remaining nuclear power plants in Germany that had been planned to be phased out in Q4 2022, were ordered to remain operational until mid April 2023.

European TSOs also faced other energy market challenges in 2022 that affected security of supply. A sharp reduction in the availability of nuclear generation capacity in France – due to widespread repairs - and the low water levels in hydro power plants at many of the European countries – subsequently lowered the capability for energy exports. In addition to this, the dry summer of 2022 led to lower water levels in many rivers – including the Rhine in Germany – which hampered the transportation of coal. These and other pressures on the energy market in 2022 are causing TenneT and other TSOs to evaluate and coordinate at a European level the security of their supply. Every year TenneT performs such an analysis to determine potential effects and measures, both in the Netherlands and in Germany. Based on this analysis, there were no additional measures deemed necessary in the Netherlands. In Germany, the German ministry of Economic Affairs and Climate Action requested the German TSOs to conduct an in-depth additional analysis to assess the electricity supply situation from a generation and transmission adequacy perspective and to determine system needs for winter 2022/2023. Several scenarios and solutions were presented to the German government. The recommendations required timely government action to secure supply of electricity in the winter of 2022/2023, which has resulted in several actions, such as better utilisation of the grid by dynamic line rating, usage of high-temperature conductors and load flow steering assets, as well as the aforementioned actions regarding nuclear and coal-fired plants in Germany.

Congestion situation in the Netherlands

Rapid developments in the energy market due to high gas prices, the war in Ukraine and the ensuing energy uncertainty have led to a number of new congestion areas on the electricity grid in the Netherlands in 2022. In June, a temporary stop on new grid connections for businesses was announced in the provinces of Noord-Brabant and Limburg. The number of connection requests from new solar parks, companies wanting to electrify and the growing number of heat pumps and charging stations grew faster than the grid can be expanded.

Immediately after the announcement, the Minister of Climate and Energy set up a task force with all stakeholders such as governments, interest groups and grid operators to find solutions to grid scarcity and also develop a national action programme.

This national action programme was published in December. It includes measures to speed up grid expansions, flexible contract forms, better programming and also to make ‘smarter’ use of the existing grid by focusing on flexibility.

In Noord-Brabant and Limburg, TenneT created extra capacity by focusing on congestion management measures, similar to traffic congestion avoidance. This involves paying users a fee to relieve the grid at busy times. The possibility of applying this to other areas in 2023 is also being investigated. Network congestion will remain a part of the transition in the coming years. Through co-operation between government, grid operators and industry, we can take the right steps towards a climate-neutral energy supply.

Beyond creating uncertainty in the energy landscape, the war in Ukraine has also further accelerated demand for electricity. To avoid escalating gas bills, many households are switching to electricity for heating and business users are moving over to electrification for industrial processes earlier than planned. This includes energy-intensive industries, such as steel, aluminium, copper and chemistry. Following this surge in electrification, we saw an increasing number of requests from customers to connect to our grid in 2022 (see our section on ‘Congestion situation in the Netherlands’).

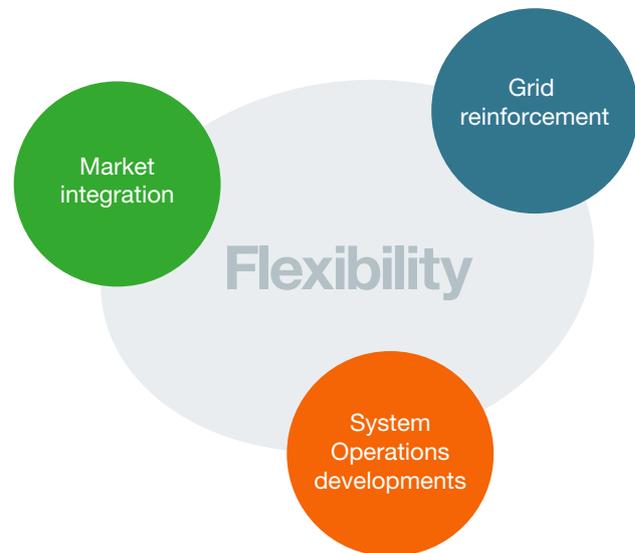
Despite these challenges, the current geopolitical situation and energy market volatility in Europe represent a unique opportunity to accelerate the energy transition and build societal and political understanding and support for TenneT’s work. With European governments being more proactive and ambitious in reducing their dependence on gas imports, and increasing the pace of electrification, there is renewed unity and urgency behind energy security and the energy transition.

In 2022, we faced additional challenges in our grid due to growing congestion. An example of when this could occur is when for instance in Germany a high feed-in of renewable energy sources in the North – such as on very windy days – needs to be transmitted to the load centres in the South, and cannot be fully accommodated due to the limited available transmission capacity of the high-voltage grid without causing overloads. This endangers our security of supply as electricity cannot be transmitted across overloaded powerlines. Therefore redispatch actions are applied to bring the system back to secure and adequate limits.

Securing supply tomorrow

For TenneT, planning and building a future-proof energy system that provides security of supply tomorrow is made more challenging because of the fast-changing nature of the energy system. The volatile and intermittent nature of wind and solar power, and the long distances between where power is generated and where it is consumed create entirely new technological, engineering and market challenges for TSOs. Innovation will be critical to meet these challenges, not only related to more effective and efficient use of our assets, but also to boost our system operations and improve market design. To achieve this, there are three focus areas that will be essential for securing supply in the future: grid reinforcement, market integration and system operations developments.

Our three focus areas



Grid reinforcement

Grid reinforcement is not only essential to reduce the pressure on our grid today, but also to prepare it for the increasing demands and dynamics of the future energy system. This is also a way to prevent congestion, next to the congestion management measures we have taken to relieve pressure on the grid at the busiest times. In several areas of our grid we are increasing capacity.

The fast-growth of generation capacity in the North Sea requires an increase in transmission capacity in the offshore and part of the onshore grids. On top of this, the rapid shift to electrification in society is further increasing the need for reinforcement and additional capacity. The electricity grid was built over a century ago, with parts of our onshore grid also realised in the 1960s and 1970s. With the distance between the generation and consumption of electricity becoming greater in the past decades, our grid needs to be updated to cope with this demand and urgently requires modernisation and reinforcement. Substantial work is underway in the Netherlands and Germany to deliver these reinforcements and ensure our grid has the capacity and flexibility to cope with changing energy needs. The construction of the new HVDC corridors in Germany – SuedLink and SuedOstLink – as well as the upgrading of five 380 kV overhead lines in the Netherlands, are just some examples of our extensive reinforcement work. For more details on our grid reinforcement projects see ‘[Ensure a critical infrastructure](#)’ chapter.

Market integration

Market integration is at the centre of the European Union's ambition to create a single European electricity market.

Working closely with other TSOs, TenneT is taking a prominent role in this development.

An interconnected European electricity market has physical and commercial aspects. TenneT is actively involved in both, for example by building cross-border interconnectors that allow neighbouring countries to seamlessly exchange energy, and also by facilitating the commercial electricity market between European countries.

As for the physical connection of European grids across borders, TenneT has now built 17 interconnectors, connecting our grid with the grids from other TSOs. For full details of our cross-border connections see the grid map on our website. A major landmark in market facilitation was reached in 2022. Together with 14 other TSOs, we introduced a new mechanism to further integrate the European electricity market, making it more efficient and robust. The new Day-Ahead Flow-Based Market Coupling Mechanism enables the European power grid to transmit more electricity across borders at a lower overall cost.

With the introduction of flow-based capacity calculation, the network capacity is typically calculated taking the whole regional grid into account, as well as the economic value of the energy exchanges. Now, electricity delivery across borders within the CORE region (Austria, Belgium, Croatia, the Czech Republic, France, Germany, Hungary, Luxemburg, the Netherlands, Poland, Romania, Slovakia and Slovenia) is optimised by allocating capacity to the flows with the highest economical value. This means in general a larger value of electricity can be exchanged between zones.

Furthermore, TenneT also collaborates with other TSOs and market parties to boost security of supply through market integration initiatives. For example, TenneT is one of many European TSOs involved in the Platform for the International Coordination of Automated Frequency Restoration and Stable System Operation (PICASSO) and the Manually Activated Reserves Initiative (MARI) – two projects that facilitate the European-wide exchange of balancing energy. The PICASSO platform went live in June 2022, with MARI following in September 2022. All four German TSOs connected to the platform in October 2022.

System Operations developments

As well as building new assets and facilitating the electricity markets, we must also invest in new concepts for operating the grid, operating a more dynamic system and making a more efficient and optimised use of our system through new digital solutions. As our grid becomes more dependent on renewable energy sources, our Energy System Planning (ESP) team is exploring multiple solutions to ease congestion, improve reliability and manage power flows across the grid. By improving the predictability and stability of the grid, we can reduce the need to use conventional power sources to keep the grid in balance, which will therefore help to reduce increasingly high redispatch costs. Two techniques we are using for these purposes include phase-shifting transformers and mechanically switched capacitor with damping network (MSCDN) technology. Phase-shifting transformers allow us to influence power flows in the grid, by reducing or increasing the transferred power. This control improves our ability to balance the volatility of renewable energy sources, such as wind and solar. TenneT installed the first four units of this technology in the southern substation of Wuergau and will install four more in Krempermarsch, in the northern part of Germany. In coming years, the German TSOs, including TenneT, are expected to reinforce the grid with 36 phase-shifting transformers. MSCDN is a grid stabilisation technology that allows us to absorb voltage fluctuations in a substation and thereby stabilise the operation of the transmission grid.

Another important development to make our systems resilient for years to come is our Control Room of the Future (CROF) programme, which relates to, among others, the update of our current operational system. The CROF has the ambition to develop methodologies, processes and tools in order to guarantee excellence at system operations, including among others improved forecasts, dynamic security assessment, inertia monitoring, and topology optimisation. More information on this can be found in the '[Solve societal challenges with stakeholders and through partnerships](#)' chapter.

Flexibility in demand and supply of electricity

Flexibility will be crucial to cope with the unpredictability and volatility of renewable energy sources, while reducing the need for grid expansion. Flexibility is how TSOs refer to using on-demand energy sources to keep the grid secure and in balance. Traditionally, TSOs used fossil-fueled power plants to guarantee an adequate system and to maintain a balance between electricity supply and demand. However, with more renewable energy sources being fed into the grid, supply and demand becomes more volatile impacting

system balance and power flows within the grid. In addition, clean energy targets increasingly restrict TSOs' opportunity to use conventional power as a source of flexibility

As a solution, TenneT, along with other TSOs, is looking for new sources of flexibility. Storing electricity in energy carriers, like battery energy systems and hydrogen, is an important area of focus, as they provide low-carbon on-demand flexibility. The challenge is to achieve this at the scale needed for a fully decarbonised energy system and how to integrate widely distributed sources of stored electricity into the grid. The location of flexible energy sources will also become increasingly critical – for example placing large electrolysers near the coast where offshore wind is landed to shore. Innovation and partnerships are critical in TenneT's flexibility strategy. (For more detail on innovations in Flexibility see the '[Solve societal challenges with stakeholders and through partnerships](#)' chapter).

TenneT has been driving various initiatives in co-operation with other grid operators and market partners to make distributed flexibility available for the grid through the optimisation of data exchange processes between market parties and promotion of the use of distributed flexibility options.

For example, TenneT has started several pilot projects to include smaller flexibility options into congestion management processes. In Germany, from 2022 onwards, plants and storage devices above 100 kW will be available for redispatch (today the limit is above 10 MW). In the Netherlands TenneT is strongly engaged in the GOPACS (grid operator platform for congestion solutions) initiative together with the Dutch DSO's.

By 2035, Germany expects to have technology-specific flexibilities of almost 80 GW from distributed flexibility options, such as electric vehicles, heat pumps and home storage. TenneT is also one of the TSOs behind Equigy, a pan-European project to efficiently integrate distributed flexibilities into the grid. More examples, such as the GAIA-X project we participate in, can be found in the '[Solve societal challenges with stakeholders and through partnerships](#)' chapter.

System resilience

As the transmission grid is the backbone of economic and social activity, it is regarded as critical infrastructure and as such requires maximum protection from both physical threats (such as extreme weather events) and digital threats, such as terrorist or cyber-threats. For TenneT, this protection is not only essential for national security, but also to maintain the 99.99963% grid availability that end-users expect from us.

Societal value of the availability of our grid

Transmitting electricity to large industries and via DSOs to millions of households powers and empowers society. This is our main task and also our main societal impact as a company. Designing, building, maintaining and operating a grid that is available all the time is the most important impact TenneT can have for society, to ensure that the people living in the areas we serve are able to live their lives and organisations can do their work. Achieving this impact requires each part of the energy supply chain to work together, therefore this achievement is not just the result of our own actions, but this societal impact we make together with others in the supply chain, such as electricity generation companies, other TSOs and distribution system operators.

However, an electricity grid that is available to supply electricity to its customers for 99.99963% of the time creates value. Our assessment, based on academic research, shows that the estimated societal value created by the availability of our Dutch grid surpasses the gross domestic product (GDP) of the Netherlands, which was over EUR 850 billion in 2021. This is because the supply of electricity does not only create economic value, but also direct and indirect benefits, such as being able to enjoy leisure time. For more information on this assessment and our methodology, please refer to the Additional CSR data document on our website. We will continue to further develop societal impact indicators during the next years and invite others to help us with this.

Cyber threats are encountered almost daily by European grid operators, demonstrating the need for constant vigilance. Growing geo-political tensions in the world, most notably with Russia, further intensify the need for protection of our critical infrastructure and IT networks.

As our grid operation becomes increasingly digitalised and data-dependent, we are aware that the risks of cyber threats grow with more points in our system to target. With every new large project we conduct to expand and modernise the grid in the Netherlands and Germany, we pay close attention to mitigating security risks, overseen by our growing team of experts. Thanks to our prevention measures, TenneT has successfully deflected numerous cyber-threats in recent years.

As the guardians of critical infrastructure, we co-operate fully with the authorities on cyber protection and fulfil all legal requirements. In Germany, TenneT is certified according to the BNetzA security catalogue, based on the ISO 27001 security standard. We also voluntarily apply this standard in the Netherlands to harmonise cyber security at the highest possible standard. The efficiency and effectiveness of our cyber-protection procedures are demonstrated annually to an external certification body. We frequently perform penetration tests, with support of external consultants, to check the resilience of our IT infrastructure.

In addition to cyber-threats, we also need to protect our assets against physical threats, such as the theft of valuable raw materials, such as copper, which is targeted due to its high market price, or threats related to climate related events. And, as we are building high-value assets near the busy shipping area of the Dutch and German North Sea, we need to protect against accidental collisions and damage.

TenneT closely monitors the physical security related to our infrastructure, both on- and offshore. To determine and assess the actual threat levels, we are closely working together with relevant stakeholders, such as governmental institutions and other companies in critical infrastructure. Next to measures that e.g. governments can take in the areas we serve, TenneT takes a spectrum of measures based on our assessments to reduce the risks and vulnerabilities.

This can be caused for instance by extreme weather events, which we see more frequently due to the effects of climate change. A good example of how we cope with these growing threats to our physical infrastructure, is the event related to Hollandse Kust (beta), where a vessel collided with the jacket of this offshore grid connection system.

In January 2022, a cargo ship lost anchorage during a storm and drifted into a collision with the jacket foundation of this offshore substation. In designing our assets, we strive to take the effects of extreme weather events related to the area these are built into account. The necessity of this is underpinned by the recent extreme weather events.

What could prevent us from realising our goals?

As our electricity supply relies more and more on weather-dependent sources, we face more challenges on how we operate our grid in its current form and also how to plan for its expansion. As one of our challenges for the coming years, TenneT has to address the risk of congestion when it is not possible to connect new customers to the in-feed of renewable energy. When there is congestion, we need to provide alternative sources of power, which raises the financial question of rising redispatch costs that, in the end, society has to pay for.

For TenneT connecting and co-operating with partners (either political or the market) who have the knowledge and expertise or the technology needed to secure supply today and tomorrow becomes more and more important. For instance by exchanging experiences with European TSOs via ENTSO-E, to retain political support for long term planning of our assets, but also to attract the right partners who can support us in our climate ambition or new markets such as hydrogen or battery storage.

New technologies help us mitigate risks related to security of supply, particularly controllability capabilities and digitalisation has a potential to make optimal use of our grid. For example, data analytics can help us gain insights on how we can use weather predictions, assess real-time electricity demand, survey our assets and also help us keep the grid secure and in balance by connecting to an increasing number of producers and consumers. However, although technology will play a crucial role in realising the energy transition, there are currently no decisive breakthroughs that will simultaneously guarantee security of supply, affordability for society and competitiveness of industry prices.

The last couple of years showed us that climate change can pose significant challenges to security of supply. The droughts that led to hydropower shortages, and the growing frequency and risk of floods, storms and fires, threaten the stability of the electricity market. And as our system is increasingly getting more dependent on renewables, extreme weather can challenge security of supply in other ways. Making better use of available weather predictions could help us anticipate when extreme conditions could occur.



Deliver a high security of supply

Hans Schermeyer

Product Owner Energy Services at Viessmann

As heat pumps and distributed energy become a bigger part of our energy system, they will bring additional demands on the grid. But smart control of these appliances can help to solve these demands, as well as providing new ways to help balance the grid.

“Everyday at work I try hard to put our users’ needs at the very core of our activity through solving purposeful challenges for society. Like having heat pumps run when the sun is shining. And have them not run when the grid needs a lower demand. Providing grid services on residential level with the Viessmann heat pumps of our users was definitely one of the highlights of 2022. Kudos to our TenneT colleagues which helped to make the ViFlex project happen by releasing the “Flexmodus” to our users!”



Ensure critical infrastructure for society

TenneT is one of Europe's largest investors in national and cross-border transport capacity on land and at sea. As such, our infrastructure will be key to Europe's ambition to be a climate-neutral continent by 2050 as we deliver a grid predominantly supplied by renewable energy sources, in line with the Paris Agreement and national climate targets. As well as planning for the future, we need our current and often ageing asset base to be maintained and in good working order, keeping the lights on and meeting fast-rising demands for electricity.

In 2022, our grid and the wider energy market experienced the consequences of the war in Ukraine, with higher energy prices, inflation, resource scarcity and supply chain disruption. Maintaining the pace of our investments in new critical infrastructure, while also maintaining our existing assets, was particularly demanding in this unpredictable context. At the same time, these geopolitical developments mean an acceleration of green energy targets and a raising of political ambition to achieve energy independence through renewables. As a result, 2022 saw governments become more proactive in orchestrating the energy transition and national industrial policy.

For example, in May 2022, the Esbjerg Declaration highlighted the role of North Sea offshore wind in strengthening the EU's energy security. The leaders of the European Commission, Denmark, Belgium, the Netherlands and Germany pledged to expand the combined North Sea offshore-wind capacity of the four countries to 65 GW by 2030 and 150 GW by 2050. Almost two-thirds of this - 40 GW - is accounted for by TenneT, with approximately 20 GW each in the German and Dutch North Sea. TenneT will deliver new connections to implement these ambitions within the next 10 years.

To accelerate offshore development, the Dutch government updated the Offshore Development Framework in June 2022, while the German government published a new draft site development plan in July. Both plans significantly increase offshore wind ambitions and require more projects to be delivered around the 2030 timeframe. As a result, TenneT has been asked to deliver fourteen 2 GW HVDC offshore grid-connection systems between 2028 and 2031 in both countries.

To accommodate these offshore developments, we also need to expand and strengthen our onshore infrastructure. In 2022, we added approximately 500 km of additional connections, both overhead and underground. In addition, we were proud of the reinforcement and maintenance work we performed to boost transmission capacity and our innovation efforts so we can drive higher utilisation of our existing assets.

Ultimately, the combination of energy market uncertainty, the urgency of energy security and the accelerated shift from fossil fuels to renewable electricity make our investments in critical infrastructure more crucial than ever.

Our performance in 2022



The war in Ukraine and resulting energy crisis made tendering for key strategic projects significantly more challenging, not only because of rising costs but also due to supply chain disruption and the need to find alternative

sources of critical materials, such as steel procured from Russia and Belarus. Many of our suppliers also faced their own supply chain difficulties, creating knock-on effects through the system.

Despite these challenges, our focus in 2022 and in coming years is all about increasing our outputs. In 2022, we invested EUR 4.5 billion in the grid, a 13% increase compared to EUR 4.0 billion in 2021. With energy security in the spotlight, we focused on both short-term and long-term solutions to deliver on our critical task: ensuring the continuous availability of electricity for nearly 43 million end-users across the Netherlands and Germany.

Onshore

The share of electricity in the energy mix is expected to grow from 20% today to 40-60% in 2050. To make sure we can facilitate this demand, and connect the growing infeed of renewables, we need to expand, strengthen and modernise our onshore grid. To alleviate the current pressure on our existing grid, we plan to invest substantially in the Dutch and German onshore grid in the next decade.

Long-distance DC ‘green corridors’

A key factor in alleviating pressure on the onshore grid is the development of long-distance high-voltage green-energy ‘superhighways’ – running from the North Sea coast where wind energy is carried onshore to the areas where the energy is most needed, such as in the south and west of Germany. TenneT is co-operating with TransnetBW and 50Hertz respectively for the development of two major north-south corridors in Germany – SuedLink and SuedOstLink. When operational, these high-capacity DC connections will be among the most important in Germany for achieving climate neutrality and energy security. SuedLink is a 700 km connection linking Brunsbüttel (in Schleswig-Holstein) to Bergheimfeld -West (in Bayern), while SuedOstLink is a more than 500 km connection linking Wolmirstedt (in Saxony-Anhalt) to Landshut (in Bavaria). Both corridors have a capacity of 4 GW and will run completely underground. They are expected to be operational in 2028. In addition, there is a plan to bridge the two connections with a third DC corridor, the NordOstLink. This would connect the North Sea coast at Schleswig-Holstein to the Schwerin area in Mecklenburg-Western Pomerania, further contributing to the reliable transmission of offshore wind energy to the onshore grid.

Both SuedLink and SuedOstLink have started the final approval procedure and are preparing for the construction phase. For SuedLink, this requires the construction of a four-metre-diameter and around five-kilometre-long tunnel under the Elbe River, with substantial engineering works. In 2022, the contracts for the last two converter stations in Wilster and Bergheimfeld/West were awarded.

For SuedOstLink, production, delivery and assembly of the second underground cabling system is due to take place in 2024/2025. As with SuedLink, much of the cabling has already been ordered and is in stock ready for installation. In 2021, two converter stations were already awarded. In both projects, strong long-term partnerships with fellow TSOs TransnetBW and 50Hertz, as well as with key contractors and suppliers are key in boosting progress and momentum.

‘Beter Benutten’

Making more use of our existing assets is a key part of our onshore grid reinforcement work, helping our grid meet higher transmission demands next to building new lines. This work helps strike the balance between affordability, security of supply and sustainability. An example of this work in action is our new Better Use of Existing 380 kV programme (‘Beter Benutten’) in the Netherlands.

The programme consists of several individual 380 kV overhead line reinforcement projects. The first project (between Lelystad and Ens) was commissioned in 2020, the second one in 2022 (between Diemen and Lelystad). The next projects are planned to be commissioned over the next few years and consist of the sections between Krimpen and Geertruidenberg (execution 2022-2023), between Ens and Zwolle (execution 2023), Rilland and Zandvliet (execution 2023) and Eindhoven and Maasbracht (execution 2024-2026).

More highlights in 2022 showcasing how we extended or strengthened our onshore grid

- In **Emden-Conneforde**, TenneT delivered a new 61 km-long high-capacity 380 kV power line. This new connection can transmit three-and-a-half times as much electricity as the previous one. It will primarily transmit and distribute wind power from the North Sea.
- The **Westküstenleitung** (West Coast line) in Schleswig-Holstein between Brunsbüttel and the border with Denmark has a total length of around 140 km. Five substations are also being delivered as part of this project. In November 2022, the fourth section of the 380 kV line was commissioned. With the final and fifth section, the entire project is planned to be completed towards the end of 2023.
- With an increasing amount of renewable energy being fed into the grid in Schleswig-Holstein, it is necessary to expand the existing grid structure. The planned **Wahle-Mecklar** line will connect the transformer substation in Wahle near Braunschweig in Lower Saxony with Mecklar, near the Ludwigsau transformer substation in Hesse. The 230 km connection includes a 380 kV overhead line with three underground cabling sections as well as five substations. In 2022, sections A and B with a length of

Future solutions for DC overlay grid

Steering fast-growing volumes of wind power more efficiently to where it is consumed is being explored through the future development of a high-voltage meshed DC overlay grid, connecting offshore and onshore and across borders.

The advantage of DC is that large capacities of electricity can be transmitted – 2 GW per cable system – over longer distances with lower grid losses. Currently, DC connections are only point-to-point, so if there is a failure the whole line is down. With a meshed network of DC connections, with circuit-breakers, we can steer the DC load even in the event of a failure. Additionally, it avoids the need for converting electricity to AC and back to DC at critical nodes in the grid and helps to increase grid utilisation of our assets.

This is a large-scale, long-term project. Achieving it involves ground-breaking innovations, such as the development of DC circuit-breakers that do not currently exist at scale, and standardised interconnected DC convertors.

Part of this plan will be the construction of innovative multi-terminal DC hubs. In 2022, TenneT signed an agreement with fellow German TSO 50Hertz to realise a pilot multi-terminal DC hub in the area of Heide (Schleswig-Holstein) and has also co-operated with Amprion on the Rastede hub. We are confident that DC hub solutions are more efficient than point-to-point DC connections, because they require fewer converters. This saves on cost and reduces the environmental impact. However, to realise this ambition we need a multi-vendor market for DC connectors, not only for cost efficiency, but also so the converters can be interconnected and communicated in a meshed grid.

TenneT is using learnings from our onshore hub projects to move forward with offshore DC hub development. For example, TenneT has co-developed a concept of combined offshore-energy systems. The idea is to connect wind farms to different countries and at the same time set up a direct electrical interconnection between these countries at lower cost. With its partners, TenneT is working towards a first internationally connected offshore wind-power hub in the North Sea.

105 km were successfully commissioned, one substation was finished and construction activities in the last two sections C and D continued. The aim is to complete this project during 2024.

- The **Ostbayernring** aims to increase transmission capacity of the current connections and prepare the grid for a growing infeed of renewables. It includes the construction of a 185 km transmission corridor connecting Redwitz to Schwandorf in the south-east of Germany. Construction works have started in 2022.
- On the 52 km **Diemen-Lelystad-Ens** connection, we have replaced and reinforced existing lines and pylons to increase the transmission capacity. The project is a pilot to explore reduced lead times. While the first section was already commissioned in 2020, in March 2022 the technical upgrade of the second section was completed which means that the connection is now technically suitable for transmitting more electricity. We are also expanding transmission capacity on the **Geertruidenberg-Krimpen** connection.

- On the 150 kV connection between **Tilburg** and **Best**, TenneT is reinforcing the grid and replacing overhead lines with underground cables using the horizontal drilling method. In a pilot in 2022, horizontal drilling was applied over a distance of almost 2000 meters. This method minimises negative impacts on society and environment.

Maintenance

As TenneT's onshore grid comes under more pressure, with increased loads and fast-growing demand for new connections, it is not only important to extend our network but also to maximise the use of our existing assets. In this respect, it is essential to maintain our grid so that all our existing assets are available for use, have a maximum lifecycle and perform their intended function. In doing so, we not only boost security of supply but also improve affordability for society. Maintenance accounts for approximately 40% of our investments as a TSO, for both Germany and the Netherlands.

With some assets in our network dating back to the 1960s and 1970s, part of our maintenance work is concerned with the replacement of obsolete assets with new equipment. To ease this process, we aim to standardise and modularise our equipment as much as possible, making it easier and more efficient to fit and maintain assets that share common design and components. The modules can also be tested and configured in a controlled environment before installation. We are following this 'plug and play' approach with our Bay Replacement programme, for example, currently in pilot phase before going to full scale roll-out, replacing more than 140 end-of-life substations.

And with many new assets being added to the grid, our maintenance team has to cover a growing network. With a scarcity of technical personnel to boost our maintenance team's capacity, we aim to mitigate this through increased efficiency, working smarter with new technology and routines. For example, with our Delivery Booster initiative, in which our colleagues in the field suggest ideas for improved efficiency and streamlined maintenance processes. Delivery Booster has become a successful way to drive efficiency from the ground up, freeing up additional time and resources so we can perform more work.

We are also boosting our training capacity to get new maintenance colleagues into the field faster. For example in the Cre@Te program, where we focus on hiring, training and retaining 'critical resources', meaning our specialist colleagues in technical functions. In the last two years, we have been able to hire more than 90 FTE through this program. In a dedicated indoor training centre, new colleagues were trained on the knowledge and skills needed for these functions while operating in a safe environment without high voltage. We will continue to focus on the growth of these critical employees, making sure they are better trained and also demanding less from the current employees in the field.

Finally, we have introduced a new approach to Integrated Planning, allowing us to centralise all the demands on our field resources to help us plan and prioritise the tasks ahead. Making clear choices on the most and less urgent tasks is an important part of allocating our resources most efficiently.

Offshore

In the European Green Deal, the European Union (EU) has set itself the ambition of realising around 300 GW of offshore generation capacity in Europe by 2050, supporting its aim to become the first climate-neutral continent. As TenneT already operates more than half the offshore wind

connections in the EU and is one of the world leaders in connecting offshore wind farms to the onshore grid, we are ready for the challenge of connecting around 40 GW of offshore wind energy to the Dutch and German grid by 2030.

The North Sea plays an important role in these ambitions as it has the potential to be Europe's clean-energy 'power house' of the future. Realising these ambitions in a sustainable and environmentally friendly manner will require international co-operation among European governments, fellow TSOs, NGOs and other stakeholders. Wind farms will need to be interconnected across countries, supported by distribution hubs and high-performance grid infrastructure. This vision will be key to boosting energy security in Europe, enabling a transition away from fossil fuels.

Doubling connection capacity with the 2GW Program

The innovative 2GW Program is a key element in TenneT's offshore strategy and plays a crucial role in delivering the offshore wind capacity needed for Europe's energy goals. The programme combines a new technological, administrative, and contractual standard with a unique and holistic transnational approach. Carried out in a forward-looking market design it provides a blueprint for future offshore grid connections, enabling higher wind capacity to be connected faster and at a lower cost. After a strong raise in offshore wind energy targets both in Germany and the Netherlands, the 2GW Program will now deliver at least 14 offshore grid connection systems by 2031.

The programme's innovative 525 kV HVDC cross-linked polyethylene (XLPE) cable system is a technological quantum leap. Meanwhile, the new platform design and a 2 GW HVDC transmission system set a new industry-wide standard for offshore grid connection systems. If TenneT were to continue using our previous cables, such as the 700 MW AC cable in the Netherlands or the 900 MW DC cable in Germany, it would need to build 40-50 new connections to reach the 2031 target for offshore wind. For 28 GW of green energy, TenneT now only needs 14 grid connections – less than half the number of what would be needed if using previous systems. This will strongly reduce the workload and save time, money, and resources in the process.

To support acceleration in offshore grid development and ensure capacity in the supplier market, TenneT invited to tender for two major framework agreements with key market partners for a period of up to eight years. Following this approach, TenneT released two large-scale EU tenders for offshore – one for at least 15 grid connection systems, including offshore and onshore stations as well as the

corresponding HVDC systems in June and one for more than ten cable systems in September. Both tenders are expected to be awarded in Q1/Q2 2023.

This approach brings together the right actors at the right time. It will stimulate the market as a whole. It will pool know-how, create synergies, and increase and secure essential market capacities for Europe. In doing so, TenneT has developed a concrete action plan to further accelerate offshore grid development in the North Sea and beyond.

More highlights in 2022 to develop our offshore grid:

- In June, we received grid readiness certificates for both **Hollandse Kust (Zuid)** grid connections, with a 1,400 MW transmission high-voltage connection for the offshore wind farms Hollandse Kust (Zuid) I and II.
- In September, TenneT completed the rollout of the **Hollandse Kust (Noord)** topside transformer platform, for installation 18.5 km off the coast of the Netherlands. The platform will be followed by two more – each with 700 MW capacity – to bring green electricity from the Hollandse Kust (Noord) wind farm onto the onshore grid. The wind farm is expected to be operational in 2023.
- In the third quarter of 2022, the jacket of **Hollandse Kust (West Alpha)** was installed. This is an offshore

transformer-grid connection system, some 50 km off the coast of Egmond.

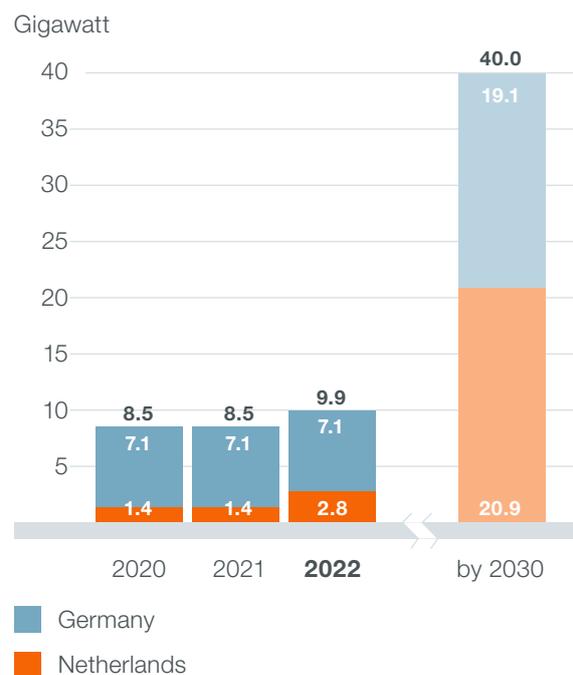
- In August, TenneT marked a major milestone in bringing more green wind power from the German North Sea, with the sail-out of the offshore platform DoWin Kappa. After three years of construction, the platform was transported from Spain and installed in the German North Sea, where it will be part of the **DoWin6** grid-connection system. The 900 MW connection will supply more than one million households with green wind power from the German North Sea.
- **DoWin5:** given that construction of the platform at the Singapore shipyard is currently behind schedule, due to previous restrictions related to the COVID-19, several acceleration measures were agreed with the contractor in 2022.
- **BorWin5:** the construction of the platform, land station and land-cable route was started. Energisation is planned to take place in 2025.
- **Borwin6:** TenneT awarded contracts for the construction and installation of the converter stations at sea and land, as well as for cable production and laying. Energisation is planned to take place in 2027.

Offshore targets 2022-2030

The European Union has an ambitious strategy for offshore wind energy. This is reflected in the targets at the national level: for 2030, Germany has a target of 30 GW of offshore wind capacity, while the Netherlands is aiming for 21 GW around 2030. TenneT will provide an important contribution to these targets with the offshore grid connection for 40 GW: approximately 20 GW in the German part of the North Sea and 20 GW in the Dutch part*. This means a strong growth of TenneT's offshore connection capacity by 2030, compared to 2022. TenneT has developed a new 2GW standard to enable this acceleration. The 2GW Program has a strong focus on harmonisation and standardisation. It provides a blueprint for future offshore grid connection systems and enables faster deployment while also reducing the number of grid connections. The standardization allows framework contracts with the supply chain for multiple connections to ensure maximum planning security.

* 1GW of older offshore wind farms in the Netherlands use a private connection to the onshore grid.

Installed offshore capacity by TenneT



What could prevent us from realising our goals?

To get to where we need to be, a range of decisions must be made: from standards on manufacturing, leaner permitting procedures, integrated energy system planning (for example hydrogen) to closer co-operation with large customers, and other TSOs and DSOs. This requires appropriate European and national legislation and regulations, and an investment framework that enables us to meet the needs and objectives of society, the economy and politics.

For the coming years TenneT faces a very high to critical risk impacting project delivery in the Netherlands. The Council of State in the Netherlands repealed the 'construction exemption'; the exemption for nitrogen deposition caused by construction activities. Because of this decision, TenneT is required to calculate for each construction and operation phase how it affects the nitrogen emissions. This has an immediate effect and ultimately affects TenneT's projects, either in delivery or preparation delays. On short term, it is expected that around 25 projects could be delayed by 1 to 2 years. On the longer term, around 100 projects could be delayed by 6 to 12 months. Due to the Council of State decision, TenneT could face the critical risk of standstill of the Dutch portfolio if no adequate and structural solution is found.

If the projects are not delivered according to our schedule, there will be a domino effect of delays in other sectors such as industry and residential construction. This is because these sectors need grid connections to complete their construction and sustainability projects. This puts us in a vicious circle: to reduce nitrogen, for instance, sectors need to become more sustainable. This requires the electricity grid to be extended, but those projects experience major delays because they do not get the necessary permits because of the nitrogen impasse. On the short term, TenneT is seeking acceptance of environmental assessments by competent authorities, to proceed as soon as possible with the required permits. For the longer run, we need the support of the respective governments to ensure that grid operators can take this role as a catalyst for sustainable development and prioritise when allocating nitrogen deposition. In addition, apart from the solutions above that the government can implement, TenneT itself is also taking action to avoid delays. For instance, TenneT is committed to measures to minimise nitrogen emissions during the construction phase by using emission-free construction equipment.

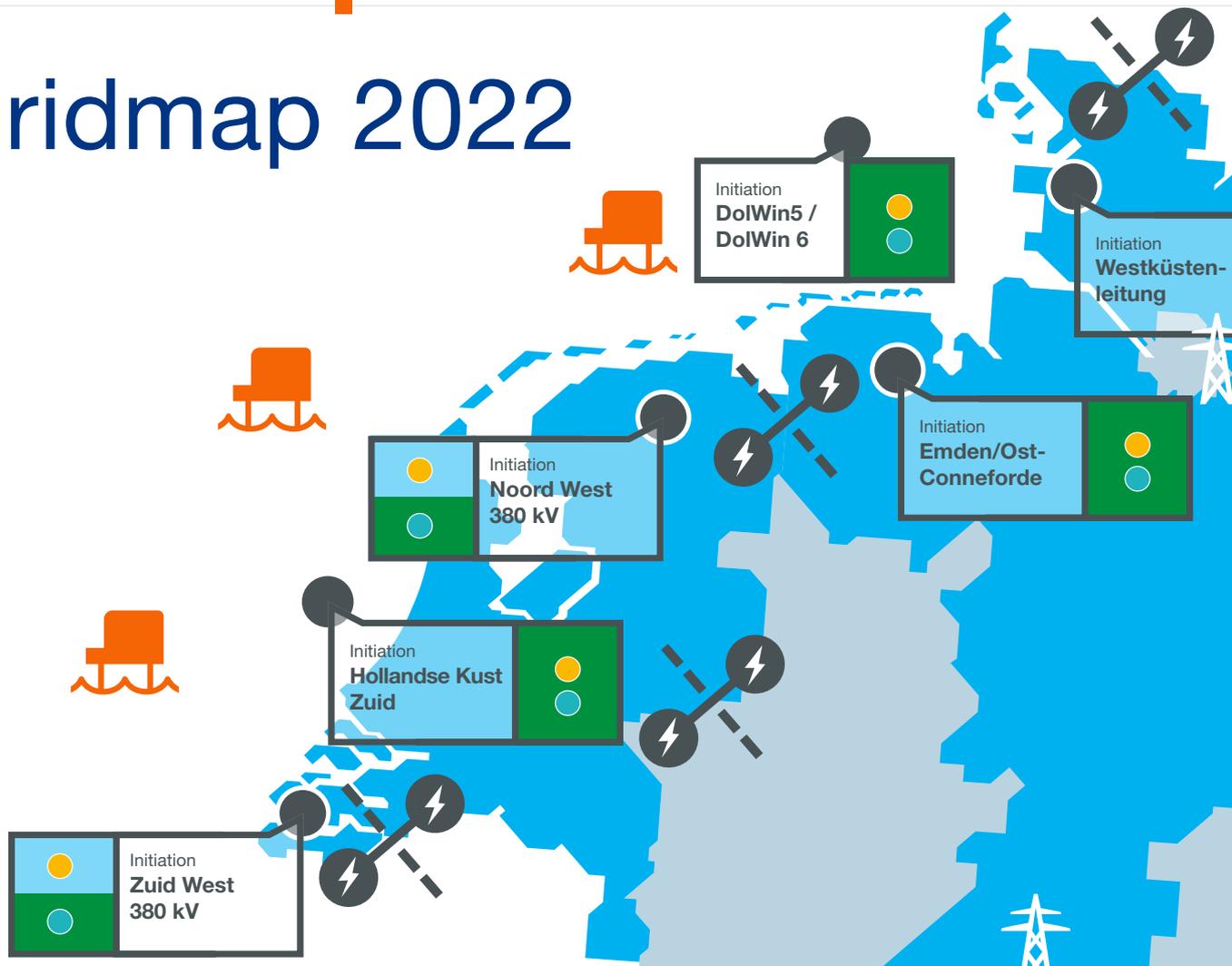
A continuing risk is the slow licensing and permitting procedure directly delaying our planning and building progress. Limited space is available to build and expand our grid in the natural landscape. In the current political and regulatory climate, most of the time spent on a critical infrastructure project is on planning and licensing. It often takes eight years to achieve the necessary permitting for a project that takes two years to construct. If we can only move at this speed, the projects needed to achieve the targets of 2030, even 2040, are already running against a tight deadline. Hence the importance of reducing the permitting time. As a result, new laws have been introduced by the Dutch and German governments to effectively reduce the permitting time.

The effect of extreme weather conditions is mitigated during the design, construction and maintenance of our assets, for example in the choice of location and materials used. Furthermore, TenneT insures all substations and buildings during construction and operation against risks from natural catastrophes.

As with the scarcity of talent, we also face more competition in the next decade in hiring the right skills and competences, sourcing the essential products, materials and suppliers we need to fulfil our projects. Precise management and demand planning across our supply chain, as well as close relationships with key suppliers, will be increasingly critical for delivering our projects on time.

Our progress depends on a close co-operation between governments, other TSOs, DSOs, large customers, and key suppliers. Only jointly can we develop innovative ways to provide reliable, clean and affordable electricity for a sustainable future, through initiatives such as the North Sea power hub for North-West Europe.

Gridmap 2022



Investment approval process



Technical data

TenneT's critical infrastructure consists of the assets needed to fulfill our main tasks. It helps us to transmit electricity to approximately 43 million end-users in the areas we serve, connecting and integrating electricity markets and to facilitate the transition to a greener and brighter energy future.

Interconnectors

17

2021: 17
2020: 16

Substations

478

2021: 475
2020: 468

Completed offshore connections

16

2021: 14
2020: 14

Circuit length (kilometers)

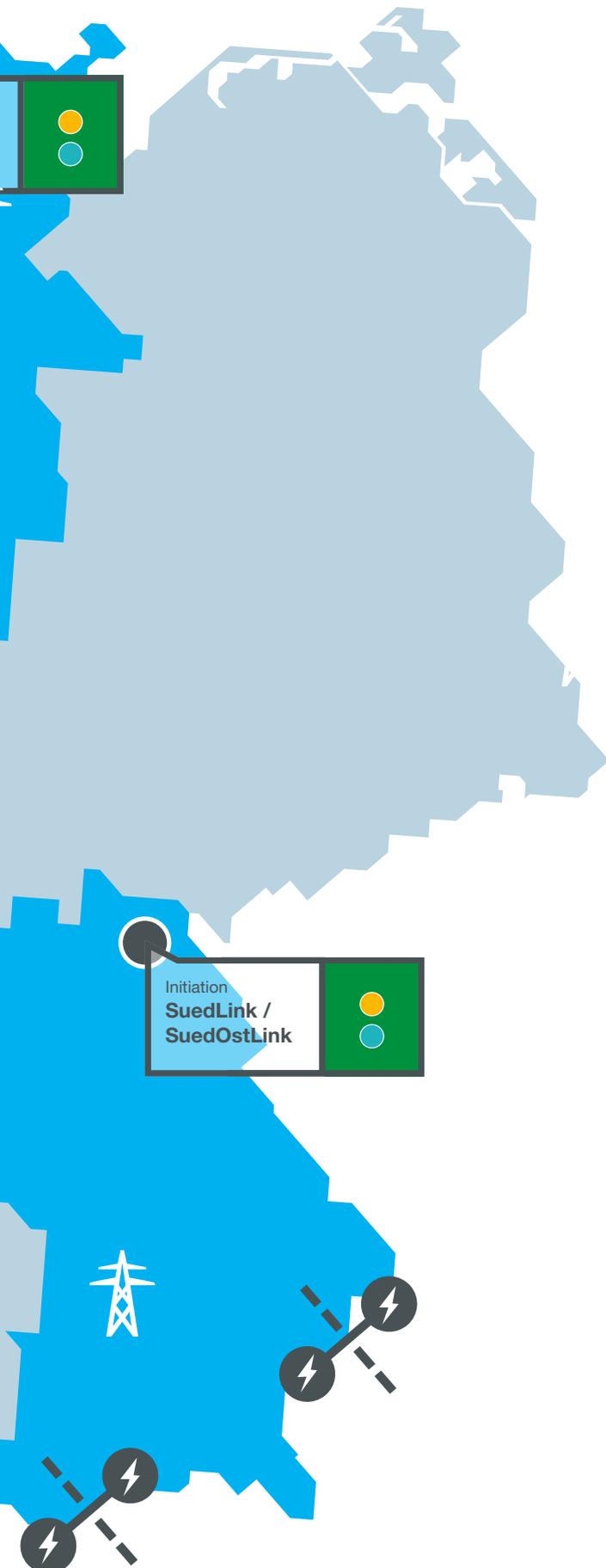
25,009

2021: 24,518
2020: 23,866

Pylons (approximately)

27,600

2021: 27,500
2020: 27,000





Ensure critical infrastructure for society

Anne-Marie Spierings
Gedeputeerde Energie, Circulaire economie
en Milieu van Noord-Brabant



In the Netherlands, we faced an increase of grid congestions last year. In North Brabant and Limburg, new companies could temporarily not be connected. This had a major impact on the region.

“The absorption stop for wholesale customers in June 2022 came as a big shock. Of course, we knew there were big challenges for the electricity grid to keep up with the energy transition. We were already running into this with large wind farms and the Moerdijk port and the industrial area. But that the full stop that was declared for two entire provinces was something we did not see coming. TenneT, Enexis, the state and the provinces of Limburg and Noord-Brabant then - under the leadership of Ben Voorhorst - developed a good approach. Sometimes, apparently, it takes a crisis to solve bottlenecks quickly. Above all, let us continue this energetic and constructive cooperation in the coming years.”

Create a safe and inspiring workplace

Every day at TenneT, we are working hard to deliver on our purpose – to connect everyone with a brighter energy future. It is a purpose that drives each of our employees and contributes to create an inspiring and motivating workplace. As a company that powers society, we rely on the power of our growing workforce to help us fulfil our societal task to provide a secure supply of electricity, while achieving the challenges of the energy transition.

We consider TenneT's employees to be our most valuable asset. Our physical assets on land and at sea are critical infrastructure and they are the result of the combined efforts, teamwork, and commitment of people across our organisation – and others working with us – to achieve our strategic goals. At TenneT, our workforce comprises primarily of our own employees, the colleagues that work for us, which has grown from around 600 when TenneT was founded in 1998 to 5,930 employees in 2022. In addition, we have many other valued colleagues that are externally contracted that help us deliver on our ambitions and ensure that we are able to fulfil our promise. In 2022 this amounted to 1,467 colleagues, compared to 1,452 last year. Their combined efforts ensure that we are able to keep the lights on every day and support us in our ambition to drive the energy transition. With the increasing ambitions from the governments in the areas we serve, we need to grow even more to meet them.

In 2025, we anticipate we will need to be operating at peak capacity to be able to achieve the European Union's climate targets – a 55% reduction in carbon emissions by 2030. To be prepared for this, we are working hard to enable accommodating up to 10,000 employees and subcontractors in a great and safe place to work and while striving for zero harm. To underpin, this is not a target in itself, but it is the size of the workforce we want to be able to accommodate if necessary for meeting our 2025 strategic goals.

However, many other players in the energy market are gearing up in the same timeframe, and competition for talent – especially in technical roles – is intense. We are competing in a small, candidate-driven market. As such, we have to be smart in our recruiting, and ensure the strategy covers being an employer of choice as that is where people like to work and stay for a long time. With people at the heart of TenneT, and by following a path of responsible growth, we are putting ourselves in the best position to meet the challenges ahead. This is why our strategic pillar 'energise our people and organisation' is so important.

And we want to be a company where our employees grow and feel confident to speak up and be themselves. As part of this, we see the advantages of building a diverse and inclusive culture, with talents that reflect the communities we serve. Through diversity, inclusion, and a safe working culture, we aim to create more innovative solutions to drive the energy transition.

We are aware that accelerating the scale and pace of our work means that additional challenges might occur with respect to safety – for our own employees and those of our contractors. That is why we need to grow and realise the future energy system in a responsible way. We are determined to create a safe environment for our people to work, where each person returns home safely at the end of the day. We are saddened that we were unable to on 2 occasions in 2022.

Our performance in 2022

	Performance	Target	Status	Trend
Safe workforce TRIR (including contractors)	4.4	4.5		As we regrettably had two fatal incidents one employee and one contractor, we believe our safety performance is not on par. Even though we showed steady improvement on our TRIR over the year and met our target, we are working hard to ensure a safe place to work for all.
	2022: 4.4 2021: 5.8 2020: 4.1 ¹			

	Performance	Status	Trend
Healthy workforce² Absentee rate Netherlands / Germany	NL 3.7 GE 4.1		This year's absentee rate was unfortunately higher than past years. We noted that this is comparable to the performance of peers and lower than the nationwide rate in both the Netherlands and Germany.
	2021: NL 3.1, GE 2.6 2020: NL 2.7 ³ , GE 2.5		

	Performance	Target	Status	Trend
Diverse workforce Diversity (% female inflow of total inflow)	33%	30% in 2023		Due to our efforts to attract more female talent, we recorded a slightly higher percentage than last year and met our target. This contributes to our journey to create a more diverse workforce.
	2021: 31% 2020: 33%			

1 The 2020 TRIR is presented based on the previous definition. When applying the updated definition the 2020 TRIR is 5.4.

2 Please note that we present the absentee rate between both countries separately as they are not fully comparable. For more information refer to our [Reporting Guidance](#) document.

3 The 2020 absentee rate for the Netherlands is presented based on the previous definition. When applying the updated definition the 2020 absentee rate is 2.7.

In 2022 our workforce grew to 7,397 compared to 6,620 in 2021. Our workforce is becoming more diverse, with 70 different nationalities compared to 63 last year, and we also see developments in other areas of being an inclusive and diverse workforce as a result of our efforts in this field. This includes, but is not limited to, areas such as gender diversity, as we see the female inflow as a percentage of total inflow increasing from 31% last year to 33% this year.

As regards safety, our efforts in 2022 resulted in a Total Recordable Injury Rate (TRIR) of 4.4, compared to a 5.8 rate in 2021. We are deeply saddened that despite all our efforts, we have been unable to prevent the fatal incidents that occurred this year. We deeply regret the loss of a young employee in May at the TenneT storage warehouse for the project Ostbayernring near Wernberg-Köblitz in the district of Schwandorf. Another fatality occurred in July, where an employee of a contractor was seriously injured during the unloading of parts of a temporary powerline portal at a construction warehouse in the Emden/ Ost - Conneforde grid expansion project.

We also track our absentee rate on a quarterly basis, as a measure to track the health of our workforce. In Germany, we recorded an absentee rate of 4.1 (2021:2.6) and in the Netherlands this was 3.7 (3.1 in 2021).

At the beginning of this year, many COVID-19 measures from the governments in the areas we serve were still in effect. Authorities in Germany and the Netherlands scaled these measures down in the course of 2022, however the effects of the pandemic still impacted the health of our people. In 2022, colleagues still caught COVID-19. Some unfortunately also suffer from Long-COVID and many other infections increased when people met again. At the same time, the pressure on our workforce due to absent colleagues potentially also affected our people, such as their mental health and higher workload as examples of this. This underpins the importance of our support program Always Energy, and discussions around leadership and how we work at TenneT.

Safety

Ensuring a safe working environment for the people working for and with us, is a key prerequisite in our work, every day. It is the foundation for everything we do for our workforce as none of this matters if they do not return home safely. We are keenly aware of the risks associated with our activities. Safety has multiple aspects, in the physical sense as well as from a psychological sense. From a physical sense, working at height with high-voltage assets and with heavy lifting equipment and materials, onshore as well as offshore, is a key risk. Our aim regarding safety at TenneT is simple: we want all people working for TenneT to come home safe every day and aim for zero harm in the workplace.

The pursuit of zero harm is reflected in many areas, with our own employees, with our contractors, in our operations in the field and in our offices. It is something everyone at TenneT has a responsibility for.

As our organisation grows, so does our exposure to risk. As we expand our grid at multiple disconnected sites, we have to mitigate the risks of large construction sites and consider the safety standards of multiple subcontractors and their teams. Scarcity of human resources further adds to the safety complexity, with fewer highly experienced workers available, and safety training and standards harder to oversee and control across our expansive supply chain.

These added complexities underpin the importance of why safety is of the highest priority to us.

As such, we focus on building stricter and simpler processes and principles for behaviours at TenneT to support our safety ambition of zero harm. We have updated our Life-Saving Rules (LSRs) and put more emphasis on the application of the 'Fair Approach'. The Fair Approach means that anyone who sees someone breaking a LSR reaches out to the person who broke the rule. The aim is to find out why he/she broke the LSR in order to learn from it and define organisational measures to prevent similar breaches in future. Furthermore, we have been working on strengthening our safety strategy and safety performance with the introduction of a new Safety Roadmap 2025. The Roadmap shows how we aim to embed safety further into our ways of working, into our leadership performance management, and in how we work with our supply chain partners.

An example of the safety actions included in the new roadmap include our Safety Leadership Programme, with the motto 'Safety needs our Energy', to enhance a proactive safety culture within TenneT. This provides a behavioural guidance on how to develop a positive and stimulating environment in which all our employees and partners can work safely. This is supported with a programme to make it an integral part of our leadership, behaviour and processes. Our company's leaders were trained on this in a two-day training.

Future-proof our organisation by recruiting the best talent

As TenneT prepares to accommodate up to 10,000 internal and external employees by 2025, recruitment is a strategically key success factor for our business.

TenneT has started to use a more competency based approach, meaning hiring people for their individual talent interests and skills rather than solely for their experience. This is a prerequisite for TenneT's recruiting and development. The candidate availability in a tight market requires us to develop our recruitment approach and move away from traditional working practices.

To further identify and interest talents in TenneT we intend to engage with them early in their career and ideally stay in touch through our talent pools. To this end, education, and partnerships with academic institutions play an important role in our recruitment efforts (see '[Solve societal challenges with stakeholders and through partnerships](#)'). Examples of this includes internships, the apprenticeships we have in Germany and also introducing them to our work in their studies such as with the Power Minor which we have been working together with the universities of applied sciences of The Hague, Amsterdam and of Arnhem and Nijmegen.

Attracting talent is just one part of the equation. Ensuring people feel energised and are motivated to be part of our company is equally important. A good balance between on-the-job training and developmental opportunities are needed to grow individual talent, as well as creating a workplace where people feel energised, like to work, are inspired and are connected to us as a company. That is why we provide our colleagues the opportunity to invest in themselves. An example of this is our TenneT Academy, which supports our colleagues find and select courses to help them in their careers.

Bring out the best in our people in an inclusive and safe environment

To ensure our workforce feels energised and that they are able to contribute every day, we aim to create a work environment that is safe and inclusive. We have described our views and policies on safety in a physical sense, but creating a workplace where our workforce feels safe in a non-physical manner is another important aspect of safety, such as social safety and mental health. This means not only paying attention to physical safety, where the biggest impacts are at our project sites, but also in our offices. For everyone at TenneT, we want to create a safe working environment, also in a broader sense. Feeling accepted and encouraged to speak up is an important part of the success of TenneT. So step by step we are working on building an inclusive and safe environment. It is of great importance for the success of TenneT that people feel they can speak freely without fear of negative consequences and build a culture of openness and mutual respect with no discrimination.

Inclusion & Diversity

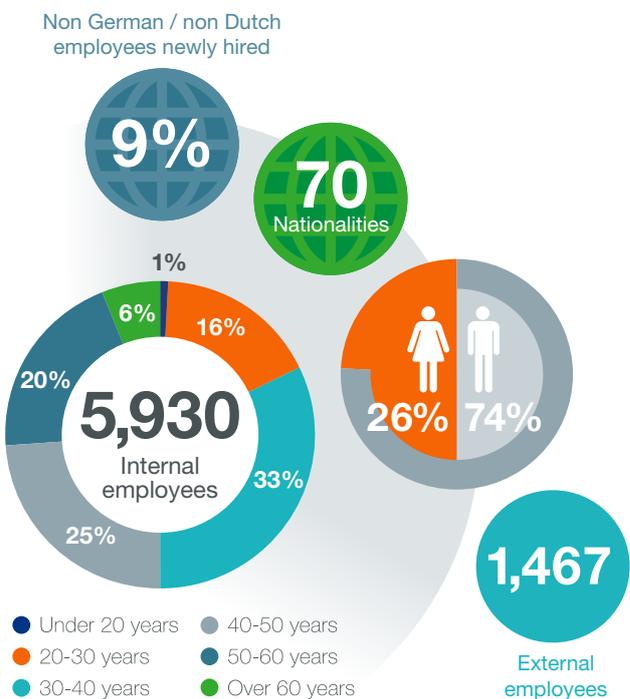
At TenneT we appreciate difference, it is a prerequisite for solving the energy transition. So no matter where you are from or who you are we want you to feel welcome and accepted at TenneT. This is particularly visible in our International Trainee group, just to mention one example. This traineeship welcomes participants from both the Netherlands and Germany, as well as other countries, with different educational backgrounds and through assignments in several units within the company they start their careers at TenneT.

Therefore we are embedding I&D in every step of our employee journey. It requires long time efforts as unconscious and conscious biases are normal and need attention to take good decisions in recruiting, promoting and developing our employees. This is a constant learning process, where our employees are the most important input givers.

We are seeing the results of our efforts with an increasingly international employee base. In 2022, we have 70 different nationalities represented among our diverse employee population and 9.1% of our new hires were not of either Dutch or German nationality. This is a great success as tax laws currently do not foster this. We have to hire our international employees on either a Dutch or a German contract to make it work.

As part of our work to promote inclusion and diversity at TenneT in 2022, we held Disability Days in Germany in October at Lehrte and Bayreuth. In October we celebrated National Coming Out Day 2022 through our social media channels, showing our support for the LGBTQIA+ community. We are also promoting inclusion and diversity by working together with other organisations, such as the Refugee Talent Hub. More on this can be found in the '[Solve societal challenges with stakeholders and through partnerships](#)' chapter.

Diversity at TenneT



Gender equity

We strive for equal pay for equal work. This is why in 2021, TenneT began its first investigation into a gender salary gap. The first results of this assessment indicate that a gender salary gap might exist in both the Netherlands and in Germany. Data limitations and historical factors create

challenges for us to exactly determine all factors that have led to this situation, but we are taking measures to address, close and prevent gender pay gaps where they occur. This will be a continued focus, particularly as creating a level playing field for comparisons is almost impossible. When hiring, it is a focus area and particular attention is given for part time and paternity gaps as they are the source for different development of salaries.

We have followed up on a 2021 survey leading to several initiatives to strengthen a women-friendly workplace at all times. We implemented a reporting system to monitor equal application of rewards, benefits and career opportunities. We have invested to secure female safety gear (Personal Safety Equipment) and we have embedded an improved reporting channel for unequal treatment including sexism and harassment.

In addition, we are working to encourage more young women to pursue careers at TenneT. For example, we held an open day for school students called Girls Day in April 2022, in which over 6,000 young women participated.

Organise for our people to perform at their best and to work as one company

Since 2018, our organisation has been on our Transforming TenneT journey, designed to re-calibrate our business for growth. Today, given the scale of the challenges in the energy transition and accelerated climate ambitions, we are strengthening our working practices such as increased focus on performance management. We have set clear transformation priorities to drive our performance and help us further accelerate.

To meet our end goals, we are making choices as we are not able to address all challenges at once. To move faster and simplify, we are also adopting smarter ways of working and how we can organise ourselves, such as collaborating more with other stakeholders, i.e. with partners in our supply chain. The new long-term framework agreements with suppliers in the offshore 2GW Program are an example of this approach (see '[Solve societal challenges with stakeholders and through partnerships](#)'). This is how we are able to organise ourselves for growth within a running business.

To increase our delivery speed, we also enhanced our internal new ways of working with respect to performance management, which has been rolled out across the company. The aim is to provide a standardised approach for performance management that can scale with our growth.

Regular discussion with employees around results, and addressing obstacles in their path, stimulates the development of our employees individually and collectively.

What could prevent us from reaching our goals?

As our organisation grows, so does our exposure to certain risks. We are under increasing pressure to deliver a fast-expanding portfolio of projects across a wide variety of onshore and offshore locations. This creates pressure on adhering to legal obligations, our Code of Conduct, as well as pressure to attract the right competences and talent on time. In addition, this also relates to adhering to health and safety rules, where it is essential that TenneT addresses the increased risk for safety incidents, or major accidents, if more deliverables are required in our fast-expanding portfolio in the same timeframe and with the same staffing. This creates pressure on adhering to legal obligations, our Code of Conduct, health and safety rules.

This involves both our own employees and our contractors. A situation of intentionally or unintentionally balancing safety requirements versus on-time project delivery is not an acceptable risk. To address this, we need to adapt our safety practices to the work we do and embed a top-to-bottom safety culture that is consistent across all our units and through our supply chain. Hence education is to train all stakeholders, without distinction between internal employees and contractors, about the importance and adherence to all safety regulations whether working at a construction site or at the office. Due to the unfortunate safety incidents in 2022, it has become ever more important for us to ensure that all contractors and subcontractors adhere to our high standard safety rules, without exception. As a result, we increasingly build safety requirements into our tenders, thereby cementing it into the beginning of our relationships with suppliers and making it a pre-condition of doing business with TenneT.

Hiring and retaining new talent for the coming years is essential if TenneT is to deliver on its promises to support 2030 climate targets. A foreseen and growing risk is the unavailability of the right talent for the coming three years. Many other organisations in the value chain are gearing up for the same climate targets, and competition for talent – especially in technical roles – is intense. This leads to the widespread limited availability of specialist skills and an overheated job-market. Since applicants no longer only consider primary benefits but give more weight to internal succession and chances of progressing in their careers, TenneT needs to continuously stress its image as an attractive employer. This is essential not only for new hires, but also to retain current employees.

One way to address the increasing hiring risk is to have a competency-based approach, hiring people based more on their individual talents, interests and skills as opposed to a requirement for specific experiences. In this way, we can proactively identify talents we want to work with and then match them to roles, as opposed to reactively waiting for vacancies that we then need to fill. However, we need to ensure we have simplified and standardised processes that can be scaled efficiently across the organisation without over-burdening our people and inhibiting our ability to deliver against our challenging targets.

As regards improving safety practices among our contractors, we take a two-pronged approach. On one hand, we increasingly build safety requirements into our tenders, thereby embedding safety into the beginning of our relationships with contractors and making it a condition of doing business with TenneT. On the other hand, we work together with contractors to ensure that they have a firm understanding and application of our safety standards, by holding safety-focused meetings with our contractors' leaders and also participating in site visits, where we jointly observe work in action and collaborate on practical safety improvements. In addition, we work with our contractors to have them certified on safety via the Safety Culture Ladder (SCL), a Dutch standard for assessing safety culture within organisations. SCL indicates the maturity of a company in the field of safety awareness, attitude and behaviour. As part of the SCL programme, the aim is for all companies working for TenneT that carry out high- and medium-risk contracts to be SCL-certified. We are proud to state that per year-end 2022 almost 92% of our order volume relates to contractors that were certified or were in the process of getting certified. We also continued to measure our own safety culture using the SCL. As part of the continuous improvement process, certification to level 4 (out of 5) of the SCL is included in TenneT's new Safety Strategy. The first parts of TenneT are now certified on level 4 such as Large Projects Netherlands - Area North. Several other units have started initiatives to become certified in 2023.

Furthermore, we have updated our LSRs in 2022. The previous LSRs have been evaluated by our SHE (Safety, Health and Environment) teams and their scope broadened, like the LSR on safe hoisting. We sharpened them to further strengthen our day-to-day safety practices. We aimed to make them even clearer and adding two additional LSRs to include safe driving and another on 'line of fire' (staying clear from the movement of a hazardous object or the release of hazardous energy, such as hot air or fire). A violation of the LSRs provides us with an opportunity to learn. We therefore expect a discussion to follow up on each incident of non-compliance and we ensure that the incident and the circumstances are reported in our incident reporting system. Reporting also enables us to map out the proposed action and monitor progress. If further non-compliance occurs, disciplinary action is taken.

Create a safe and inspiring workplace



Mahla Mirzaee Kakhki

International trainee TenneT, started in 2022



The energy transition involves a large amount of work. TenneT will grow significantly in the coming years. Finding colleagues is a tough challenge, taking place far beyond the Netherlands and Germany.

“I am originally from Mashhad in Iran and came to Germany nearly four years ago with my family, my lovely six-year-old son and my husband.

With a background in physics – my PhD from Bayreuth University is in the physics of soft matter – I was keen on working for a company which not only has environmental concerns but also matches my background, which TenneT was the great option for my goal. As a physicist one knows a bit about most fields, which could be really useful at TenneT, where some background in electrical engineering is helpful. There is a lot of respect for different cultures in the company, which is really important. Choosing to live in Germany was a really huge step for me. I was taking my PhD and looking after my son, and meanwhile I was learning German!

In this point of my life, I am very happy that I joined TenneT, as it is a safe place where people value and respect each other. Right now, I am a trainee in the Large Projects Germany team. I am learning how to write technical project concepts, for substations for instance. I am quite busy day-to-day, so time management can be challenging. As a trainee you do not just focus on daily tasks, you also take part in trainee events, attend workshops, and help organising a few events. In addition, you are of course building your own network and involved in non-stop learning.”

Create value to transition to a climate-neutral economy

As a European TSO, TenneT creates value for society by driving the energy transition and delivering a future-proof electricity grid. By playing our part, we contribute to the EU's ambitions to be a climate-neutral continent by 2050. We contribute to this through our assets, knowledge and innovations to build a reliable and affordable future-proof grid that supports society's net zero ambitions.

As we expand and reinforce our grid to facilitate the energy transition, we are conscious that we also have a negative impact on the natural world around us. Procuring and producing the materials needed to build our assets on land and at sea has an impact on nature, greenhouse gas emissions, pollution and resource scarcity. And as the energy transition is a global challenge involving a wide array of other parties from the energy sector and associated supply chain, our sector's demand on resources and impact on nature is growing all the time.

Therefore, as well as contributing to societal objectives by driving the energy transition, TenneT can create additional value by leading as a green and responsible grid operator.

Through our nature, climate and circularity ambitions, we aim to shape what we believe is necessary for a responsible growth path. With these ambitions, we can take ownership for our impact and show leadership.

We report our progress in each of these key areas, with targets set for 2025 regarding climate neutrality, net zero impact on nature, and circularity. In addition to measuring our performance against these targets, we report on our progress in contributing to a climate-neutral economy by disclosing the equivalent number of households that can, in theory, receive 100% renewable electricity as a result of our renewable energy-grid investments. This is one of our key metrics to measure our societal impact (refer to 'Societal impact we enable by driving the energy transition' below).

Our performance in 2022

Climate	Performance	Target	Status	Trend
	CO ₂ footprint of our grid losses, substations, offices and mobility (net emission in tonnes of CO ₂)	Climate neutral in 2025 ¹		Though our net carbon footprint has increased due to our grid losses, we are focusing on strategies for reduction of our indirect emissions through our supply chain and SF ₆ alternatives.
Circularity	Performance	Target	Status	Trend
	<ul style="list-style-type: none"> Reduction of virgin copper use Reduction of non-recyclable waste 	25% reduction in 2025 ^{2,3}		In 2022, we worked on further improving our insights in our material inflows and outflows. We laid the foundation for full data transparency and started incentivising suppliers on increasing recycling rates.
Nature	Performance	Target	Status	Trend
	<ul style="list-style-type: none"> (Net) impact on nature Environmental incidents 	Zero impact on nature in 2025		Our nature inclusive design measures are stepping up in scalability such as fish hotels and sinus mowing and we incorporated a replacement strategy for our most leakage prone circuits.

¹ To be fully climate neutral (SF₆ emissions, grid losses, energy use offices, stations and mobility of our employees) in 2025.

² In 2025 25% less impact of virgin copper use.

³ In 2025 25% less impact of non-recyclable waste.

Climate

We contribute to the transition to a climate-neutral society by connecting more renewables to the grid. And as a responsible grid operator, we also strive to make a green transition in our own operations by reducing our carbon footprint. In line with Science Based Targets that align with the goals of the Paris Agreement, we have set ambitious emission-reduction goals for 2030, aiming to cut our direct emissions in scope 1 and 2 by 95% and our indirect emissions (scope 3) from purchased goods and services and capital goods in our supply chain by 30%. These targets are an extension of our 2025 climate-reduction targets. The majority of scope 1 and 2 emissions are from grid losses – the electricity lost during transmission across our network – and from emissions from the insulating gas SF₆, energy use from our offices, at our stations, and the mobility of our employees. Scope 3 emissions are more challenging to measure, as they are the indirect emissions that arise in our supply chain, as a result of what we purchase and contract.

Scope 1 (Direct own emissions)

SF₆ gas

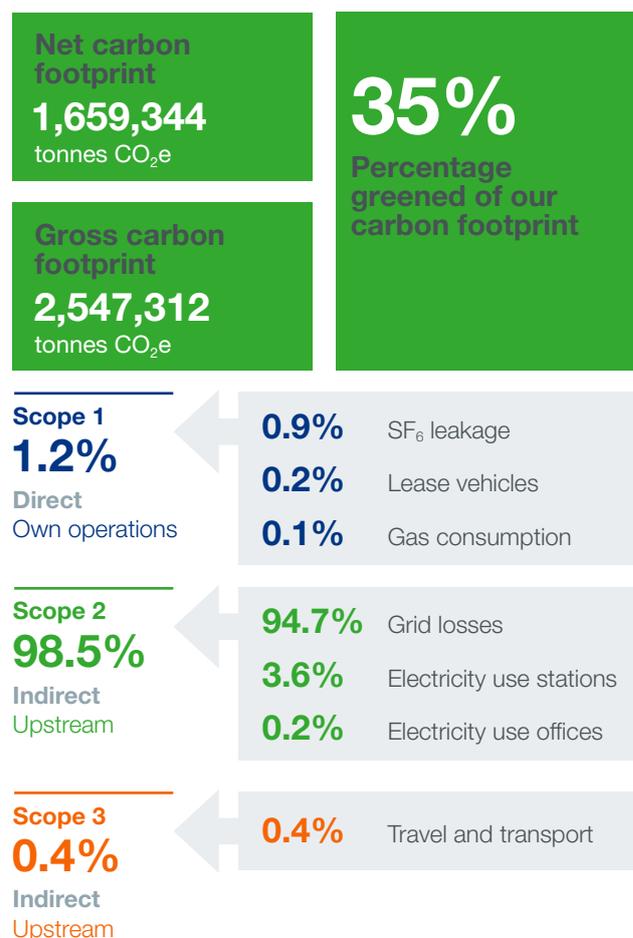
For our transmission services, TenneT needs specialist insulating and fire-extinguishing protection for high-voltage stations and distribution systems. Sulphur hexafluoride (SF₆) is widely used by TSOs as a highly effective insulator and extinguisher in switching installations. But it is also a greenhouse gas, with one unit equivalent to over 23,500 units of CO₂. If the gas leaks, during installation, maintenance, or due to faulty equipment, it is extremely damaging for the environment. While SF₆ leakages currently only account for around 1% of our carbon footprint, we still aim to mitigate its impact as much as possible. We are working to find sustainable alternatives to SF₆ that provide similar safety properties without harmful emissions. We aim for two-thirds of our assets to be SF₆-free in 2030.

During 2022 we made significant progress in this regard, with new pilots to explore SF₆-free installations in the Netherlands and Germany. In the Netherlands, for a grid expansion project at the high-voltage substation Maasbracht 380 kV, for example, we challenged suppliers to propose SF₆-free solutions for gas-insulated lines and gas-insulated switchgear. We used an internal carbon price of EUR 100 /tonne CO₂ in the project tender to stimulate alternative solutions for SF₆.

To reach our SF₆ reduction goal, it is important to perform early testing of SF₆-free equipment. In 2022, we awarded the first contract for a fully SF₆-free 420 kV gas-insulated switchgear (GIS) for the TenneT grid in Erzhausen.

The contract for this project was signed at the end of 2022. This is the first time we have taken this step, which we expect will stimulate the market to find commercial and technically effective alternatives to SF₆. We notice that the potential to collaborate with suppliers on such solutions (also see ‘Solve societal challenges with stakeholders and through partnerships’) is easier for 220 kV and 380 kV assets as this allows suppliers to develop scalable solutions for the wider European and international market. For smaller installations of 150 kV, it is harder to find suppliers to engage in solutions focused only on one market. Nevertheless, we are holding dedicated supplier sessions to explain our strategy and why we are determined to steer away from using insulating gas with such high global warming potential.

Carbon footprint



Mobility

The mobility of our employees, whether travelling to and from the office or out in the field, is part of our CO₂ emissions and is an area we are addressing with carbon-reducing policies. For example, we aim for a fully electric lease car fleet by 2025, replacing the current use of hybrids.

Societal impact we enable by driving the energy transition

The largest impact that TenneT has in terms of climate action is to enable the switch from a fossil fuel-driven economy to a climate-neutral economy by connecting renewable energy sources and transmitting the produced electricity. We define our key impact metric in this area as the equivalent number of households that in theory would have been able to receive 100% green electricity. It is important to realise that the majority of the electricity consumption comes from industry. We estimate that by the end of 2022 we have enabled the theoretical equivalent of more than 14 million households to receive green electricity.

These climate figures are not just achieved by our own operations, but also by our partners in the value chain, such as electricity generation companies and distribution system operators (DSOs). By working together, we avoided 17.2 million tons of CO₂ equivalents in 2022. More information on these impact metrics (such as the methodology) is included in our additional CSR data document.

In 2022, we also developed a TenneT Mobility Vision, including a partnership with the German rail operator Deutsche Bahn that encourages employees to travel by train for carbon-neutral journeys. As part of this drive towards more carbon-neutral travel, TenneT has implemented a bike-leasing scheme for our employees in the Netherlands and Germany.

Gas consumption

Gas usage for heating our offices and stations is also part of our scope 1 emissions. To reduce the impact of gas consumption on our carbon footprint, we purchase green gas for all offices and stations in the Netherlands and in Germany.

Scope 2 (indirect upstream)

Grid losses

Around 95% of TenneT's CO₂ footprint is due to grid losses – the loss of electricity that inevitably occurs during power transmission across our network. The grid losses are measured as the difference between the electricity fed into the grid and the electricity delivered. Grid losses depend, among other things, on the current, voltage and the distance that electricity is transmitted. Unfortunately, as we expand our network to support the energy transition our grid losses might grow proportionally higher.

Although we cannot prevent grid losses from occurring, we aim to reduce their climate impact. To this end, we green our grid losses by using guarantees of origin (GoO's) from renewable sources. In previous years, we have been able to green for 100% of grid losses in the Netherlands and 55% of grid losses in Germany. We are currently limited by

German regulation in purchasing guarantees of origin, which is why we procure GoO's corresponding to our equivalent German grid losses on group level.

In 2022, the energy crisis and resulting energy price volatility also had an impact on the prices of the GoO's. If we were to stick to greening 55% of our grid losses in Germany, costs could have increased by tenfold in 2022 compared to 2021. As the German legislation does not support procurement nor reimbursement of GoO's, we decided to green the German grid losses until a monetary limit. Although we have increased our spend in GoO's, this cannot keep pace with the increasing price of GoO's. As a result, we greened 9% of German grid losses. Though this leads to an increase in our net carbon footprint, we have to balance our climate goals with our financial health. We are in continuous dialogue with our regulator, the legislator and the other TSOs to find a way to reduce the carbon footprint of TSO and DSO grid losses in Germany.

Electricity use in stations and offices

Similar to gas usage, the electricity use in our offices and substations has an impact on our carbon footprint which we mitigate by purchasing green electricity. For our substations, we strive to decrease the carbon footprint by using solar panels, insulation measures and LED lighting where possible. We have installed solar panels on our land stations at Hollandse Kust Noord and will use the generated electricity for our own consumption.

Scope 3 (Indirect, supply chain)

In 2021, we committed to the Science-Based Targets initiative and revised our climate targets, aligning them to the 2015 Paris Agreement. This includes an ambitious target to reduce our scope 3 emissions from purchased goods and services and capital goods by 30% in 2030.

Achieving this target requires extensive engagement and a collective outlook among our suppliers on how we can collaborate to reduce emissions from the products and services we buy. Gathering enough quality data relating to our supply chain is key to making progress. To this end, during 2022, we executed an analysis on our future demand for the next decade and identified asset categories that contribute to a significant portion of our scope 3 emissions. By identifying our demand of different assets over the next 8 to 10 years and assessing the scope 3 emissions related with every type of asset, we aim to identify those procurement categories that are the most carbon intensive and have the highest potential for emission reduction. Based on this analysis we can set the right focus in integrating sustainability into the sourcing strategies of all our procurement categories.

With transformers, overhead lines and cables we identified pilot procurement categories to start with. With those assets we are already integrating sustainability in the sourcing strategies as well as in supplier relations and our tenders. Understanding emission hotspots and highest emission reduction potential per asset through Life Cycle Assessments (LCA) plays an integral part in this integration. This not only already creates first impact on scope 3 emission reduction, but also helps us gain valuable experience for the remaining procurement categories in our portfolio.

We are increasingly taking a holistic view on sustainability in our supply chain. Next to LCAs, we use tools such as the Environmental Cost Indicator (ECI) to incentivise our suppliers to reduce the environmental impact of the products and services we buy from them. By giving the environmental saving a monetary value through the ECI, we can gather more data on our environmental impacts. This approach also means suppliers are encouraged to provide more transparency on their product lifecycle emissions in our tendering process.

TenneT's sustainable Revolving Credit Facility: linking climate performance to finance

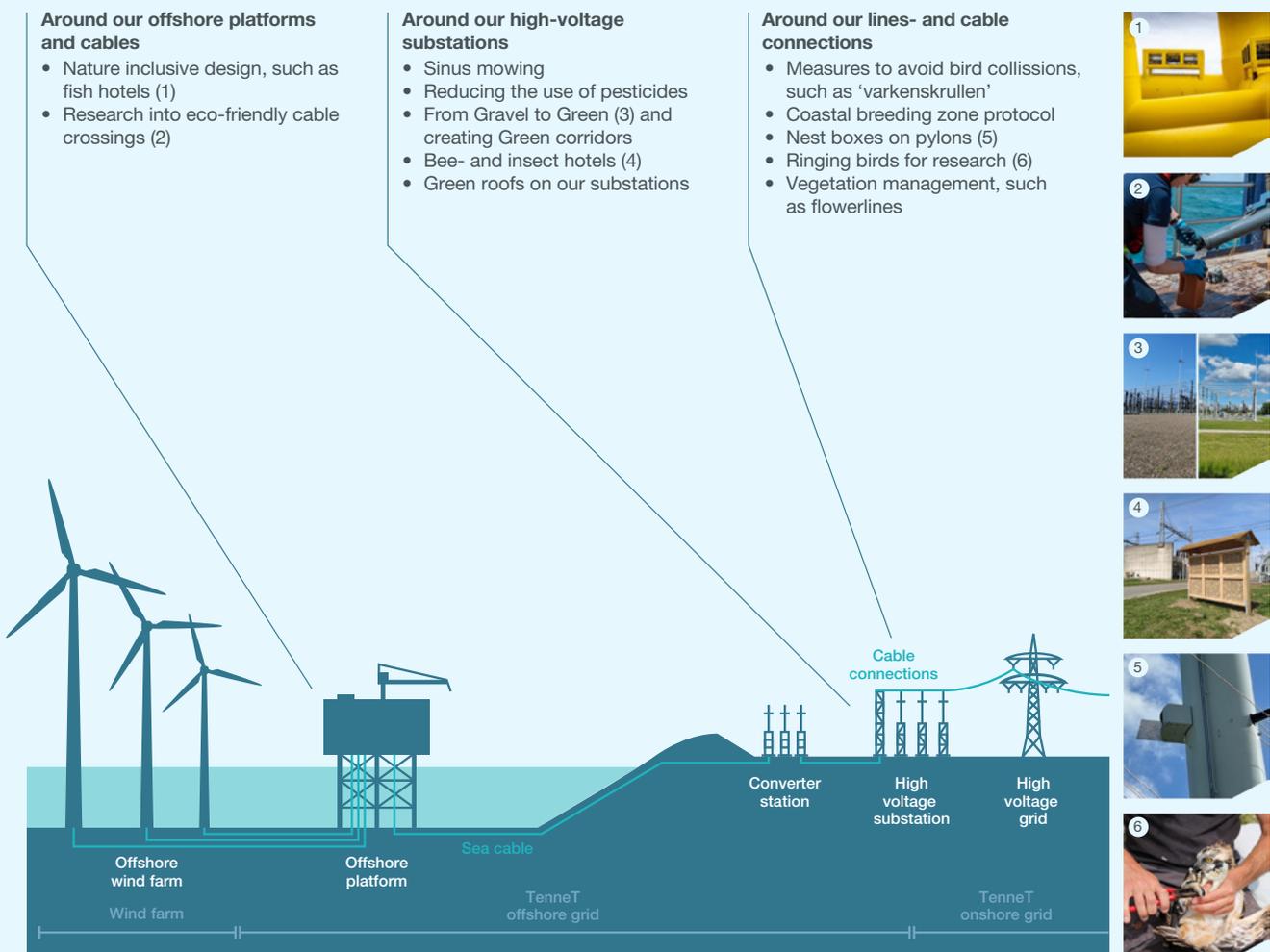
To make progress against our climate ambitions even more visible, we have linked our financing costs to our climate performance. Secure access to finance is essential to ensure that we maintain the pace of our investment portfolio. An example of this is our EUR 3.6 billion sustainable Revolving Credit Facility (RCF), which is linked to sustainability performance indicators and targets. In practice this means that, depending on the realisation of our climate-related KPIs, a discount is applied to the interest margin of the RCF. This is related to the green percentage of energy use of our stations (100% in 2022 vs 100% in 2021) and our offices (100% in 2022 vs 100% in 2021). It is also linked to the net carbon impact of mobility per employee against the total number of employees (1.4 in 2022 compared to 1.2 in 2021) and the net carbon footprint of leaked SF₆ gas divided by theoretical CO₂ impact of banked SF₆ (0.15% in 2022 compared to 0.22% in 2021). To reduce our CO₂ footprint, we compensated for a part of our leaked SF₆ through carbon offsets for generating renewable energy in Turkey.

Nature

As our assets are located on land and at sea, we have an inevitable impact on nature. We do our best to limit our negative impact, especially in vulnerable nature areas, and where possible to have a positive impact by using environmentally friendly and innovative techniques. Our goal is to reduce our net impact on nature to zero.

Our policies (such as our code of conduct) set out how we should carry out our maintenance and construction work, in accordance with nature conservation laws. As part of this, we carefully track the number of environmental incidents – such as leakages of SF₆ gas, oil leakages from our assets, and other occurrences that have a negative impact on nature. In 2022, we recorded 2,866 litres (of which 364 litres related to 2021) of oil leaked from our cables, in comparison to 1,798 litres of oil in 2021. Unlike our newer onshore and offshore assets, cables from older parts of the onshore grid, especially in the Netherlands, are more prone to leak oil. An example of this relates to the connection Waalhaven - Oudeland, where a significant part of our 2022 leakages relate to. We regret these instances where oil was leaked and always monitor our assets closely to learn from the root causes and take appropriate measures to prevent leakage or mitigate the impact of the leakage. In addition to the oil leakages, we record incidents where we have a negative impact on the environment, soil, air or water. In 2022 we recorded 101 environmental incidents in 2022, in comparison to 81 incidents in 2021.

Nature measures



In 2022, we looked into improving our measurements of net zero impact on nature. Along with students from the Wageningen University & Research, a roadmap with Key Performance Indicators for positive nature measures was developed. This will help us improve our performance measurement with regards to positive nature measures.

We also include details on nature commitments in our investment plans. For each proposed investment, a 'Commitment to Nature' paragraph details a description of the anticipated impact on nature, and measures to mitigate. In 2022, 100% of our G2 documents included a 'Commitment to Nature' paragraph.

In our commitment to have zero impact on nature, we aim to create a positive impact where possible. The visual above includes some of the nature measures that were implemented in 2022.

A comprehensive overview of our nature measures can be found on our Green Map



Highlights on our high voltage stations

In recent years, we have placed more emphasis on improving biodiversity at the sites of our high-voltage substations. In 2022, we continued to do this through our own initiatives and in collaboration with external partners, including but not limited to:

- In Zevenhuizen, we worked on creating additional ecological value through a nature-inclusive design. This includes installing bird boxes and bee hotels to improve biodiversity and using herb-rich grassland where possible.
- After successful pilots in 2020 and 2021, we increased our use of sinus mowing at substations, to improve insect habitats. Using grass at substations supports 40% more insects than sedum or gravel. A pilot study using robotic mowing is underway at Meeden station and the lessons learned from this will be used to evaluate scalability to other stations.
- During the replacement and extension of a substation in Isar, TenneT built new habitation areas for the fence lizard.

Highlights on our cable and line connections

In 2022 we stepped up our work to promote biodiversity measures around our pylons, such as planting flowers and trees and protecting bird life. Our negative impacts in this area relate mainly to bird collisions with our high-voltage lines. To minimise this impact, we determine high-risk spots and implement bird-barrier measures. We also implement positive nature measures by including nature-inclusive design or applying our 'Commitment to Nature' in each project.

- With the Step Stone Pylon Programme, we are investigating how sowing certain herbaceous mixtures can boost biodiversity around high-voltage pylons, making them 'step stones' in the landscape for insects and birds.
- For the Stade-Landesbergen connection in Germany, we are planting new trees next to the Stade substation, hanging bat caves in trees along the route, and measures to protect the habitats of skylarks.

Highlights offshore

In our work to extend our offshore grid, we aim to follow a strategy of 'nature inclusive design'. This includes conducting ecological monitoring to identify where we can have a positive impact, such as installing fish hotels around our platforms and preventing damage to maritime life from electromagnetic fields.

- In July 2022, we conducted a first monitoring campaign of the use of eco-friendly cable crossings at Hollandse Kust (Zuid) Alpha with Waardenburg Ecology. These replace the layer that is usually made of granite with calcareous rocks, which provides a safe breeding space for fish. The development of habitats around these eco-crossings will be studied for three successive years.
- Also in July 2022, we conducted a pilot with Dutch Sail and Wageningen Marine Research, where sailing crews collect video images and water samples for analysis.
- In late 2022 we monitored fish hotels installed at Hollandse Kust (Noord) and installed artificial reefs, reef balls and Arc Marine Reef Cubes.
- At Borssele Alpha, we conduct electromagnetic field monitoring, using a continuous monitoring station to gain insights into the effects of electromagnetic fields on the marine environment. Magnetic fields, caused by electricity cables under the seabed, can be detected by marine organisms, such as fish, and affect their behaviour. By assessing the effect of our cables, we can take appropriate measures to reduce negative impact.

Circularity

To realise our projects and drive the energy transition it is necessary to use raw materials and components that are naturally scarce, in short supply or difficult or even impossible to recycle. These challenges become more severe as competition for resources intensifies across the global energy sector. The scale of work required across the energy transition is immense, but resources are limited. This is not only due to the natural scarcity of critical materials such as copper, but also due to the logistical supply-chain challenges experienced in 2022, following the war in Ukraine and COVID-19 lockdowns in China. This impacted the availability and price volatility of key commodities, such as copper, steel and aluminium.

As we expand our grid with material-intensive assets such as cables, transformers, substations, steel pylons and overhead lines, the competition for raw materials intensifies. As such, all players in the energy industry need to think of how they can achieve their energy transition goals, by using fewer materials as possible, increasing circularity, and minimising waste.

Demand for limited resources is particularly important to consider when it comes to the extraction of naturally scarce raw materials that are critical to our assets – such as mineral oil, used in transformers, and copper. Global demand for virgin copper is not easily met by supply. There are some alternatives to copper in electricity cabling – such as aluminium – but we have to carefully balance the consequences of doing so. Aluminium may not be a scarce natural resource, but its production has a heavy environmental impact and its use in cables results in higher grid losses.

To reduce the environmental impact of our materials, we are adapting our tenders to include stricter circularity requirements, for example by asking suppliers to provide evidence of the percentage of their materials that are recyclable and recycled with ‘raw material passports’. Requirements such as this are being increasingly applied through our supply chain, either as requirements within tenders, or as incentives in our procurement.

On the basis of our raw material passports, we are working on improving our insight into our impact on virgin copper. In 2022, we further improved our insights by conducting base-case life cycle assessments on those assets where we make most use of copper (cables, transformers and shunt reactors), and have gained a better picture of our overall copper usage. While the assessment is still largely based on estimations and our insights into the recycling rates of our purchased assets are still limited to a restricted number of raw material passports, our analysis indicates that in 2022 around 38% of our purchased copper was recycled. We believe that when the full analysis is completed, it will indicate that the percentage of recycled copper will range from 25-40% of our total copper purchases.

A major milestone in our journey to reduce our impact on virgin copper has been made in 2022 by implementing the Environmental Cost Indicator (ECI) in our tenders for new corporate framework agreements for purchasing AC Cables, Power Transformers and Shunt Reactors. This will not only give us exact insights in the amount and sourcing of copper in these assets and their environmental impact, but also directly incentivise our suppliers to increase recycling rates in their products.

To understand the long-term impact of raw material scarcity on our business and how we can mitigate its effects, we are currently developing a strategic perspective on raw material scarcity. In particular, we are looking at the strategic imperatives of attracting and securing supplies of scarce raw materials and reducing our dependency on them

through enhanced circularity. The result will be a new policy that we can use to evaluate our current status and provide the business with concrete guidance.

For waste, we are also working on improving our insights into the amount and types of waste we produce. This year's analysis includes insights for our offices, onshore and offshore operations, and onshore projects. We were able to improve our insights into Dutch projects by improving the data flow from the project contractors. While the analysis includes actual waste reports and waste data, a major part is still based on assumptions and extrapolations. The results of this year's assessment show that around 14% of our waste is non-recyclable. We believe that, when we have completed the full analysis, this aligns with our understanding that 10-25% of our waste is non-recyclable.

The analysis also shows that we are continuously facing challenges in the flow of our waste data. For this reason, in 2022 we have laid the foundation for a complete makeover of our corporate waste reporting processes. In view of the expanding requirements imposed by the Corporate Sustainability Reporting Directive (CSRD), we have started to further improve our internal waste reporting processes throughout the different parts of the organisation and to define clear definitions, requirements and processes for waste reporting. In our German onshore operations and projects we are also investigating possibilities to further digitalise waste management and reporting, which could ultimately serve as a blueprint for expansion to the rest of the organization. We expect that these improvements will bring waste reporting and management to a new level, which will ultimately enable us to steer on the reduction of non-recyclable waste in a much more effective and targeted way.

What could prevent us from reaching our goals?

We have set ambitious targets to reduce our impact on climate, nature and resource circularity, with firm targets set for 2025 and 2030. While TenneT has to deliver on its core task of building, maintaining and operating the power grid, the materials needed to build our assets on land and at sea have an impact on nature, carbon emissions, and resource scarcity.

As our activities and operations grow in the coming years, it is expected that our impact on carbon emissions will grow simultaneously. While we try to reduce our footprint, it remains a challenge to balance our growth with a lower footprint.

This is particularly challenging for our scope 3 emissions, where we rely on collaboration with our supply chain partners to reduce our carbon footprint. This continues to be a dilemma, as the shortage of supply chain partners means they can choose which projects are most suitable for them. Hence TenneT's carbon reduction ambition could potentially limit contracting the supply chain partners on time. To reach our 2030 targets, we need to think ahead and make choices now that help us reach these targets.

Grid losses are a major contributor to our carbon emissions – accounting for 95%. Unfortunately, the nature of power transmission makes grid losses inevitable. By using more aluminium instead of copper as a conductor in our power lines, we can reduce our usage of scarce resources. However, this has the effect of higher grid losses as aluminium is a less effective conductor.

Furthermore, as our network grows onshore and offshore and by using more long-distance high-voltage connections, grid losses could grow proportionally higher. With the right technology for the future grid development, we will strive to reduce our carbon emissions.

As regards SF₆ leakages, currently accounting for 1% of our climate footprint, we are working hard to reduce our use of this insulating gas. Therefore we continue to work with our partners in both Germany and the Netherlands to find and implement sustainable solutions.

Resource circularity will become increasingly important in the years ahead. The scarcity of virgin copper and the reduced usage of oil puts pressure on alternative resources. To this end, we are changing our tender procedure to include stricter circularity requirements, for example by asking suppliers to provide evidence of the percentage of their materials that are recyclable and recycled with 'raw material passports'. We are also intensifying our use of LCAs, which allow us to calculate the lifetime environmental impact of products used in each project.

Considering our direct impact on nature and wildlife, we try to reduce bird collisions with our high-voltage lines by working with the right partners to identify high-risk bird spots and to implement preventive and animal-friendly bird barrier measures.

Create value to transition to a climate neutral economy

Antonella Battaglini CEO Renewables Grid Initiative

In the transition to a sustainable energy system, the grid is being fully reinforced and expanded. This also demands a lot from the environment and we have to handle this carefully. TenneT is fully committed to nature and the environment, both onshore and offshore.

“Europe faces multiple crises: an unprecedented energy crisis, intensifying climate change impacts and a drastic reduction of biodiversity, among others. Grid infrastructure is essential in the fight against climate change, energy dependencies and high energy prices. But, when electricity grids are planned and deployed in a nature-inclusive way they can contribute to biodiversity as well, and TenneT is setting a great example in this respect. The commitment to be nature net positive is a major step. Agreeing on international standards to monitor and report progresses are important next steps. Testing new practices, evaluating them and constantly increasing standards in biodiversity restoration is the way forward.”



Safeguard sustainable financial performance and investor ratings

The next years will require large scale investments in our grid as a result of the expansion of renewables in Germany, the Netherlands and Europe. This is the backbone for the energy transition. As one of the biggest investors in the energy transition in Europe, we are deeply committed to make an important contribution to this fundamental transformation of society and economy. This is also reflected in our financial strategy.

At the start of 2022, TenneT already faced a challenging investment agenda, with an ambitious project portfolio to drive the energy transition. Following the outbreak of the war in Ukraine in February, political and societal demands for energy security have intensified, resulting in calls for the energy transition to be accelerated even further.

In the short-term, the combined impact of disruption in the supply chains in the aftermath of the recent pandemic and the war in Ukraine led to higher prices of goods and services. For example increased raw material and energy prices, raised the costs of our investment portfolio and increased the costs for ancillary services which affects our working capital. Unpredictability in the financial markets, with volatile and fast-rising interest rates, further impacts our financing costs and planning for funding.

Despite the market conditions, the long-term external expectations placed on TenneT are higher than ever. Our annual investments are set to increase to deliver at least EUR 8 billion a year in projects while securing our supply chain, as both the EU and the Dutch and German governments step up their climate ambitions. Of our investments approximately 40% is allocated for projects in the Netherlands and 60% in Germany. Approximately 50% of our investments refers to onshore projects and 50% to offshore projects. These investments are necessary to reduce Europe's reliance on energy imports and boost energy security across the region to prepare for a climate-neutral energy system. TenneT's investments in reinforcing, expanding and modernising the grid are not just about affordability in the here and now. They are about long-term affordability and security of supply for society.

The strength of our long-term role in the energy transition, and our solid financial position, was evidenced during 2022 by our ability to attract the necessary financing from external parties. We always carefully weigh our decisions against three criteria: affordability, sustainability, and reliability. From a societal perspective, affordability is an increasingly important factor as the costs of the energy transition grow. As our activities are regulated and most of our investments result in societal costs, we need to be cautious and prudent that we invest wisely and grow responsibly.

To safeguard our financial health, we need to maintain our strong credit ratings and keep a healthy balance between equity and debt. We are committed to our A3/A- credit rating, as it provides us strong through-the-cycle access to the capital markets and allows us to borrow at the lowest possible costs which benefits the end-consumers we ultimately serve.

Our performance in 2022

	Performance	Target	Status	Trend
Healthy financial operations Adjusted underlying EBIT group ¹⁾ (EUR million)	1,162 1,162 801 796 2022 2021 2020	835		Adjusted underlying EBIT group is higher than target and 2021, mainly due to higher interest rates that increase our cost of capital reimbursement and an increase of the non-regulated results.
Satisfied capital providers ROIC group (%)	4.9% 4.9 4.2 5.1 2022 2021 2020	4.0%		The ROIC group is above target and 2021, mainly due to higher EBIT.
Safeguarded capital structure²⁾ Adjusted FFO/ Net debt group	9.7% 9.7 10.5 11.3 2022 2021 2020	8.5%		FFO to net debt decreased compared to 2021 but is still above target. The net debt position increased due to the pre-financing of the ancillary services costs.

¹ Reference is made to next page.

² Reference is made to Note 17 of the financial statements.

Impact of Ukraine war

The Ukraine war has had a notable impact on TenneT's activities, accelerating rises in energy prices, as well as driving strong awareness of the importance of security of supply. To this end, TenneT is seeing companies accelerating their investments in electricity demand and governments becoming more proactive and ambitious in bringing about the energy transition. Both the Ukraine war and the COVID-19 pandemic had a major impact on the prices of the raw materials TenneT uses in its assets. This includes steel, aluminium and copper. High market price-levels of energy have also led to a significant increase in ancillary services costs.

Ancillary services costs

The ancillary services costs increased from EUR 3,465 million in 2021 to EUR 6,439 million in 2022. Ancillary services are costs TenneT must incur to compensate for grid losses, to maintain the energy balance in the grid, and to pay for alternative routes for the electricity when grid sections are congested or unavailable due to grid expansions. The increase of the ancillary services costs is mainly caused by a price effect and partly caused by volume effects. The electricity prices reached record levels in 2022, which impacted the costs of (balancing) capacity

and energy products. The necessary planned outages in combination with the increasing infeed of renewables cause additional transmission restrictions and grid losses. Transmission restrictions are further impacted by changes in the availability of generating units as a result of the Ukraine war.

Since the higher costs of the ancillary services costs will be reimbursed through future tariffs, underlying revenues increased accordingly and as such there is no impact on our underlying EBIT. As the ancillary services costs are reimbursed in future tariffs, TenneT will receive the cash flows at a later stage and as such TenneT is pre-financing these higher ancillary services costs.

Underlying revenues and EBIT

Underlying revenue increased by EUR 4,171 million to EUR 9,840 million. The increase in the underlying revenues can mainly be explained by:

- The higher costs for ancillary services in 2022 resulting in higher underlying revenues, since those higher costs will be reimbursed through future tariffs;

- Increased revenues due to ongoing and increasing investments, resulting in a growing regulatory asset base and higher onshore and offshore revenues which are based upon these asset base values;
- Increased regulatory returns due to increased interest rates.

The underlying operating result (EBIT) increased by EUR 376 million to EUR 1,210 million. The increase of our EBIT is partly caused by higher revenues as a result of increased regulatory returns due to increased interest rates. The increase of interest rates will be reflected in increased future finance expenses which are not part of EBIT. Higher auction receipts resulted in an increased result of our non-regulated joint venture BritNed, compared to 2021 amounting to EUR 66 million. As per segment, for the TSO Netherlands EBIT amounted to EUR 312 million (2021: EUR 225 million) and for the TSO Germany to EUR 791 million (2021: EUR 561 million) during this period. For our non-regulated businesses EBIT amounted in 2022 to EUR 107 million (2021: EUR 48 million).

The adjusted underlying EBIT increased from EUR 801 million in 2021 to EUR 1,162 million in 2022.

Underlying EBIT group*

EUR million



* Refer to note 2 of the financial statements.

IFRS results

Underlying financial information is based IFRS plus the principle of recognising regulatory assets and liabilities for all of our regulated activities. This implies that amounts resulting from past events and which are allowed to be received or are required to be returned through future tariffs are recorded as an asset or liability, respectively. TenneT's Executive Board believes that the presentation of underlying financial information provides additional relevant insight in the actual financial position, financial performance, and as such economic reality. By comparison, the consolidated financial statements are prepared based on the International Financial Reporting Standards as adopted by the European Union (hereafter: IFRS). Based on prevailing opinion on IFRS it is not allowed to recognise amounts to be received or are required to be returned through future tariffs.

As such our IFRS result reflects only to date our high costs during 2022, mainly due to the earlier described ancillary services costs, but does not account for future reimbursements we will receive through correspondingly higher tariffs from grid customers. As a result, TenneT reports an IFRS EBIT loss for 2022 amounting to EUR 976 million (2021: loss EUR 275 million).

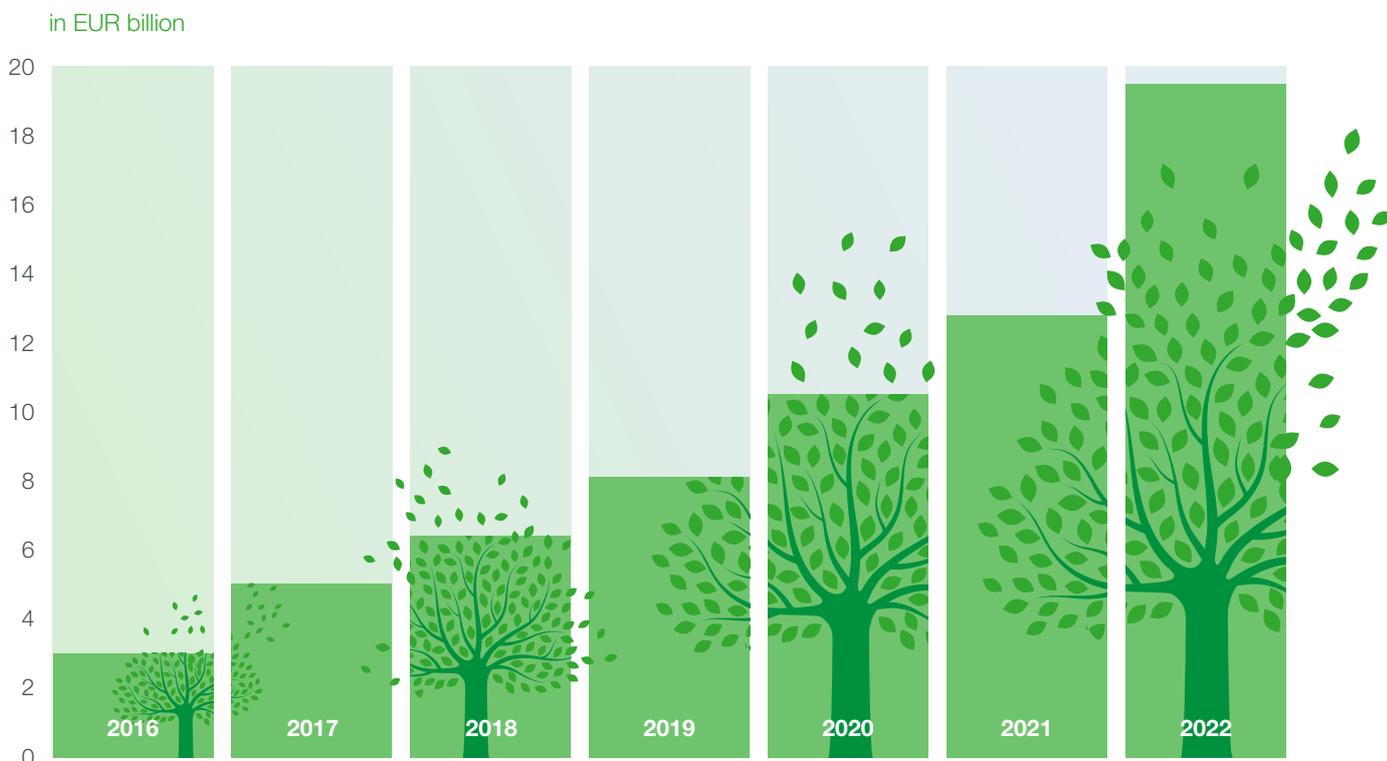
Investments and raising the necessary funding

TenneT is one of the largest investors in the energy transition in Germany and the Netherlands. A significant part of our investments are directly linked to the energy transition. The investment programme can be divided into approximately 40% for the Netherlands, 60% for Germany and the allocation between onshore and offshore is approximately 50%/50%.

During 2022, within a complex and unpredictable external environment, TenneT continued its strong efforts to drive the energy transition, investing EUR 4.5 billion in the grid (2021: EUR 4.0 billion) and once again maintaining a high grid availability of 99.99963%. TenneT expects to deliver at least EUR 8 billion annually on projects in the coming years in the onshore and offshore grids in the Netherlands and Germany in accordance with the national energy policies of both countries.

Broad and sustainable access to financing is a pre-requisite for realising these investment goals and making the energy transition happen. And 2022 has made clear that transitioning to clean energy – and fast – is also necessary for political and economic security.

Outstanding green debt



We need to ensure that these investments are financed with the right mix of equity and debt. TenneT must incur expenses before returning revenues and profits. To realise investments such as ours and build a grid that is future-proof, we need to have funds readily available – at the right cost. Part of those funds come from equity and the majority from borrowings, mostly green bonds as well as other debt. Even with the high investment and financing need in mind, our strong credit ratings were reconfirmed in 2022.

While inflation and interest rates are rising, we are still well positioned to raise the necessary financing in the debt capital markets. Our Green Bonds, issued in May (EUR 3.85 billion) and October (EUR 3.0 billion) were amongst the largest EUR corporate bond transactions in 2022. Apart from our strong credit ratings, we benefit from the fact that our Green Bonds are exactly that: green. They stand to pass the sustainability checks and balances an investor might test them against. And, of course, we will continue our efforts to report transparently on our sustainable performance in order to maintain broad and sustainable access to financing – green or otherwise. More details about our Green Bonds can be found in our Green Finance report.

In order to maintain our A-/A3 credit ratings and to realise our investment-portfolio, TenneT's internal policy is to maintain a long-term average funds from operations (hereafter: FFO) /Net debt ratio (based on adjusted 'underlying' financial information) of at least 8.5%, which meets the requirements for an A-/A3 credit rating as formulated by Standard & Poor's (hereafter: S&P) and Moody's. The aim to keep the long term average adjusted FFO/Net Debt ratio above 8.5%, while funding the investment plans requires additional equity in the foreseeable future. The exact amount and timing of the equity need depends on new energy transition policies of governments driving the investment agenda, changes in the regulatory framework and on the inflationary impact on the cost of our investment projects.

To support our strong credit rating and fund the investments in the Netherlands, the Dutch state included EUR 5.11 billion of equity in the state budget till 2025. Of this budget, EUR 1.2 billion was received in 2022. The amounts for 2023, 2024 and 2025 of respectively EUR 1.8 billion, EUR 0.6 billion and EUR 1.5 billion as included in the budget are conditional and subject to final reviews. The Dutch state has allocated the capital contribution to the Dutch investments.

TenneT and its shareholder, the Dutch state, are engaged in discussions with the German government to explore the possibility of a full sale of TenneT's German activities on acceptable terms.

Our financial strategy is focused on maintaining our credit rating at a minimum of A-/A3 and generating returns on investment in accordance with our risk profile. In 2022, our A- credit rating from S&P and our A3 rating from Moody's were reaffirmed again. Also, our ESG evaluations were reaffirmed by external rating agencies. For example, S&P again classified us as 'strong' with a score of 86/100 and Sustainalytics indicated that TenneT is at low risk of experiencing material financial impacts from ESG factors.

The adjusted FFO/Net debt ratio decreased from 10.5% per 31 December 2021 to 9.7% per 31 December 2022. The decrease is mainly caused by the regulatory framework

which requires TenneT to pre-finance the ancillary services costs directly which will flow back to TenneT in the future years through the tariffs. Per 31 December 2022 TenneT has approximately pre-financed EUR 2.5 billion for which debt has incurred resulting in decreased FFO due to higher interest expenses, whereas net debt increased. The adjusted FFO/Net debt ratio adjusted for the pre-financing of the ancillary services costs that will be settled in future tariffs is: 11.0% per 31 December 2022 (2021: 10.8%).

Contribute to achieve a reliable and predictable regulatory framework which supports our financial strategy

Propelled by the war in Ukraine and the desire to gain independence from Russian natural gas, our investments in a carbon-free, secure, and reliable electricity grid are gathering pace. This requires constant vigilance and sustained investment.

Our societal financial impact on households in our serving area

As we are serving society as a state-owned company, safeguarding our financial health is of paramount importance. Our revenue consists of the regulated income we receive for costs we incur to fulfil our task of securing supply today and tomorrow. Designing, building, maintaining, and operating a future-proof grid comes at a cost which households and companies contribute to via the payment of grid fees. We have calculated our societal financial impact on households in our service area. We have assessed our impact on the electricity invoice (retail of electricity; taxes, charges and levies; grid fees) of an average household in the Netherlands and in Germany. In Germany, our share is around 4.8% (2021: 5.6%). The impact with respect to the electricity bill on households in the Netherlands is more difficult to determine. This is due to the energy price compensation measures of the Dutch government in 2022. When we disregard the compensation measures (direct and through lowered taxes/levies), it is estimated that the share is approximately 9.1% (2021: 9.0%). When we do take the compensation measures into account, the part of the electricity bill exceeds 100%, as compensation measures fully negates: taxation, retail costs and DSO grid fees for the average household (note that the effects will differ per individual household).

TenneT sees that their part of the electricity bill (the numerator) has increased in the Netherlands, however, as the wholesale price of electricity also increased, this did not lead to a significant increase to our share relatively. On the German side, TenneT noticed that its part of the electricity bill slightly decreased compared to 2021 and the total electricity bill increased also due to the increase of the wholesale price of electricity.

The share of TenneT both in the Netherlands and in Germany might increase over the coming years, as the costs for the energy transition may rise, amid increasingly ambitious climate goals. TenneT noticed that governments are taking measures to reduce the impact of substantially increased energy prices for households and the effects of the investments required to build and maintain the grid to be able to secure supply today and tomorrow. An example of keeping the tariffs stable, is the measure by the German government to lower the effect of the required investments by ways of a federal grant. Of course the effect this has on the overall electricity bill of a household in our serving area will depend on the development of the wholesale price in the future.

The application of the EU Taxonomy at TenneT

The EU Taxonomy is a classification system, which helps to determine which economic activities related to a certain organisation can be considered to be environmentally sustainable. The aim is to provide clarity and a level-playing field on the contribution companies have in meeting Europe's environmental goals in relation to the EU Green Deal. Last year, organisations like TenneT were requested to disclose the degree to which the economic activities of organisations are eligible to the EU Taxonomy. In 2021, we had performed this assessment and determined that our economic activities are eligible. This is because our primary tasks are to provide electricity transmission services and system services and to facilitate the energy market. Those economic activities are linked to NACE code D35.12 and are concluded to substantially contribute to climate change mitigation, since TenneT is transmitting and distributing renewable energy in line with Directive (EU) 2018/2001, including necessary reinforcement or extension of the grid. In line with technical screening criterium 4.9 'Transmission and distribution of electricity' on climate mitigation.

Most of our activities (the regulated business of the TSOs in the Netherlands and Germany) are eligible, since our grid is part of the interconnected European system. Our non-regulated activities were considered ineligible and have therefore been excluded.

The next steps taken in 2022

Determining the eligibility regarding the EU Taxonomy is merely one part of the equation. The next steps are to show so-called 'alignment to the EU Taxonomy'. This means that, next to the assessment performed to determine eligibility, we also needed to assess whether we meet the 'Do No Significant Harm' (DNSH) criteria set forth in the technical screening criterium 4.9 as mentioned above. This relates to the environmental goals related to 'climate change adaptation', 'transition to a circular economy', 'pollution prevention and control' and 'protection and restoration of biodiversity and ecosystems'. The environmental goal of 'water and marine resources' is considered not applicable according to the guidance in criterium 4.9.

In addition, organisations need to state that they meet minimum safeguards. These relate to the topics of human rights, corruption, taxation and fair competition. We reviewed the criteria related to the 'Minimum Safeguards' to determine whether we believe we meet these requirements. By performing procedures, such as interviews with subject matter specialists within our company and review of documentation, we believe that we are able to meet both the DNSH criteria as well as the minimum safeguards and that our economic activity still aligns with the environmental goal of climate change mitigation. Also, we needed to verify which part of our eligible activities are also considered to be 'aligned' with the EU Taxonomy. This to determine which part of our overall revenue, operating expenses (OPEX) and capital expenditures (CAPEX) are considered to be Taxonomy aligned. We therefore performed an assessment to determine which part of our infrastructure relates to a direct connection between our substation or network and a power production plant that is more greenhouse gas intensive than 100 gCO₂e/kWh measured on a life cycle basis. We have excluded these from our final calculation to determine the reporting metrics related to this regulation.

Reporting metrics with respect to the EU Taxonomy

Based on this conclusion, we then calculated the amounts of investments, revenues and operating expenditures that are associated with this economic activity, which is in alignment with the EU Taxonomy and determined which percentage this constitutes compared to all economic activities. This results in the following percentages:

Total group aligned turnover: 98%
Total group aligned CAPEX: 100%
Total group aligned OPEX: 99%

More detailed information on this can be found in the table. Details regarding the calculation and the accounting policy related to these metrics, please refer to the additional information included in the section 'EU Taxonomy disclosure'.

As the TSO's responsibility, we need to deliver onshore and offshore grid expansion and renewals – on time and within budget. To drive the energy transition, a range of decisions must be made from standards on manufacturing devices, leaner permitting procedures, integrated system planning (including hydrogen) to close(r) co-operation with large customers, consumers, other TSOs and DSOs. This requires European and national legislation and regulations to keep pace with developments, as well as an investment framework that enables us to meet the needs and objectives of businesses, households, the economy, and politics. Our investments and operations need to be supported by a regulatory framework with a long-term focus and a high degree of reliability and predictability. While regulatory periods are typically only established for a period of three to five years, the underlying methodologies in principle provide a stable long-term regulatory framework in both the Netherlands and Germany. The nature of our business and the scale of the energy challenge require us to think decades ahead to determine how and where to invest. We need to be able to rely on a regulatory framework which can do the same and allows us to recover our long-term investment costs and our operational costs.

Together with Strategy& TenneT performed a study regarding improving the TSO regulation in the context of the European Green Deal. Regarding operational expenditure (OPEX) non-recovery we conclude that as operational costs are expected to rise structurally, the current revenue regulation frameworks, based on historical costs, leads to under-remuneration of operational costs. As such we propose forward-looking estimates for capitalised expenditure (CAPEX), OPEX and ancillary services costs. Revenue regulation should incentivise TSOs to implement cost efficient solutions in situations where OPEX- or CAPEX-based solutions are substitutes and as such a total expenses (TOTEX) approach is preferred. Moreover we conclude that incentives to stimulate and boost more innovation such as digitisation and flexibility are needed as the current framework does not create sufficient momentum.

To this end, the regulatory framework in the Netherlands was changed by the new estimation method for OPEX and CAPEX. A shortfall in estimation that is based on historical data is mitigated by ex-post settlement of all investments with a in fixed assets useful life of more than 10 years, as growth is expected based on the planned investment of the Investment Plan. The regulation furthermore provides for the timely recovery of investments of national importance ('Rijks Coördinatie Regeling' investments) by means of direct compensation in the year the costs occurred (T-0).

The operational costs estimates are based on a historical average of three years. Operational expenses for onshore are adjusted by 1% of the change in acquisition value of the projects to reflect growth and decline in operational costs as a result of changes in the asset base.

The regulation makes use of non-robust efficiency measures as a result of a flawed international TSO benchmark. TenneT clearly demonstrated the limitations and showed that the benchmark result cannot be applied. Following discussions, ACM amended the efficiency score from the initial result of 71.5% to 89.1%. TenneT challenged this decision in court, as the additionally outcome is still too low in our view.

TenneT also filed an appeal on the changed regulation for the operational costs (not ancillary services) of the system operator and the project specific efficiency assessment of Borssele. The results of the court case are expected in Summer 2023.

Together with all Dutch grid operators TenneT also filed appeal against the determination of the WACC.

In Germany, the regulatory framework for investments (on- and offshore) also changed within the last years. A deterioration was avoided due to grandfathering rules and transitional regimes. TenneT considers that regulatory changes should never devalue already-taken investments as this undermines investors' confidence in the regulatory framework. After the harmonisation of DSO and TSO investment frameworks and the Court of Justice of the European Union decision against Germany, TenneT holds the view that BNetzA should keep established and proven principles of a reliable and transparent regulatory framework, while exercising freedom of judgement to allow for more innovative and future-orientated solutions to society.

In Q2 2022 ACM issued a statement with its intention to assess a financing solution for the impact of the current shortfall in remuneration for the costs of ancillary services due the current market conditions. ACM has meanwhile communicated its intention to include an advance (between 25%-40%) of the expected difference between the budgeted and actual costs of ancillary services for the year 2023 in the tariff proposal for 2024. ACM has indicated that the final chosen percentage within the indicated range will depend on the stability of the expected tariff developments. ACM has the intention to include an advance in the tariffs of 2025 and 2026 as well, if the market conditions provide reason to do so.

In 2022, we achieved a significant regulatory milestone in Germany, when the government agreed to compensate for the higher grid fees that TenneT and other TSOs said they must charge in 2023 to reflect escalating wholesale power prices and ancillary services costs, such as redispatch. With grid fees accounting for around 4.2% of domestic energy bills and around 1.0% for industrial customers, the government's compensation of around EUR 13 billion means the TSOs cost increases are expected to be absorbed. As a result, our grid fees in Germany for 2023 will remain on the level of 2022.

What could prevent us from realising our goals?

TenneT's revenues depend mainly on the regulatory frameworks in the Netherlands and Germany and are important to finance our grid investment needs and operational costs. Any adverse changes of the regulatory framework or economic developments not catered for in the regulatory framework could impact TenneT's overall financial performance. To address this risk, a reliable, appropriate and future-proof regulatory framework is needed and supported by a study with Strategy& as earlier mentioned.

The costs for ancillary services, such as for congestion management, balancing power and other system services, are rising significantly because of the Ukraine war which had a significant impact on the cost calculations of TSOs. These would have resulted in increased network charges. In Germany, the increase would have been of around 250%, of which 95% would have been due to the rising costs of system services. In order to cushion these considerable burdens for end-consumers and industry, TenneT, together with the other TSOs, advocated for proposals to stabilise

the increase of German network tariffs by making use of a federal grant. As a result of the political negotiations with on the so-called 'third relief package' TSOs were successful in keeping transmission grid fees stable. The necessary budget of nearly EUR 13 billion is expected to be served from the proceeds from the skimming of windfall revenues of electricity generators and Germany's Economic Stability Fund (WSF). For 2023 electricity prices have dropped substantially and we expect this to have a dampening impact on the redispatch costs. In addition, an increase of our grid volume induces a further financial impact on our ancillary services. Ancillary services costs affect TenneT in multiple ways. Firstly, it puts pressure on our working capital needs and although compensated in a few years from now, the tariffs negatively impact today's IFRS result. Secondly, our ancillary services costs are rising above the planned budgets such that the tariff revenue received today is insufficient and leads to additional financing needs.

To deliver our future projects on time, additional equity is required. While TenneT is still in a strong and healthy financial position, there is a risk that our current credit rating of A- (S&P) or A3 (Moody's) could not be maintained. This risk could occur in the scenario of increasing investment volumes while not being able to raise sufficient additional equity on time. While it would be possible -although not easy- to attract future debt by issuing green bonds, as TenneT has successfully done in the past, this could negatively affect the FFO/Net debt ratio and further induce negative pressure on our credit rating. Therefore, attracting equity on time to finance our operations and to maintain a healthy balance between debt and equity becomes and remains important.

Electricity Revenue Cap in Germany

The Electricity Revenue Cap Act ('Strompreisbremsegesetz, StromPBG') was passed by the German legislator on 20 December 2022 and went into force on 24 December in the same year. It aims to protect domestic end-consumers in 2023 from strongly increased electricity prices resulting from the turmoil on the energy markets in Europe following the Ukraine war. Energy suppliers will process the price caps in their individual invoices with end-consumers. The aggregated financial impact of this will be paid out starting in the first quarter of 2023 by the TSOs to the energy suppliers on the basis of aggregated volume data. The TSOs are compensated for these payments

by direct transfers from the government and by funds received from electricity generators. To enable the process, detailed rules for the calculation of excess revenues from generators as well as for the settlement and pay out to end-consumers are determined in the law. Furthermore, the German regulator BNetzA has an oversight role in the process. Payments from TSOs to end-consumers via the energy suppliers started in February 2023 with retroactive effect as per January. First governmental transfer payments to bridge-finance occurred in February 2023. The first inflow of excess revenues from generators is expected for mid of August 2023. TSOs do not expect any liquidity or profitability risks from the regime which they perform as trustees of society and on a pass-through basis.

Sigrid Kaag

Minister of Finance of the Netherlands



In the energy system of the future, there is an important role for offshore-generated wind power. As manager of the offshore electricity grid, TenneT performs the important task of connecting this green power to the national electricity grid.

“The government's objective is to generate around 21 gigawatts of electricity via offshore wind around 2030. I am impressed by the innovative solutions TenneT is developing to carry out this task as quickly, reliably and at the lowest possible social cost. The production and transmission of this green power is essential for the future of the Netherlands. Firstly, of course, to combat climate change, but also to become more independent in our energy supply. We need to become independent of Russian gas as soon as possible and our own energy generation is crucial for this.”



Safeguard sustainable
financial performance
and investor ratings

Solve societal challenges with stakeholders and through partnerships

The energy transition is one of the biggest technological and societal challenges of our times. Shifting from fossil-based power to mainly renewable power by the EU's target of 2050 means that Europe's energy system will undergo fundamental changes in the coming decades. The task of achieving these goals is too great for any one player to act alone. It requires smart solutions and a tremendous collective effort from multiple stakeholders.

As a leading European TSO, TenneT plays a key role in realising Europe's clean energy targets. With our knowledge, expertise and vision, we can provide valuable insights into the future energy landscape. But to accomplish this, we need to work together with a wide range of partners to find innovative solutions, work more efficiently and at the lowest achievable costs. That is why we collaborate intensively with partners within and outside the sector, including with academic institutions, government agencies, technology providers, suppliers and other players in the energy market.

TenneT seeks to actively participate in the dialogue and co-operation with our stakeholders to address the complexities of the energy transition. For example, in the Netherlands we have a close co-operation with all DSOs in the association Netbeheer Nederland. In addition, we work together with other European TSOs as a member of the European Network of Transmission System Operators (ENTSO-E), and with industry partners through co-operation with industry associations such as Bundesverband der Deutschen Industrie (BDI), Energie Nederland and Vereniging voor Energie, Milieu and Water (VEMW). Furthermore, we are a member of the Nederlandse Vereniging voor Duurzame Energie (NVDE) and participate in think tanks such as Agora Energiewende on topics related to the energy transition. These partnerships are essential not only to deliver on our own strategic goals, but also to achieve the societal objectives of building an affordable, reliable and sustainable energy system.

Traditionally, our electricity model was based on a simpler model where a small number of power generation plants would serve a large number of customers, with electricity transmitted over relatively short distances. Today, electricity can be generated in any place, from home roof-mounted solar panels to onshore wind turbines and large wind farms far out in the North Sea. With widely distributed sources of power, small and large, and the volatility of the weather, a renewables-based electricity system has to be designed in

a completely new way. This brings huge challenges for the usage and expansion of the electricity network and the dynamic stability of the power system.

Strategic partnerships and innovation are not only essential to unlocking new technological solutions that drive the energy transition; they are also critical to TenneT's strategic objectives to secure supply today and tomorrow, energise our people and workforce and safeguard our financial health.

As new technologies transform the way electricity is generated, carried, stored, traded and consumed, innovation is also important for market design. The latter includes the entry of small and larger parties that will play an important role in maintaining the balance on the high-voltage grids and/or providing the necessary flexibility in a system largely based on weather-dependent energy sources.

Our performance in 2022

In the challenging times experienced in the energy sector during 2022, innovation and partnerships remain at the top of the agenda for TenneT. Considering the push by national governments to achieve greater energy security and the recent acceleration in Europe's ambitions for offshore energy, we believe that innovation and partnerships are key in designing the future energy system. This is why our innovation efforts are focused on the technology and solutions needed to develop a high-capacity and integrated offshore and onshore future grid.

Part of the innovation process at TenneT takes place bottom-up, with ideas generated by employees as well as external stakeholders, for example through crowdsourcing. Crowdsourcing is the process of connecting large groups of people based on their knowledge, expertise, commitment or profession. Top-down, the innovation process is driven by TenneT's mission and strategic priorities.

Our partnerships with the academic world, research centres, DSOs and TSOs, and our involvement in various

associations such as CIGRE or ENTSO-E also play an important role in our innovation process. During 2022, TenneT was actively involved in over 90 innovative projects.

Partnerships to secure supply, today and tomorrow

In 2022, energy security in Europe became an urgent issue. As such, renewed focus was placed on accelerating the shift to a future-proof energy system and developing cross-border connections and market solutions for boosting security of electricity supply in Northwest Europe. At the same time, the rapid increase in offshore wind and solar generation, as well as electrification by industry and consumers, has put pressure on our onshore grid and raised the need for technological solutions and partnerships to increase the capacity and utilisation of our system (see [‘Deliver a high security of supply’](#) chapter). Although we are building new assets to increase grid capacity every year, we cannot relieve all bottlenecks within the grid, leading to more congestion.

In 2022, several innovation projects focused on securing supply today and tomorrow by advancing the technologies required for a high-capacity and integrated offshore and onshore grid. Through these partnerships, we aim to tackle some of the main challenges that we foresee in securing supply, today and tomorrow.

Innovating DC technology

The future electricity grid will increasingly depend on high-voltage DC (HVDC) technology, as it allows TSOs to transmit far higher volumes of DC power to the onshore grid over much longer distances. It also results in lower grid losses, more cost-efficiency and a lower environmental impact. However, developing an interconnected and interoperable DC grid requires significant innovation in DC technology, requiring the collaboration of multiple partners alongside TenneT.

For example, it will require DC circuit-breakers and interoperable multi-vendor DC convertors. To develop these new technologies and other solutions, TenneT participates in **READY4DC**, a large and diverse community of experts, including technology suppliers, which will assess the major technical and legal aspects of building an interoperable multi-terminal, multi-vendor DC grid in Europe.

Another key challenge of innovating DC technology is interoperability, as multiple converter stations from a variety of technology providers (multivendor) will need to be integrated. To explore this topic, TenneT is involved in a partnership project called **InterOPERA**. Focused on

enabling interoperability of multi-vendor HVDC grids, the project proposes a coordinated approach between a diverse, high-level group of industries at the forefront of renewable energy development and grid management. With four HVDC vendors, eight other TSOs, two wind turbine vendors and three wind park developers, the project brings industrial knowledge and practical abilities together to make future HVDC systems mutually compatible and interoperable by design.

TenneT is also working with partners to ensure the development of HVDC technology in future grids is as reliable as possible. This will help ensure HVDC can contribute to security of supply in a renewables-based energy system and help to accelerate the energy transition. These aims are the focus of **HVDC-Wise**, a multidisciplinary project engaging 14 partners from 11 countries including five academic institutions, four TSOs and five industrial bodies. It will assess future HVDC-based grid architecture concepts and their ability to fulfil TSOs’ resilience and reliability needs. The project will identify and assess new technologies for HVDC-based grid architecture and how they could be deployed in widespread AC/DC transmission grids.

Finally, the development of DC grid solutions requires the efficient integration of the onshore- and offshore grid. With fellow TSOs and technology suppliers, we are working together on the development of **Multi-terminal DC hubs** to support extremely large amounts of renewable energy sources being fed into the grid and distributed to end-users without causing congestion in the network. More on this can be found in the chapter [‘Ensure critical infrastructure for society’](#).

Increasing grid utilisation

One of the most important ways to secure supply today, is to improve the resilience of our grid and maximise the use of our existing assets: by improving grid utilisation, we can do more with what we already have. This reduces the need to constantly expand our grid, and thereby benefits society by allowing us to drive the energy transition faster, with improved affordability and security of supply.

This was the core aim of the InnoSys 2030 research project, which was successfully completed in December 2021. A total of 17 partners including transmission and distribution system operators, control system manufacturers and research institutes, investigated how grid utilisation can be increased over a three-year project, with new concepts, simulations, demonstrations and field experiments. The consortium developed a roadmap that provides an implementation path for the new concepts, such as load

flow optimisation and 'curative' remedial measures, until 2030 and beyond. Part of these follow-up actions are being taken up in a new project introduced in 2022 called **PROGRESS**.

Optimising grid control

Similar to the InnoSys 2030 project, the **Control Room of the Future (CROF)** aims to prepare system operations for the future, from methodology, process and tools perspectives. For instance, it looks at increasing grid utilisation and automation, by making TenneT's grid control centres future-proof so they can handle the challenges of our increasingly data-driven grid. The CROF programme also supports our operators as they adapt to the new systems and workloads associated with our changing grid, including training and skills. A roadmap for the CROF R&D programme has been set, including software development, grid data, grid security assessment, system dynamics, decision support, communication interfaces and operator training. The roadmap for technology and methodology includes several topics that are to be developed until 2031.

Digitalisation and data exchange

Designing a resilient and efficient energy system of the future will depend on a reliable and secure architecture for exchanging data across borders, between different energy players and with consumers. It will also need to be robust, to cope with increasing decentralisation and complexity, and enable interoperability between energy systems. To work towards this goal TenneT is among partners participating in the international **GAIA-X** project. Representatives from business, science and politics collaborate to create a proposal for the next generation of data infrastructure, including the realisation of sovereign data exchange in a European cloud. Having received funding in 2021, the project is scheduled for three years and, once completed, aims to set a new standard in energy data exchange.

Partnerships to drive the energy transition

To meet the challenges of the energy transition, we need to work in partnership with a wide range of players to unlock the technological solutions that will enable a climate neutral energy system for Europe. Driven by political climate ambitions and geopolitical uncertainty in Europe, the political and social momentum behind the energy transition has never been higher, requiring all stakeholders to work together to accelerate the realisation of climate targets.

Designing the future grid

At TenneT, our wide-ranging work to build the grid of the future in time to meet Europe's climate goals is organised

under our Target Grid 2045, which includes a roadmap for growing our infrastructure, using a wide range of smart solutions and innovative technology. In addition to planning the infrastructure required for a future-proof energy system, TenneT is also conducting studies to plan the market design instruments needed. This is the aim of project **MARGRET** (Market and Grid Alignment and an Efficient Energy Transition). After more than a year of research and collaboration across departments and with external stakeholders, the project team aimed to set the vision for a robust energy market design that can enable the energy transition. For example, it stressed the importance of unbiased price signals and grid tariffs, as well as accounting for physical constraints in energy prices. In total, the project produced eight viewpoints that will now serve as a guide for new initiatives related to energy market design.

Achieving the energy transition also depends on the development of a fully integrated and cross-border connected offshore grid. TenneT is already advanced with the connection of offshore wind farms to the onshore grid, but in the future it sees the need for the large scale roll-out and integration of offshore wind in the North Sea through the development of interconnected power hubs. In the long-running **North Sea Wind Power Hub (NSWPH)** project, TenneT Netherlands, TenneT Germany, Energinet and Gasunie propose a fundamentally new approach to long-term offshore grid planning, combining wind power in-feed and interconnection to surrounding North Sea countries. A research and engagement programme has been in execution which currently forms the basis for several initiatives to prepare for the first 'hub-and-spoke' projects, meaning that offshore wind farms will connect to one or several hub islands. Based on the NSWPH expertise, the Dutch government announced in 2019 that the roll-out ambitions of offshore wind from 2031 onwards will follow this hub based approach. Accordingly, the first hub projects in the North Sea are now under exploration, as well as the collaboration between the North Sea countries to jointly develop the first hub and spokes projects.

Flexibility and energy system coupling

In the future energy system, a wide variety of complementary energy sources will need to be integrated into the grid. For example, electrolysers will use wind and solar-generated energy to create green hydrogen that can be used to store electricity or as fuel for heating and transport. Batteries will also be used as a flexible source of energy, in static battery parks or in mobile devices such as electric vehicles. The coupling of these energy infrastructures will be key to the success of a renewable energy-based power system.

To plan for this, TenneT teamed up with Dutch DSOs and the gas grid operator Gasunie to conduct studies on the optimal energy infrastructure required in Germany and the Netherlands in 2050. The scenarios in **Infrastructure Outlook 2050 / I13050** show that all energy infrastructures will have to expand considerably, and that there will be a great need for new forms of flexibility, such as hydrogen storage and batteries. The studies also conclude that governmental direction is needed regarding the size and location of flexibility assets – such as electrolysers – in the energy network. Electrolysers have the potential to contribute significant electrical loads. For example, the Dutch government is planning to build electrolysers with a capacity of 3 to 4 GW by 2030, while Germany is planning 5 GW by 2030.

Furthermore, together with fellow European TSOs, TenneT is developing a Crowd Balancing Platform called **Equigy**. This cross-border blockchain platform enables participants to actively offer smaller flexibility devices, such as car or home batteries, on the electricity balancing markets. As traditional consumers of electricity can now also become a provider of flexibility services, Equigy opens up the market to more participants and aims to increase decentralised flexibility by doing so.

Accelerating our projects through partnerships with suppliers

To make the energy transition happen in the relatively short time of European climate targets, we need to work closely with our contractors, building long-term relationships that give them confidence to invest and share our growth. Given the volatile supplier market and supply chain disruption that increased in 2022, it is even more critical for TenneT to create long-lasting relationships with its key contractors. This philosophy was piloted in 2021 with the **EU-303 framework** contract, initially used in onshore substation building and maintenance contracts in the Netherlands with nine of our international supply chain partners. Following the success of this model, further EU-30x and other framework contracts were developed in the course of 2022, most notably with the new framework agreements introduced for tenders for our pioneering **2GW Program** (see '[Ensure Critical Infrastructure for Society](#)'), with a focus on sustainability.

Partnerships to energise our people and organisation

As TenneT aims to accommodate a workforce of up to 10,000 people by 2025, we need to step up our efforts to hire new talents and retain our current workforce. Therefore, we need to create an energising, inclusive, diverse and sustainable workplace, where people from all types of backgrounds can thrive. This requires innovative approaches and new partnerships with stakeholders within and outside the energy sector.

Academic partnerships

To foster connections and recruit new talent – especially scarce technical talent – it is essential for TenneT to forge close partnerships with the academic world and research centres, such as **FAU Erlangen-Nürnberg, TU Ilmenau** and **TU Delft**. With the **University of Bayreuth**, TenneT has signed a letter of intent aimed to foster knowledge exchange and joint research projects, as well as training and marketing of an energy cluster in Bayreuth. In the Netherlands together with the vocational education institute **ROC van Twente** TenneT is offering a new module specifically designed to prepare technicians for the energy transition. Vocational technical training programmes like this are essential for building the talent resources we need to drive the energy transition at speed and scale in the Netherlands and Germany.

Attracting diverse talent

For many years, TenneT has worked closely with the **Refugee Talent Hub** in the Netherlands and **TENT Partnership** in Germany to provide opportunities for refugees through apprenticeships and vocational training. Both schemes link refugees and employers with paid employment as the goal. We are keen to offer opportunities for learning and potential employment with refugees, which also helps to drive the diversity of talent we have within TenneT. In 2022 we organised open days with Refugee Talent Hub to allow refugee talents to learn more about the company and to meet members of staff. In 2022 we were proud to offer 10 newcomers a work experience position. Of the newcomers that started before 2022, seven have found permanent employment at TenneT.

Collaborative innovation

To engage and connect diverse talent and drive ideas forward internally, we have set up a collaborative innovation network called the **Acceleration Room**. It was established to improve our internal transparency and company-wide communication regarding TenneT's innovation activities.

It also helps us to accelerate ideas at an early stage by connecting different units of the organisation to share insights and latest developments on our wide-ranging innovation work.

Partnerships to safeguard our financial health

To ensure we are able to meet the expectations of our capital providers and also contribute to an affordable energy system, we aim to make the right choices to help achieve this. This means working together with stakeholders that can provide us the option to finance future projects, doing so with better conditions that help us deliver on our strategic ambitions.

Dialogues with our regulators

To secure our financial health, TenneT aims to contribute to a reliable and predictable regulatory framework that supports our (financial) strategy. Therefore, we engage in dialogues with our regulators to discuss our strategy and the role of regulation in this. In 2022, we organised Board to Board meetings with Dutch and German regulators, and also held meetings with our national regulators and ACER to explain our strategic topics. In addition to this, we were in intensive exchange with all relevant stakeholders regarding the development of the grid fees for 2023 and specifically discussed the reimbursement of significantly higher costs for ancillary services. Finally, we held several meetings to prepare the fourth regulatory period in Germany (2024-2028) and continued the appeal process against the current regulatory period in the Netherlands (2022-2026).

Our co-operation with co-investors

To finance the expansion of offshore grid connections, TenneT co-operates with external co-investors such as KfW-IPEX, Copenhagen Infrastructure Partners (CIP) and Chubu Electric Power. Via separate legal entities the co-investors contribute equity and receive financial participation rights in return. Their contribution helps to ensure adequate financial ratios. Furthermore, their participation strengthens TenneT's interest in a reliable and stable regulatory framework as co-investors interests have been communicated to policymakers and regulators.

Partner banks

To secure a solid financing and ensure that we can drive the energy transition in an affordable way, we maintain strong relationships with our shareholder, the Dutch state, and with the banks that participate in TenneT's Revolving Credit Facility (RCF) – ABN AMRO, BNG, BNP Paribas, Commerzbank, Deutsche Bank, HSBC, ING, NatWest, Rabobank, Santander, UniCredit and SMBC. The majority of these relationship banks also participated in TenneT's previous RCF, showing the strength of our long-term relationships. Through these partnerships, we are able to secure our financing.

In 2022, we issued EUR 6.85 billion of Green Bonds with the support of our banking partners and have become the largest EUR corporate green debt issuer globally. The financial importance of this model is strengthened by the growing number of investors seeking to invest in companies that contribute to the EU's Green Deal ambitions, such as companies with activities that align with the EU Taxonomy. More information on how TenneT assessed how our activities are eligible with the EU Taxonomy can be found in the chapter '[Safeguard sustainable financial performance and investor ratings](#)'.

What could prevent us from realising our goals?

In 2022, the turbulence in the energy markets and energy crisis – caused by Russia's invasion of Ukraine – increased the urgency to accelerate the energy transition by the Dutch and German governments. This was demonstrated by the recent Esbjerg Declaration of May 2022. As two-thirds of the capacity in this ambitious offshore plan (40 GW) is accounted for by TenneT, the scale of the challenge is clear.

To accomplish the innovation portfolio, it is essential to establish a wide range of skilled partners and develop innovative solutions together, for instance with the European Network of Transmission System Operators (ENTSO-E), academic institutions, government agencies and technology providers. We need to continue developing attractive and mutually beneficial business solutions – such as our long-term framework agreements for our 2GW Program – to ensure we bring our best partners with us to achieve our goals. Therefore, it remains important to focus on the right processes and improve where necessary so that we can attract the right partnerships at the right time.



Supervisory Board (fltr): Stijn van Els, Ab van der Touw, Laetitia Griffith, Edna Schöne, Essimari Kairisto.

Ultimately, TenneT relies on strong partnerships with a wide range of stakeholders enabling us to achieve the 2025 and 2030 targets. Getting there will involve collaboration, negotiation and the balancing of common and individual goals, but the destination of a clean energy future is shared by all.

Find out more about Innovations at TenneT





Albino Marques

Coordinator for the Continental Europe Region of ENTSO-E's Operation Committee



Following an urgent request by Ukrenergo and Moldova for emergency synchronisation, the TSOs of Continental Europe agreed to start on 16 March 2022 the trial synchronisation of the Continental European Power System with the power systems of Ukraine and Moldova.

“Co-operation is the heart of ENTSO-E, the European Network of Transmission System Operators for Electricity. The interconnection of the transmission grids happened on 16 March 2022 - 17 days after request and more than 1 year before planned. This acceleration of the synchronisation project, ongoing since 2017, has been possible thanks to the previous studies carried out and the adoption of risks mitigation measures. Continental Europe TSOs are now supporting the stability of the Ukrainian-Moldovan power system and at the same time making available interconnection capacity to allow export or import of energy as needed by Ukraine and Moldova. The extraordinary will of co-operation and help of all TSOs (also for humanitarian reasons) was key for the success of the work of the Task Force that was put in place the day after Russian invasion. This was an outstanding example of what cooperation between TSOs can achieve.”

Solve societal challenges with stakeholders and through partnerships

Statements of the Executive Board

The Executive Board is responsible for designing and operating TenneT's risk management and internal control system, and for reviewing its effectiveness.

Statement of responsibility

The Executive Board is responsible for designing and operating TenneT's risk management and internal control system, and for reviewing its effectiveness.

The risk management and internal control system consists of the following elements:

- The enterprise risk management system aimed to identify, analyse, define mitigating measures and monitor the development of risks relevant to TenneT;
- The internal control framework aimed to manage and control critical processes, including control self-assessments to document the effectiveness of control processes;
- Business plans and quarterly reports with information on financial and non-financial objectives and their achievement;
- Internal audits of key processes and follow-up on audit findings with relevant management;
- Actions based on recommendations made in the external auditor's management letter;
- An upwardly cascading internal Letter of Representation (LOR) process, resulting in a company-wide LOR signed by the Executive Board;
- A compliance management system that enables TenneT to demonstrate its compliance with relevant laws- and regulations, industry codes and standards, as well as its commitment to good corporate governance, best practices, ethics and stakeholder expectations among others risk of internal fraud, bribery or corruption.

The Executive Board periodically reviews and analyses the strategic, operational, financial and compliance risks to which TenneT is exposed. It also regularly assesses the design and effectiveness of the risk management and internal control system. The results of these assessments are shared with the Audit, Risk & Compliance Committee, acting as a committee of Supervisory Board, the Supervisory Board itself and the external auditor.

The risk management and internal control system does not provide absolute assurance that all corporate objectives will be fully achieved, nor does it give full assurance that material errors, losses, fraud or violations of laws and regulations will not occur in the operational processes and/or the financial reporting.

Taking the above into account, the Executive Board is of the opinion that TenneT's risk management and internal control system provides reasonable assurance that TenneT's financial reporting does not contain any errors of material significance and that the risk management and internal control system has operated effectively in the year under review.

In control statement

We confirm that, to the best of our knowledge, the financial statements for the period 1 January to 31 December 2022 have been prepared in accordance with IFRS as adopted by the EU, and with Part 9 of Book 2 of the Dutch Civil Code; that the disclosures in the financial statements are a true and fair view of TenneT's assets, liabilities, financial position and results as a whole; and that the disclosures in the Integrated Annual Report give a true and fair review of TenneT's financial performance, results and position, together with a description of the most significant risks and uncertainties the company faces. Furthermore, we confirm that to the best of our knowledge, the Group has adequate resources to remain in operation during the next 12 months and consequently the financial statements have been prepared on a going concern basis.

Arnhem, 8 March 2023

M.J.J. van Beek
T.C. Meyerjürgens
M.C. Abbenhuis
A.C.H. Freitag

The Executive Board



**M.J.J. (Manon)
van Beek**

**Chair Executive Board /
Chief Executive Officer**

52, Dutch (f)

Initial appointment:
1 September 2018

Expiry second term:
31 August 2026



T.C. (Tim) Meyerjürgens

**Member Executive Board /
Chief Operating Officer**

47, German (m)

Initial appointment:
1 March 2019

Expiry first term:
29 February 2024



M.C. (Maarten) Abbenhuis

**Member Executive Board /
Chief Operating Officer**

49, Dutch (m)

Initial appointment:
1 January 2021

Expiry first term:
31 December 2024



A.C.H. (Arina) Freitag

**Member Executive Board /
Chief Financial Officer**

52, German (f)

Initial appointment:
1 January 2022

Expiry first term:
31 December 2025

Other positions qualitate qua:

- Chair Aufsichtsrat TenneT TSO GmbH
- Member Board TenneT Verwaltungs GmbH

Other positions:

- Chair Board Giving Back Foundation

- Chair Board Refugee Talent Hub Foundation
- General Member Board of German-Dutch Chamber of Commerce DNHK
- Council of the Thinktank Agora Energiewende
- Chair Supervisory Board Kanker.nl Foundation (until September 2022)

Other positions qualitate qua:

- Member Board TenneT TSO B.V.
- Member Board TenneT TSO GmbH
- Member Board TenneT Verwaltungs GmbH
- Member Board TenneT Offshore GmbH

Other positions:

- Member Executive Board WAB (Wind Energy Association Bremerhaven)
- Member Advisory Board Offshore Wind Energy MBA

- Member Board of Trustees German Offshore Wind Energy Foundation
- Member Advisory Board Federal Association of Wind Farms Offshore
- Member Board of Directors FGH (Forschungsgemeinschaft für Elektrische Anlagen und Stromwirtschaft e. V.)
- Member Board of Trustees FGE (Forschungsgesellschaft Energie e. V.)
- Member of the German National Committee of CIGRE
- Chair Supervisory Board of GreenneT

Other positions qualitate qua:

- Member Board TenneT TSO B.V.
- Member Board TenneT TSO GmbH

Other positions:

- Member Board Netbeheer Nederland
- Member Cooperation Board TSCNET Services GmbH
- Member Advisory Board TenneT for GOPACS Foundation

- Supervisory Board member of Royal Swinkels Family Brewers N.V.

Other positions qualitate qua:

- Member Board TenneT TSO B.V.
- Member Board TenneT TSO GmbH
- Member of the Board of TenneT Offshore GmbH

Other positions:

- Member Supervisory Board of GreenneT
- Member Board Flexcess GmbH