

Grid fee outlook for the Netherlands 2045

August 2024



Executive Summary

Aurora Energy Research is a leading global provider of power market forecasting and analytics for critical investment and financing decisions. Our mission is to facilitate the global energy transition through widely trusted quantitative analysis and high-quality decision support.

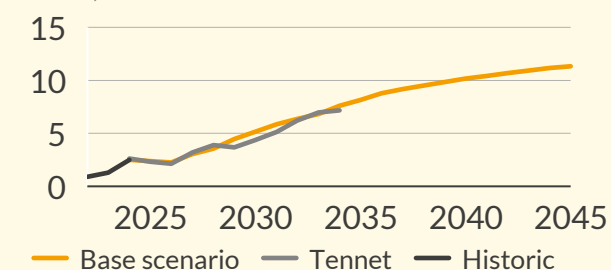
This report contains our outlook on grid fees in the Netherlands until 2045, based on our target-driven Net Zero scenario. This scenario represents a world where the net-zero target is reached by 2050 and a carbon-neutral power sector is realised in 2035, in line with governmental ambitions.

This report is commissioned by Tata Steel, Shell, Nyrstar, bp, Nobian, Sabic, and Chemelot.

- 1 **Grid costs in the Netherlands have nearly tripled in the last two years, and are expected to continue to rise significantly.**
 - Over the last two years, grid costs have strongly increased, driven by unexpectedly high energy prices in the period 2021-2023.
 - These costs are expected to keep increasing in the future, largely due to new investments in the offshore grids.
 - This results in strongly increasing grid fees for offtakers.
- 2 **Grid fees are much higher than in other countries; to create a level playing field for large offtakers at least 319 mn € / year is needed.**
 - The costs to close this gap would get even larger if grid fees were to be harmonised for all offtakers in the Netherlands, up to 1.6 bn €.
 - Towards 2030, the gap increases further, to 514 mn € for large offtakers and 2.8 bn € for all offtakers.
- 3 **Excluding (part of) financing of grid expansion from grid fees is the most impactful measure to improve competitiveness.**
 - Alternative funding of the costs for the offshore grid could reduce annual grid fees with up to 53% in the long term.
 - This reduction could increase to up to 82% if further onshore grid expansion is also funded alternatively.
 - Other measures, such as extending the depreciation period of the grid, are much less effective.

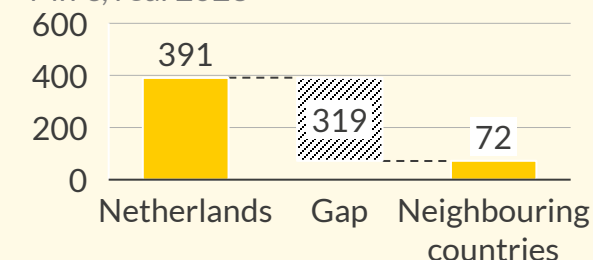
Annual allowed revenue¹ projection

Bn €, real 2023



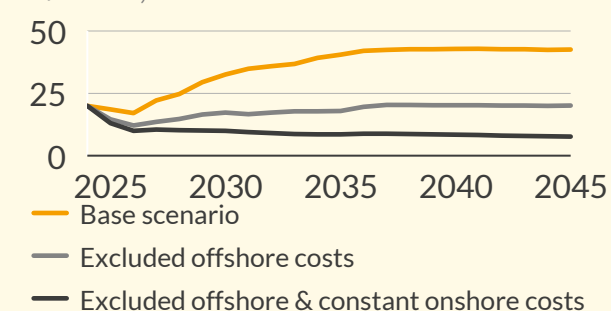
Total grid fees large offtakers - 2024

Mn €, real 2023



Annual HV² grid fee projection

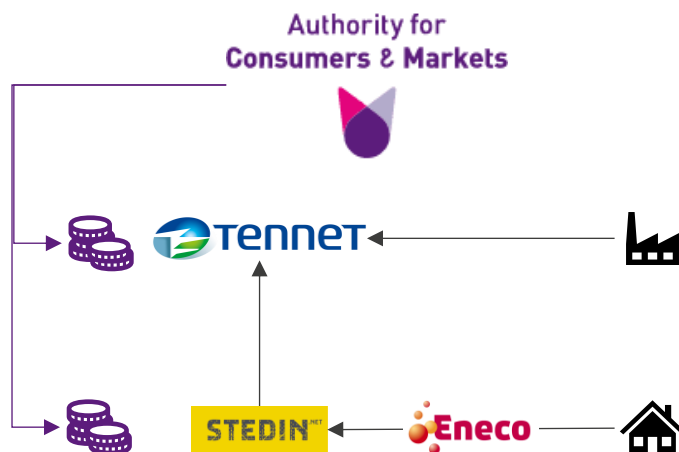
€/MWh, real 2023



1) Term used by Tennet to describe the total grid costs; 2) High Voltage

Grid fees are regulated by ACM, based on a cost-of-service methodology, which includes a combination of transmission and system tasks

Stakeholders grid fees

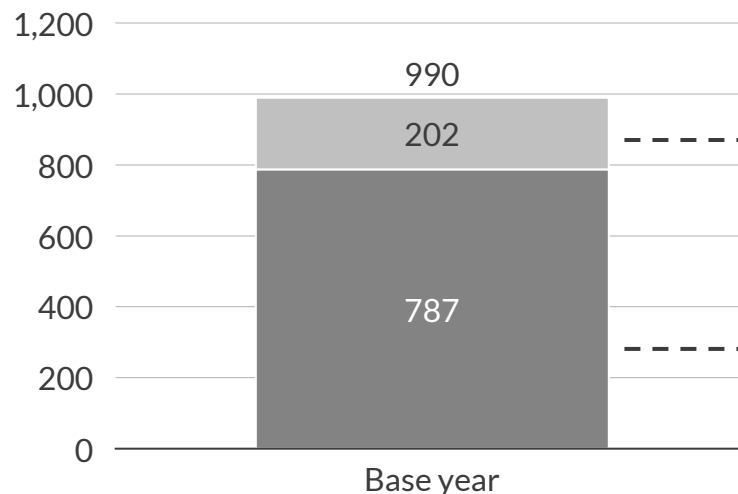


- Through grid fees, Dutch off-takers pay for the transmission of electricity, the construction and maintenance of the grid, and balancing services.
- Whereas large off-takers pay directly to the operator, household and other small off-taker costs are collected through energy supplier. The DSOs¹ are seen as off-takers of the TSO² grid.
- The regulator ACM determines grid fees, by setting a maximum revenue and assumed transmission volumes for the TSO and the DSOs.

← Payment of grid fees ← Budget setting

Efficient TSO cost-of-service 2022–2026

mn €, real 2023

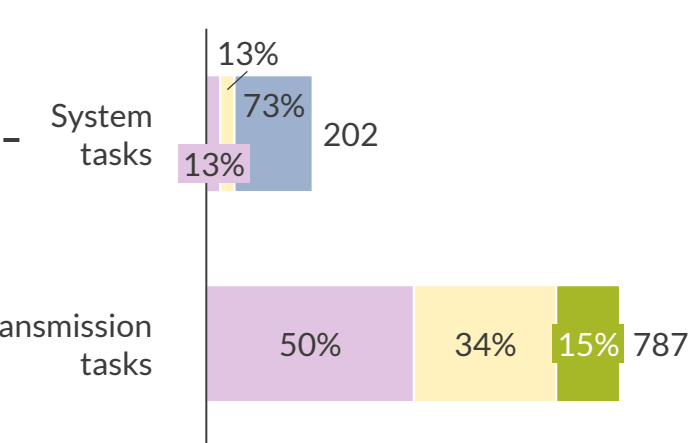


- Maximum revenue is based on a cost-of-service methodology determined at the start of the regulatory period, which in turn is based on Tennet's expenses over previous years³. This does not include additions and corrections⁴.
- Tennet has a double role as the operator of the high-voltage grid (transmission) and the responsible party for balancing (system).
- The efficient cost-of-service for these two tasks is determined separately.

■ Transmission tasks ■ System tasks

Efficient TSO cost of service breakdown

mn €, real 2023



- The categories consist of a CAPEX⁵ component—composed of depreciation and the cost of capital for existing assets and new investments—and an OPEX⁶ component, including labour, overhead, and energy costs.
- For transmission tasks, energy costs consist of grid losses, reactive power, and solving transmission bottlenecks. For system tasks, these costs are the realisation of ancillary services through the FCR, aFFR, mFFR⁷, and contracting black start capacity.

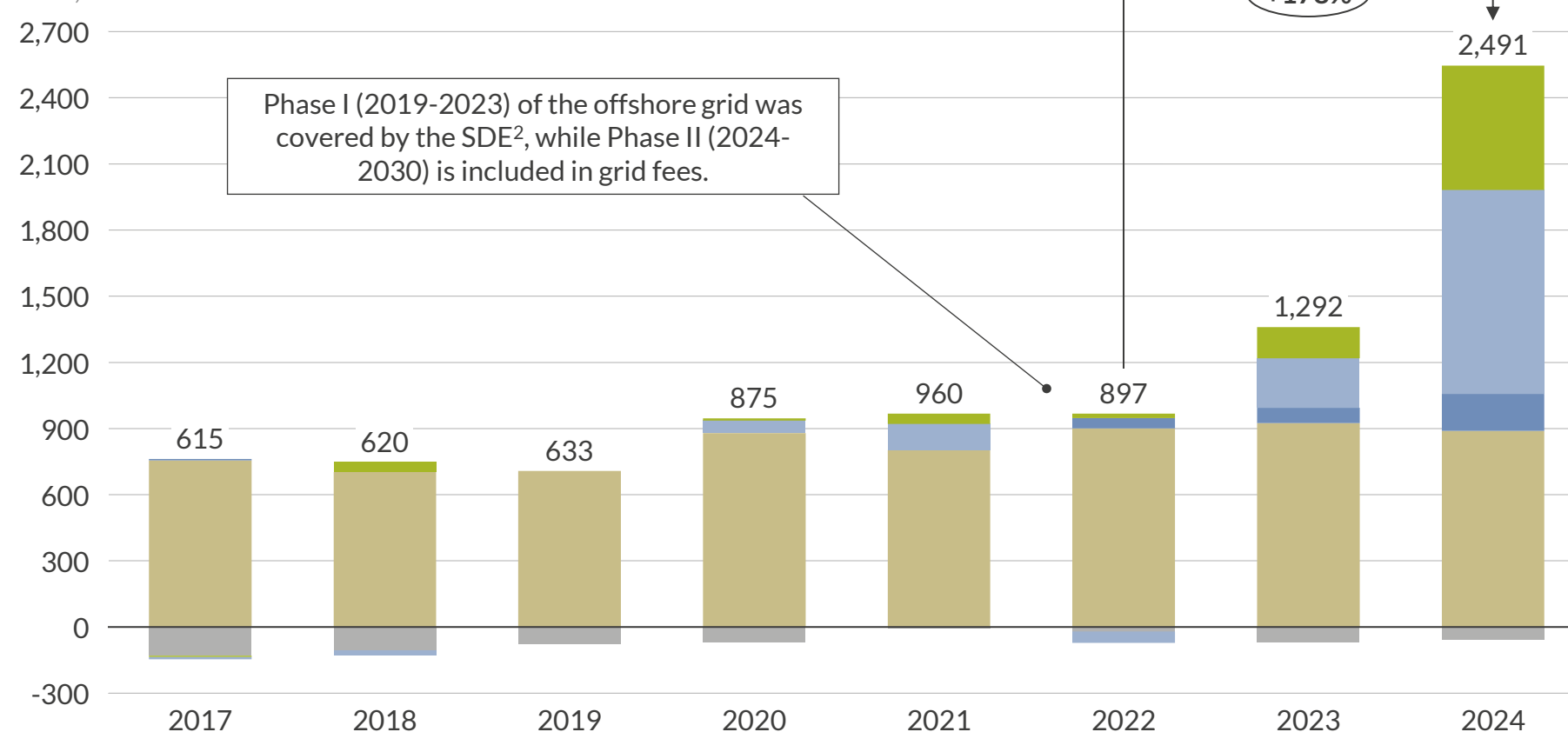
■ CAPEX ■ Other OPEX ■ Ancillary ser. ■ Energy

1) Distribution system operator; 2) Transmission system operator; 3) The current regulatory period is 2022–2026, the base year is 2021 and the cost is based on expenses over 2018–2020; 4) Corrections include, among others, offshore grid costs, post-settlement WACC and post-settlement investments; 5) Capital expenditures; 6) Operational expenditures; 7) Respectively, Frequency Containment Reserve, automatic Frequency Restoration Reserve, and manual Frequency Restoration Reserve.

Allowed revenue almost tripled over the past 2 years due to corrections for high energy prices and the cost of the offshore grid

Total allowed revenue Tennet¹

mn €, real 2023



■ Pre-calculated budget
 ■ Ancillary services - correction
 ■ Other tasks and corrections
 ■ Offshore grid
 ■ Energy costs - correction

1) Only includes components that are included in the grid fee calculation, this means that costs for the offshore grid phase I are not shown; 2) As these platforms are currently in operation, they will keep generating costs which will continue to be covered by subsidies.

Sources: Aurora Energy Research, Tennet, ACM.

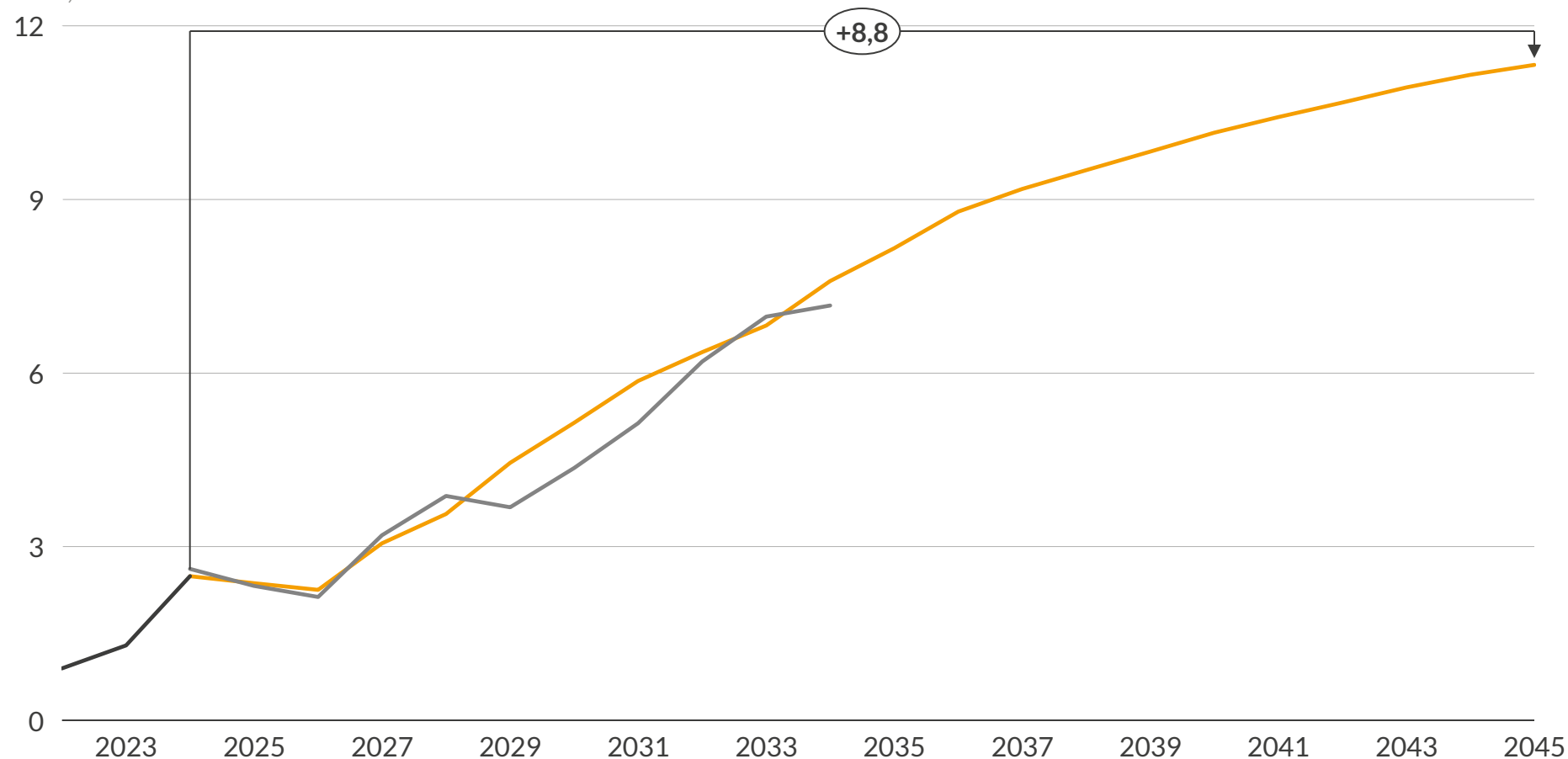
Comments

- Allowed Revenue (AR) was relatively stable until 2022 as there were no major corrections.
- Between 2022 and 2024, AR almost tripled, mostly due to corrections for high energy prices over 2021-2023.
- The costs of the offshore grid have also seen an important increase which Tennet estimates will continue.
- Tennet's allowed revenues are used to set grid fees for both the High Voltage (HV) and Extra High Voltage (EHV) grid levels. The grid fees have a contracted and a usage component.

Allowed revenue will continue to increase, with ~8.8 Bn € between 2024 and 2045, as the grid requires extra investments

Annual allowed revenue forecast v. Tennet outlook

Bn €, real 2023



— Base scenario¹ — Tennet projection — Historic

1) The base scenario is based on Aurora's Net Zero scenario, representing a world where the Net Zero target is achieved by 2050 and power sector carbon intensity reaches 0gCO₂/kWh by 2035, in line with government ambitions.

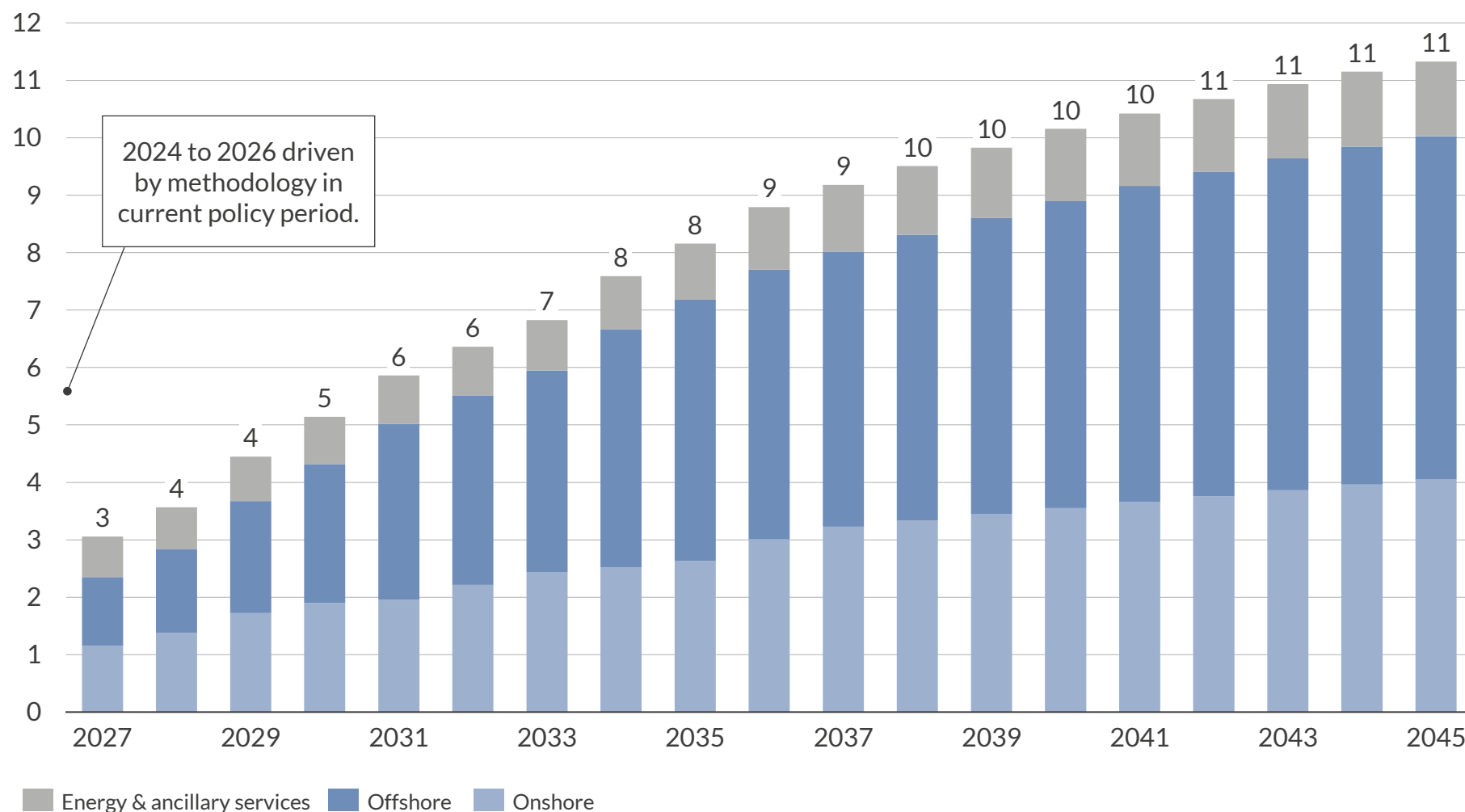
Sources: Aurora Energy Research, Tennet, ACM

- Allowed revenue (AR), the revenues that Tennet is allowed to make to cover the costs of grid investments and provided services, is expected to significantly increase over time.
 - Leading to a ~106% increase towards 2030, and up to a ~355% increase towards 2050.
- The projected trend is in line with the outlook that Tennet recently published.
 - Tennet's forecast fluctuates around our base case, mainly driven by different assumptions on how and when energy & power costs are reimbursed.

By 2031, the offshore grid accounts for over 50% of total costs and is the main driver of rising allowed revenues

Annual allowed revenue forecast by cost component

Bn €, real 2023



- The expected increase of annual AR is largely driven by the rising costs for investments in grid expansion and reinforcement.
 - Until 2033, Tennet has included significant investments in their IP2024.
 - Afterwards, in our base case we expect the growth of mainly offshore wind to continue showing sizeable growth, requiring additional investment.
- The largest driver of the costs are the investments in the offshore grid.
 - Costs for the offshore grid account for more than half of total AR from 2031 onwards.
- Neighbouring countries benefit from the grid investments, as they allow the Netherlands to export more electricity.

Tennet’s allowed revenues are used to set fees on the high and extra high voltage grid, based on the contracted and peak offtake capacity

Grid fee structure

Component	Subcomponent	Unit
Transmission of electricity	Fixed charge	€/month
	Contracted capacity	€/kW/year
	Peak offtake	€/kW/month
	Consumption	€/kWh/year
Connection	One-off connection fee	€
	Periodic connection fee	€/month
Meter	Meter rate	€/year

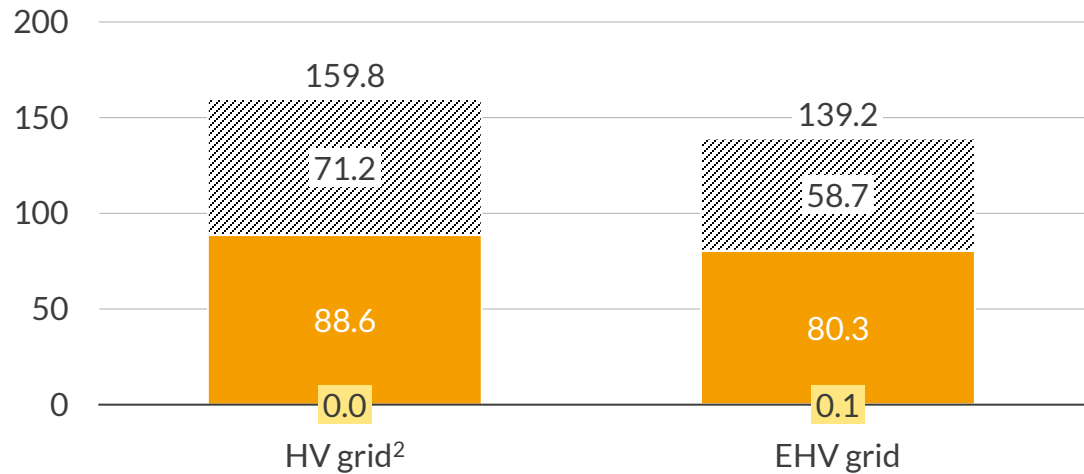
- Grid costs are recovered through the transmission fees. Users are charged by contracted capacity and monthly maximum offtake¹ consumed by the offtaker. Low- and middle-voltage grid users pay an additional consumption fee.
- These variable subcomponents cover the construction, maintenance and operation of the grid. Whereas all users pay an equal additional fixed charge covering other costs like administration.
- Aside from these grid fees, users separately pay for their connection to the grid and the operations of their meter. These represents only a small fraction of the transmission fees.

 Determined by cost of service methodology

1) Determined as the average load of a 15-minute period unless agreed otherwise with the system operator; 2) HV and EHV, represent high voltage and extra high voltage; 3) With the exception of the ‘randmeren’ grid, which is high voltage and operated by Liander.

Sources: Aurora Energy Research, Tennet, Stedin, Liander, ACM.

Total grid fees 2024 for 100MW baseload offtaker
€/kW/year (real 2023)

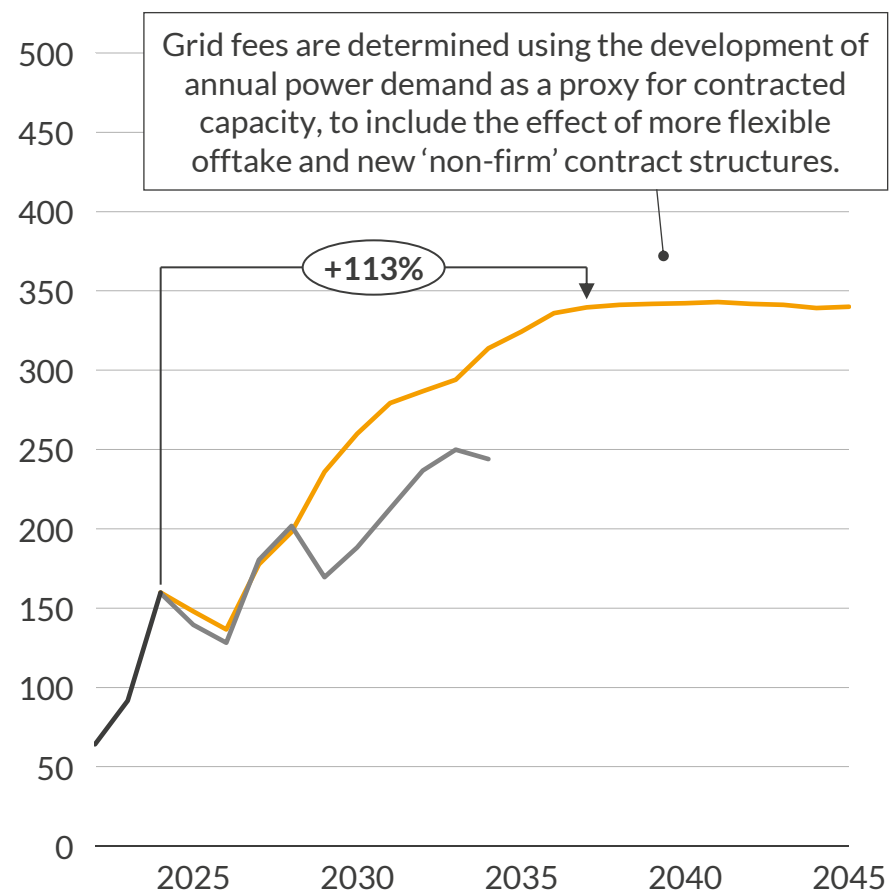


- Grid fees are specific to the operator and the grid (voltage level). Both the high voltage and extra high voltage grid are operated only by Tennet³.
- Through a non-firm connection and transmission agreement (NFA) assets can reduce their grid fees on contracted capacity to 0. A time-bound transmission right (ATR85) will be introduced in 2025 which allows flexible offtakers to reduce their grid fees.
- For both the high voltage and extra high voltage grid, the fixed charge is an almost negligible part of grid fees. The large majority of the grid fees consists of the contracted capacity and peak offtake fees.

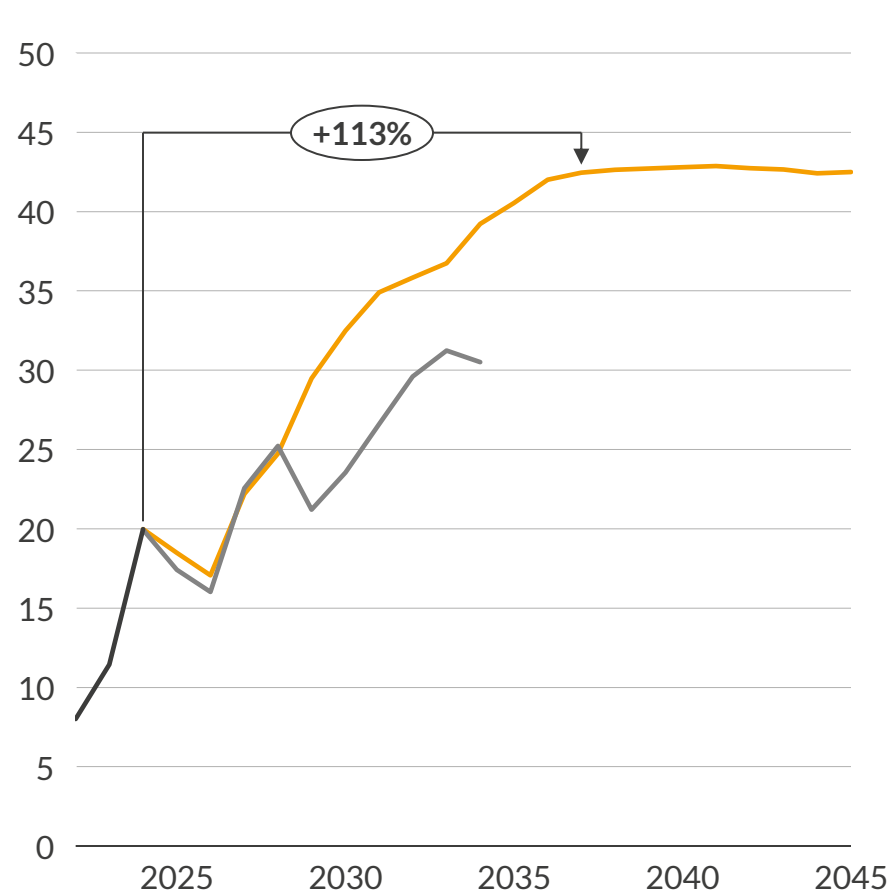
 Contracted capacity  Peak offtake  Fixed charge

Grid fees have almost tripled in the last 2 years, and are expected to keep rising significantly, increasing to up to ~43 €/MWh

Annual HV¹ grid fee projection for baseload offtakers²
€/kW, real 2023



Annual HV¹ grid fee projection for baseload offtakers²
€/MWh, real 2023



- We forecast the development of grid fees in the Netherlands based on:
 - The development of allowed revenues
 - The development of offtake volumes³ of Aurora Net Zero, see appendix.
- Grid fees have significantly risen between 2022 & 2024, due to the higher-than-expected power prices between 2021 and 2023.
- Towards 2037 fees are expected to increase even further with +113%, after which grid fees stabilise due to a growing offtake base.
- We calculate grid fees in €/MWh based on a baseload 8000 flh offtaker.
 - Fees will be higher for more flexible offtakers with less full load hours⁵.

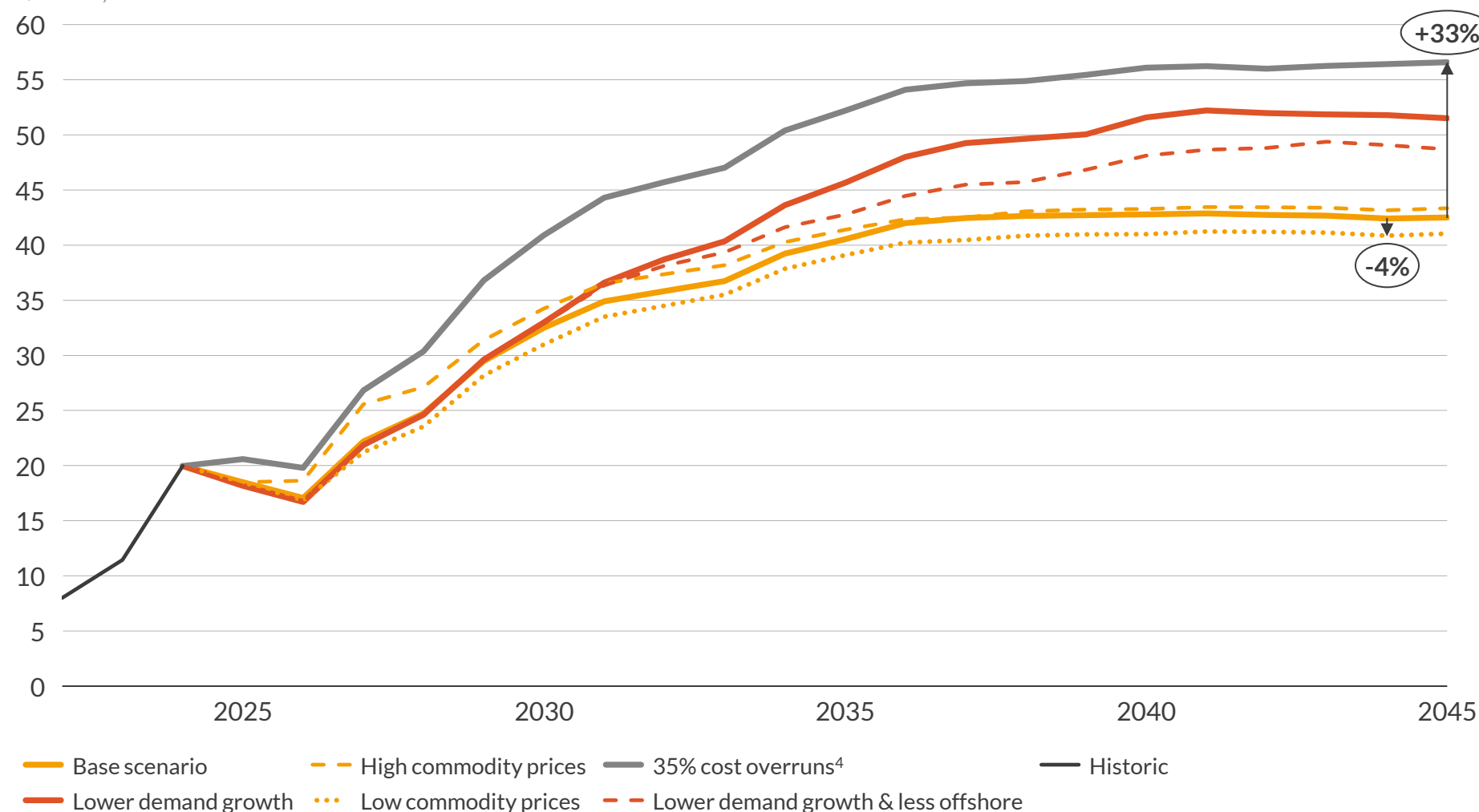
— Base scenario — Tennet projection⁴ — Historic

1) High Voltage; 2) Based on a baseload 8000 flh offtake profile; 3) Based on annual domestic power consumption, as a proxy of further electrification and the development of offtake connection capacity – more context can be found in the Appendix; 4) Visually extracted from Tennet's outlook; 5) They could be eligible for exemptions under non-firm contract agreements.

Sources: Aurora Energy Research, Tennet, ACM

The level of grid fees are most sensitive to grid cost overruns, but lower-than-expected demand growth can also push fees up further

Annual HV¹ grid fee projection & sensitivities, based on a baseload 8000 flh² offtake profile
€/MWh, real 2023



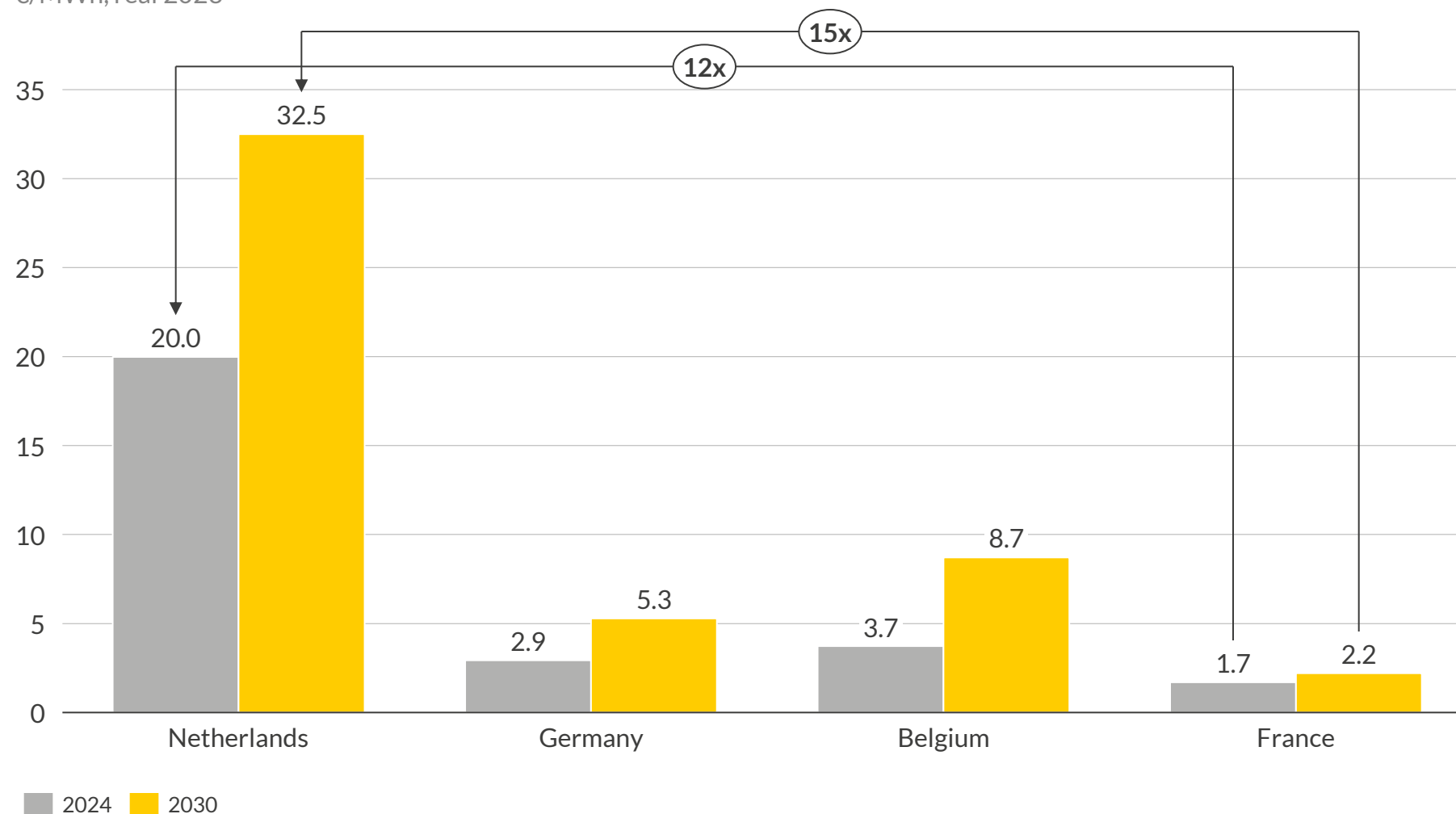
1) High Voltage; 2) Based on a 100MW asset connected to the high voltage grid; 3) Based on Aurora's Low (P90) pricing scenario; 4) Based on more extreme cost overruns of EU grid expansion projects as a benchmark (65%), under the assumption that these cost overruns will not be incurred for all projects.

Sources: Aurora Energy Research, Tennet, ACM

- While grid fees are already expected to increase ~110% between 2024 & 2036, they could increase even further if expected costs of new investments are overrun⁴.
 - With up to 33% increases compared to the base case in the long term.
- On the other hand, lower commodity prices³, can slightly decrease the grid fees due to lower costs for the energy & ancillary services provided.
 - With up to 4% lower grid fees compared to the base case in the long term.
- Lower demand growth would reduce costs, but also implies less offtakers to distribute the costs over, increasing grid fees as well.

Grid fees for Dutch baseload offtakers are up to 12x as high as in neighbouring countries, and the difference grows towards 2030

Yearly grid fees for baseload offtakers^{1,2}, excluding taxes
€/MWh, real 2023

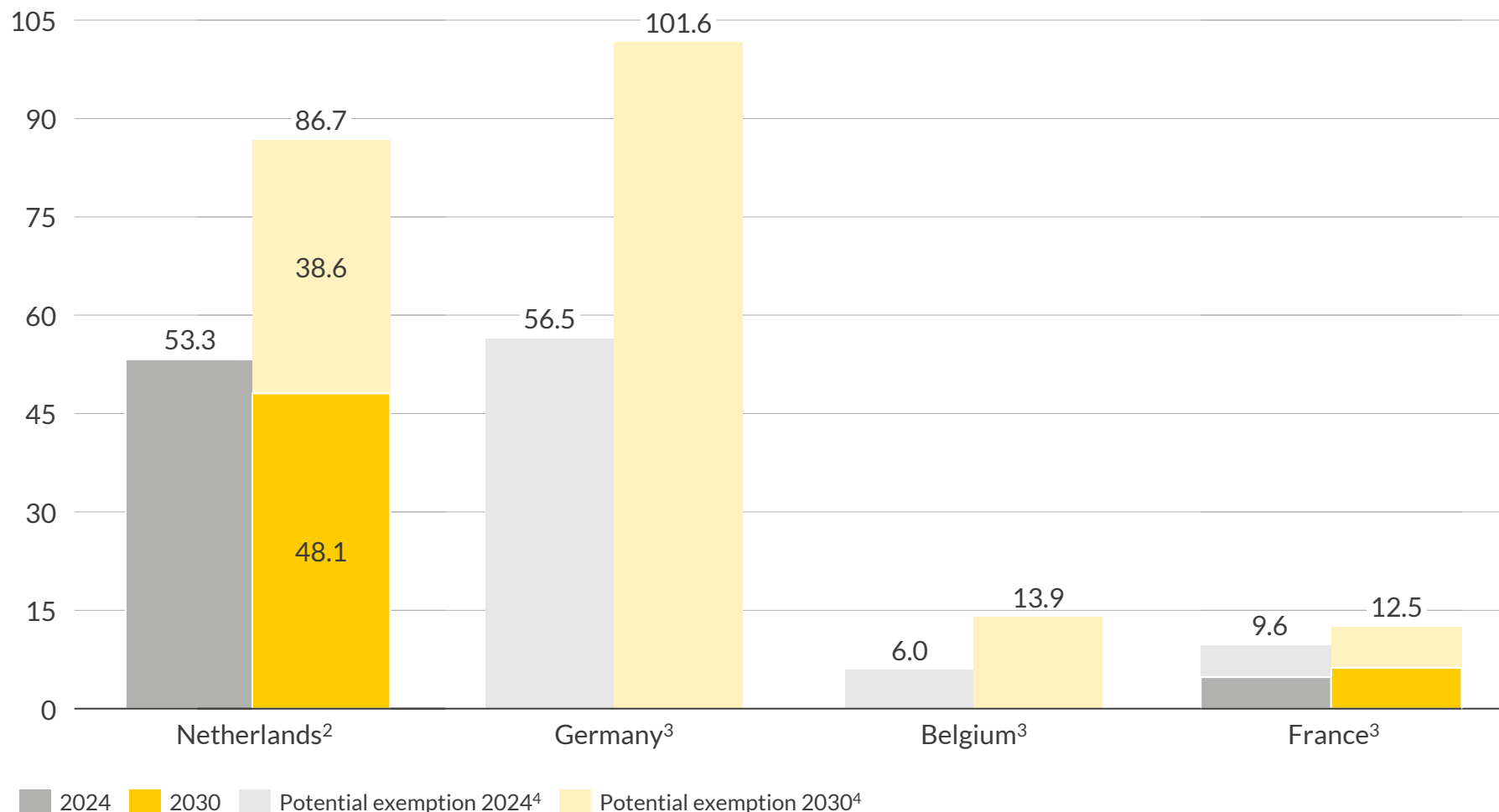


1) Based on a 100MW asset connected to the high voltage grid with 8000 full load hours; 2) The grid fees include discounts and price caps

- Baseload offtakers with an offtake profile of more than 8000 hours receive a discount of up to 90% in Germany, and of 81% in France. Belgium also has limits on grid fees for large offtakers.
- Grid fees for a baseload offtaker in the Netherlands 2024 are 4x to 12x as high as grid fees in neighbouring countries.
- In 2030, the large gap between Dutch grid fees and those in neighbouring countries remains. Grid fees are still 4x as high as Belgian grid fees and 15x as high as French grid fees.

Flexible Dutch offtakers pay even higher grid fees, whereas flex technologies often have exemptions in neighbouring countries

Yearly grid fees¹ for a 3000 flh offtake profile, excluding taxes
€/MWh, real 2023



1) Based on a 100MW asset connected to the high voltage grid; 2) From 2025, flexible offtakers can get an exemption from the contracted capacity part of the grid fees. See appendix for more details; 3) Based on methodology of E-bridge report; 4) Germany: batteries and electrolyzers, Belgium: batteries for first 10 years, France: batteries. Does not include time of use discounts.

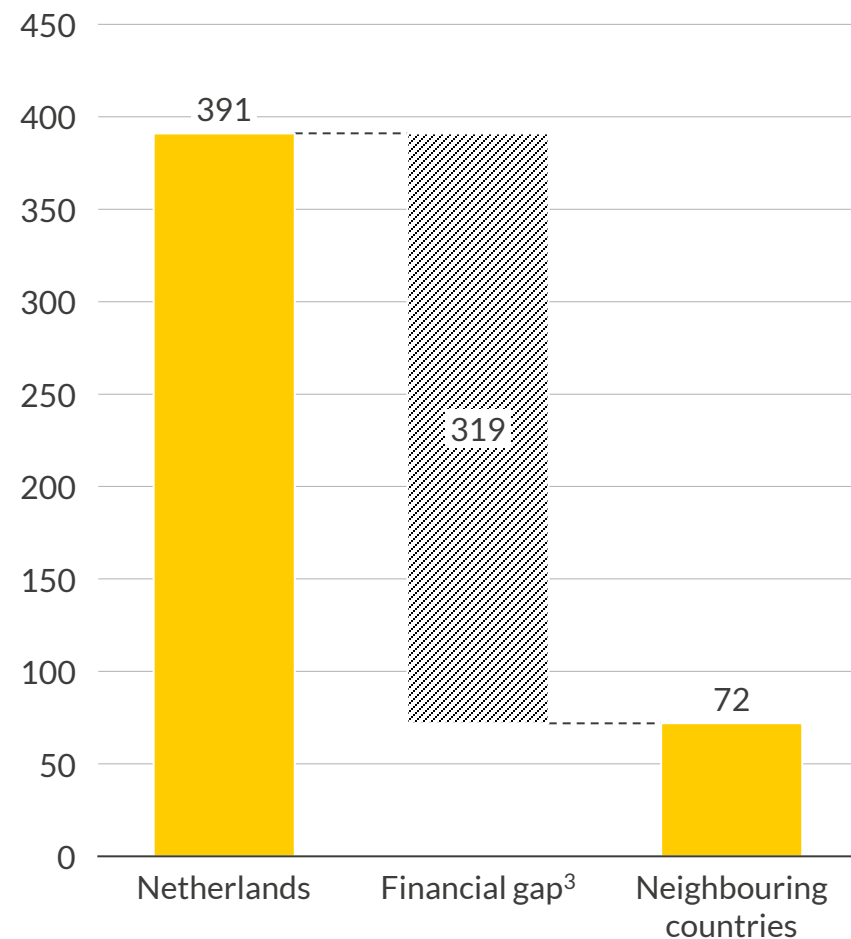
Sources: Aurora Energy Research, E-bridge, Tennet, Elia, RTE

- To calculate grid fees for more flexible offtakers, such as batteries, electrolyzers, and e-boilers, we assume a 3000 full load hour profile as a reference offtake profile.
- Grid fees for flexible offtakers are similar in the Netherlands and Germany, but batteries and electrolyzers are exempted from grid fees in Germany under certain conditions.
- In Belgium and France, grid fees are up to 89% lower than in the Netherlands. Batteries are exempt from grid fees in Belgium for the first 10 years of operation, and in France they can get a 50% exemption.
- The situation in 2030 is similar to 2024, where Germany has higher grid fees than the Netherlands, and Belgian and French grid fees are much lower.

An EU level-playing-field on grid fees for large offtakers requires 319 mn € in 2024, increasing to 514 mn € in 2030

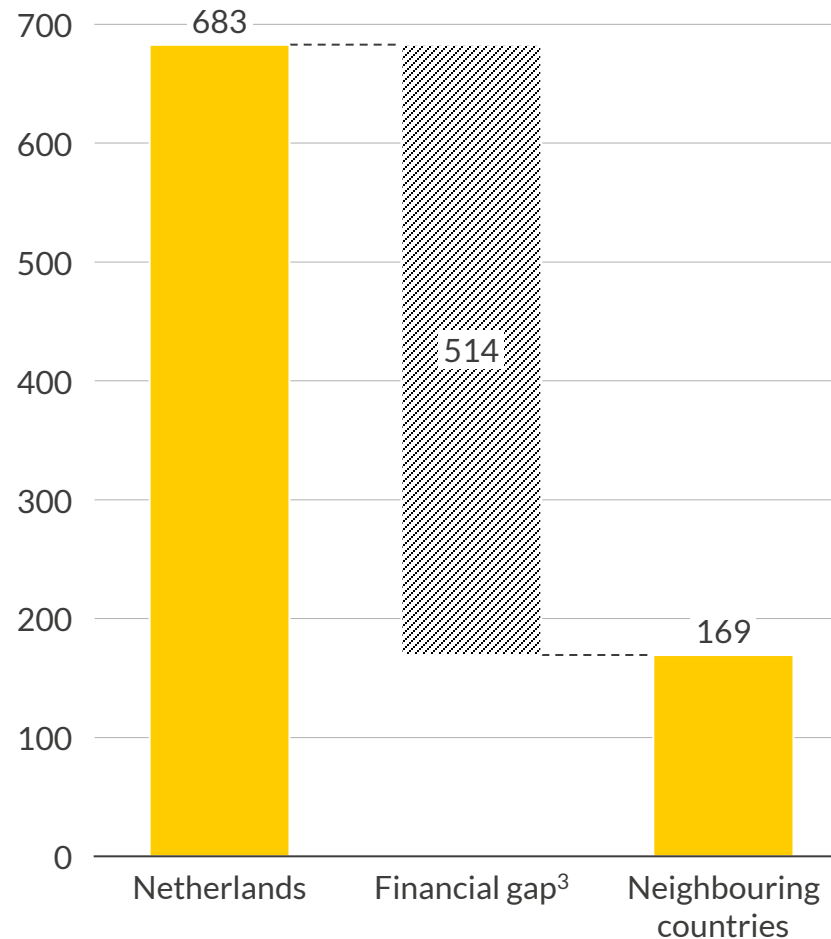
Total grid fees paid in 2024 by large offtakers¹

Mn €, real 2023



Total grid fees paid in 2030 by large offtakers²

Mn €, real 2023



- The total grid fees paid for 2024 take into account Tennet's *rekenvolumina*, the volumes contracted by the DSOs⁴ are subtracted from this, so only large offtakers connected to the HV or EHV⁵ grid are considered. Volumes are scaled with Aurora's Net Zero industrial demand projection for 2030.
- In the *Hoofdpijnenakkoord*, the new government set out that Dutch energy costs should not significantly diverge from neighbouring countries.
- However, Dutch grid fees in 2024 are already much higher than in neighbouring countries, and 319 mn € of investment would be needed for 2024 to set grid fees at an equal level for large offtakers.
- This financial gap rises to 514 mn € towards 2030.

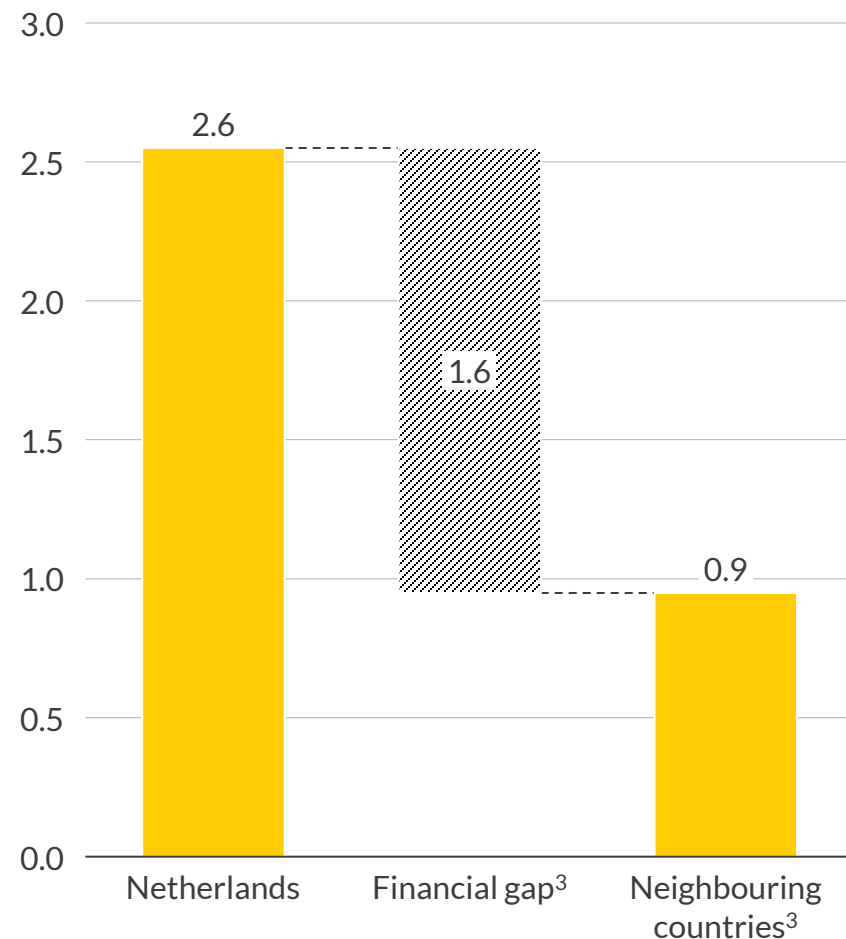
1) Only baseload offtake assumed; 2) Based on a split between baseload and flexible offtake, from our Net Zero scenario. Discounts are included for baseload offtakers but not for flexible offtakers as they are subject to conditions; 3) Average of Germany, Belgium and France; 4) Distribution System Operator; 5) High Voltage and Extra High Voltage respectively.

Sources: Aurora Energy Research, E-bridge, *Hoofdpijnenakkoord*, Tennet, Elia, RTE

The financial gap for all offtakers requires further study; using rough assumptions we find up to 1.6 bn € in 2024, and up to 2.8 bn € in 2030

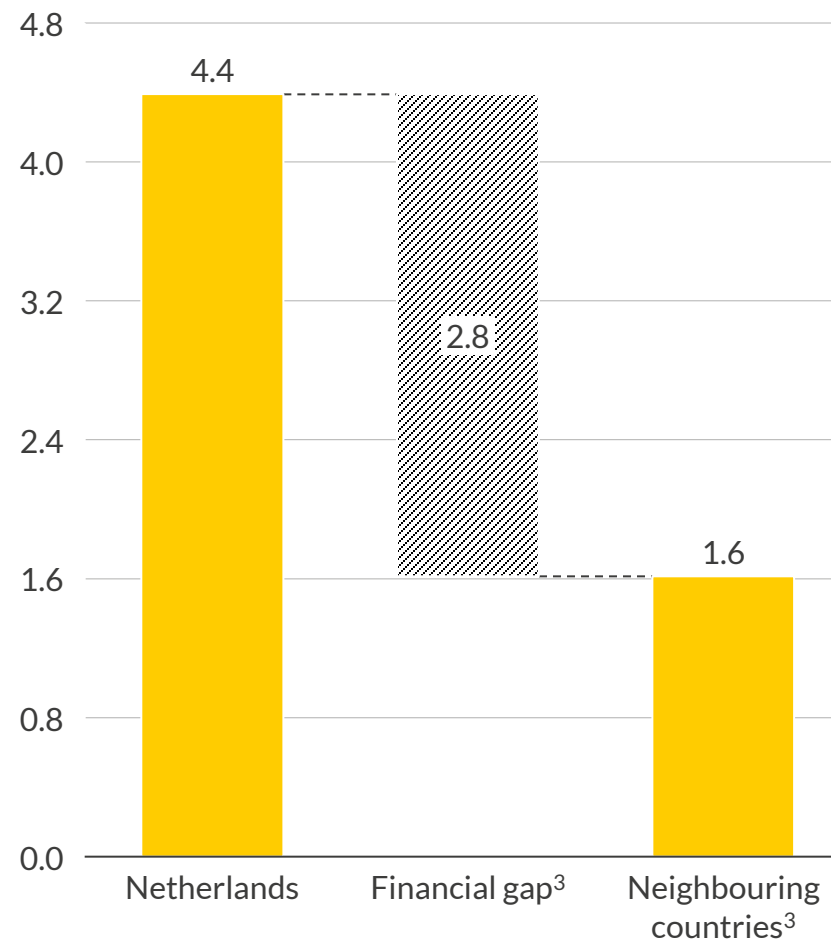
Total grid fees paid for HV and EHV¹ grid levels 2024²

Bn €, real 2023



Total grid fees paid for HV and EHV grid levels 2030²

Bn €, real 2023



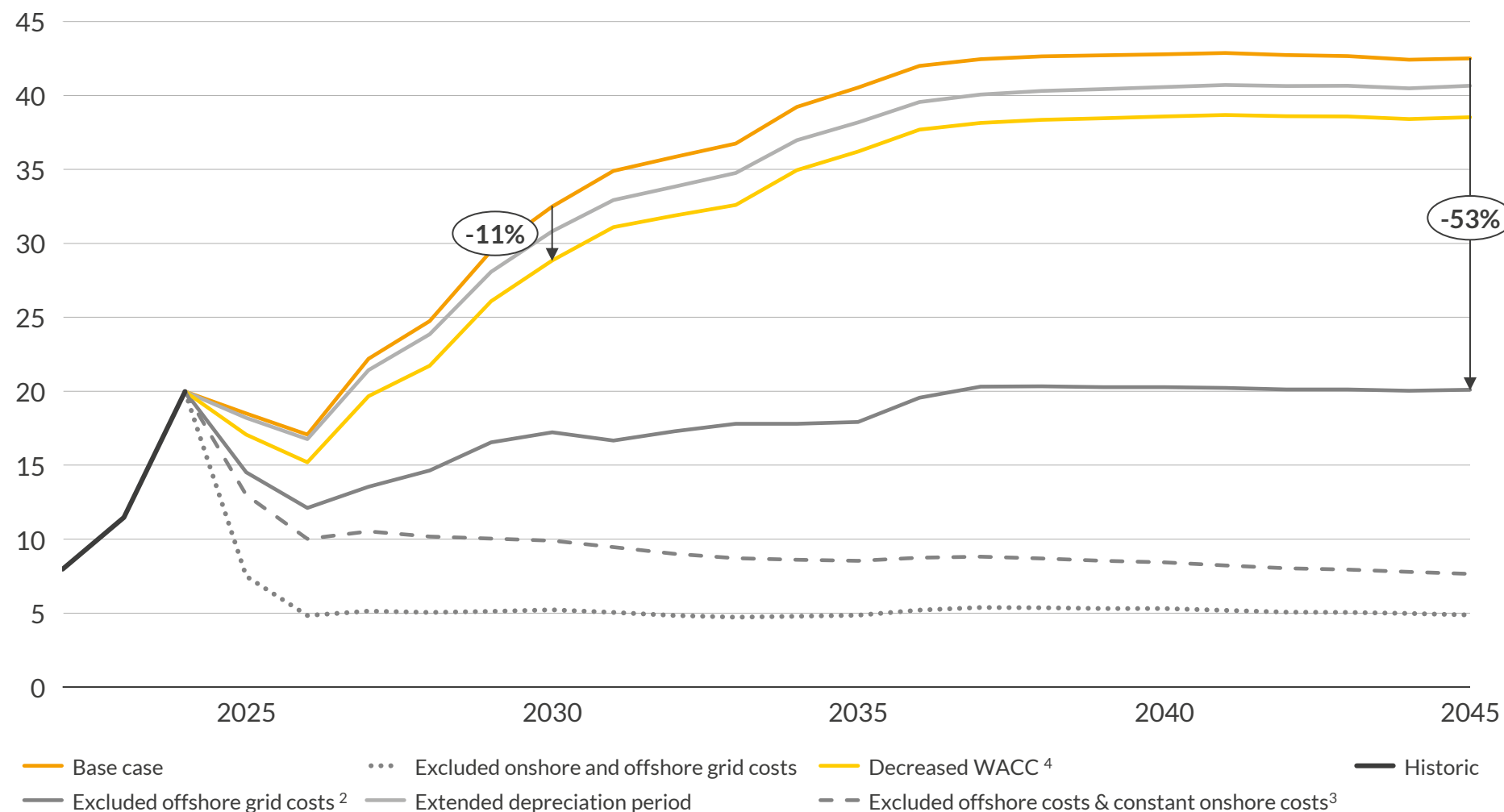
- The total grid fees paid for 2024 take into account Tennet's *rekenvolumina*, these volumes are scaled with Aurora's Net Zero demand projection for 2030.
- Creating a level international playing field for all offtakers could require up to 1.6 bn € in 2024, and up to 2.8 bn € in 2030.
 - These amounts come with a higher level of uncertainty, as the offtake profiles of other grid users strongly differ and we were not able to establish the exact level of other offtake profiles abroad receiving discounts or exemptions.
- This financial gap is more dependent on the country used for comparison. Compared to Germany, the Netherlands might have lower grid fees for a large part of the DSO offtake.

1) High Voltage and Extra High Voltage; 2) Based on an offtaker profile split between baseload, flexible, and DSO. Baseload offtake is based on our Net Zero industrial demand, flexible offtake is based on our Net Zero electrolyser and 50% of heating demand, and DSO offtake makes up the remaining demand; 3) Delta based only on France, with its grid fee based on e-bridge report.

Sources: Aurora Energy Research, E-bridge, Hoofddijnenakkoord, Tennet, Elia, RTE

The most impactful long-term measure identified to keep a level playing field is to finance grid expansion through alternative funding

Annual HV grid fee projection & potential measures to reduce for all grid users, based on an 8000 flh¹ offtake profile
€/MWh, real 2023



1) Based on a 100MW asset connected to the high voltage grid; 2) An average annual investment of 1.4 Bn € to realise this for the period 2025-2030; 3) An average annual investment of 2.1 Bn € to realise this for the period 2025-2030; 4) Weighted Average Cost of Capital.

Sources: Aurora Energy Research

- There are several measures that would improve the level playing field and reduce grid fees for all offtakers, we tested lowering WACC⁴, alternative financing of grid costs, and lowering WACC⁴.
- The measure with the highest impact is alternative financing of grid infrastructure.
 - Excluding offshore grid costs can reduce the fee by more than 50%, stabilizing it at the initial 2024 level of 20 €/MWh².
 - This reduction could increase to over 80% if further onshore grid expansion is also alternatively funded³.
- Decreasing the real WACC⁴ with 1% lowers the fee by up to 11%. Extending depreciation by 10 years has an average effect of ~4-5% reduction per year on the long term.

Details and disclaimer

Publication

Grid fee outlook for the Netherlands 2045

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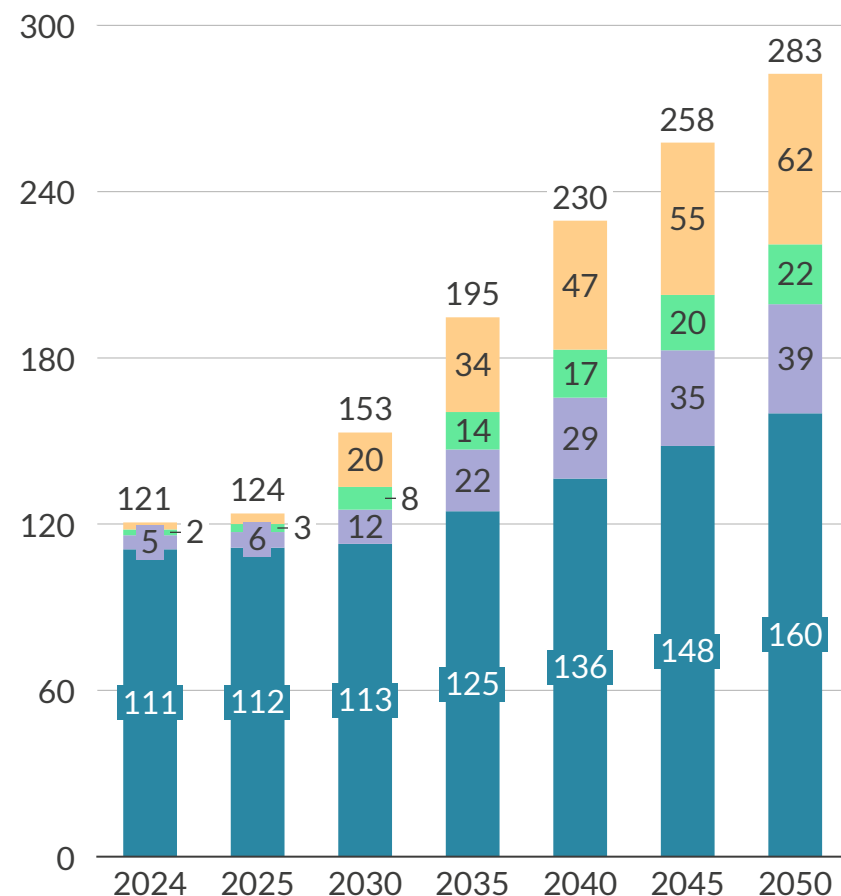
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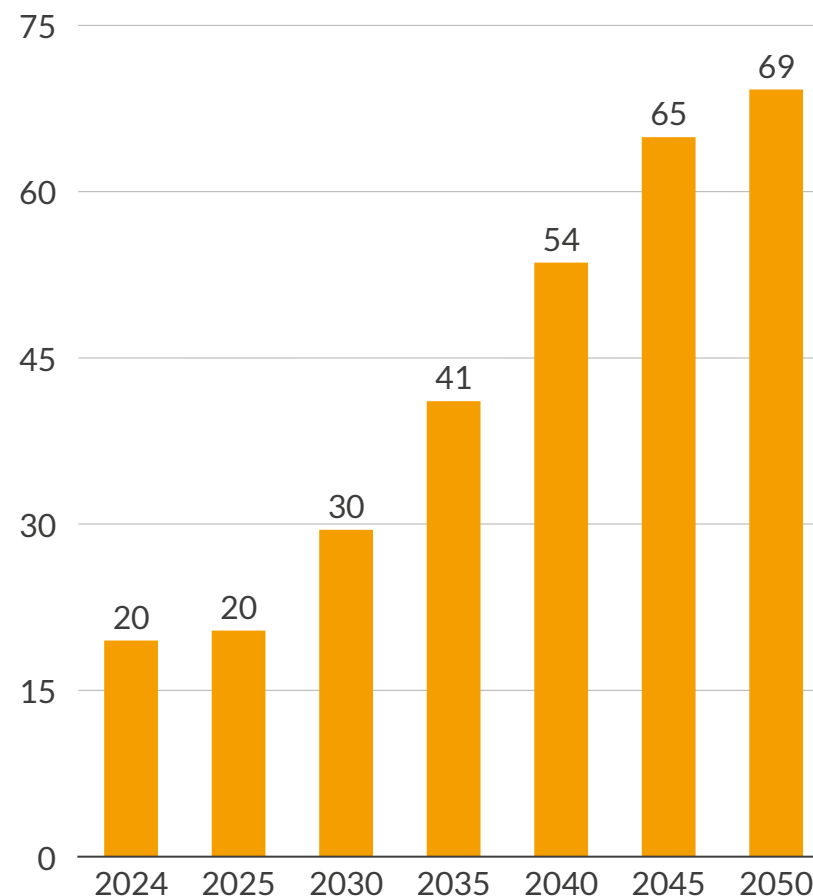
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The total and peak annual power demand in Aurora Net Zero is expected to increase strongly, driven by more flexible demand sources

Net Electricity Demand – Aurora Net Zero¹
TWh



Peak Electricity Demand – Aurora Net Zero
GW



Hydrogen² EVs Heat pumps & P2H Base power demand³ Peak power demand³

1) Total net electricity demand includes sectoral demand as well as transmission losses but excludes power plant self-consumption and demand from efficiency losses of storage. 2) Demand for hydrogen production from electrolysis. 3) Underlying demand excluding heat pumps and EVs. 4) GDP between 2023 and 2060 is expected to grow by 1.88% on average.

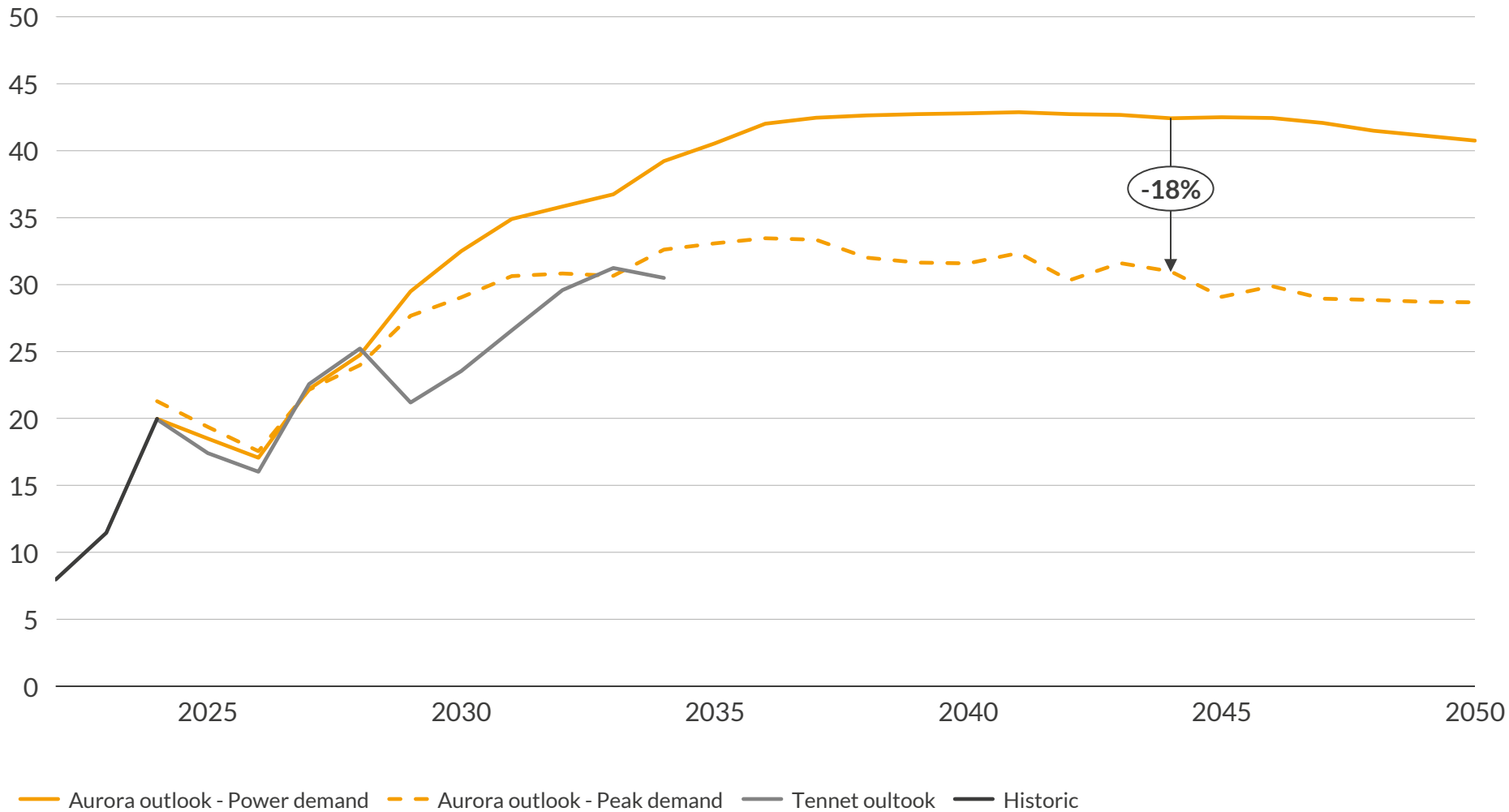
Sources: Aurora Energy Research

- Base demand is expected to rise, driven by GDP growth⁴ and further electrification of the different economic sectors. Efficiency gains partially counteract this upward trend up until 2040.
- Capacity from large scale electric boilers in industry (P2H) that dispatch flexibly is expected to increase in the short term driven by attractive subsidies. Heat pumps are expected to break through in the built environment in the long term. This leads to a growth in power demand for heating of 34TWh in 2060 compared to current values.
- With plans for the Netherlands to become a hydrogen hub, we expect power demand for electrolyzers to increase from almost zero in 2024 to 13TWh in 2030 and further grow almost fourfold from 2030 to 2060.

Growth in power demand was used as a proxy for the growing offtake base, to account for ATR85 discounts of flexible offtakers

Annual grid fee projection different demand assumptions v. Tennet outlook

€/MWh, real 2023



- The development of power demand is used as a proxy to determine the development of grid fees based on AR levels.
 - This reflects more flexible contract structures being used in the future, providing discounts for flexible users.
 - As most future demand increase is expected to be driven by flexible demand, contracted capacity is an overestimation of the base over which to spread AR.
- If most flexible offtakers will not receive discounts (e.g., under the ATR85 proposal), peak demand would be a better proxy to forecast grid fees.
 - In this case, grid fees would end up ~18% lower on average. Given current developments this seems unlikely, and grid fees would still go up.