

Gridlock in the Netherlands

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Having no grid capacity on high- and medium-voltage electricity networks seems to be the new normal in the Netherlands.¹ Grids across the world have become bottlenecks slowing the advancement of renewables, but the Netherlands seems to have been hit by the problem particularly early and hard. The Dutch story showcases how grids can become a bottleneck for the expansion of renewables and electrification in any country with such ambitions.

The first signs of congestion occurred in 2018, upon feed-in from solar photovoltaic (PV) parks in Drenthe and Groningen — and today the “electricity grid in all provinces is largely full, probably full or almost full.”² In December 2022, Rob Jetten, the Minister of Climate and Energy, presented — and urged swift implementation of — a list of actions to address the connection conundrum on high-voltage grids in a national action programme on grid congestion.³ A similar strategy for low-voltage grids is to be developed.⁴

The Netherlands plans to be climate neutral by 2050, with the power sector achieving this objective by 2035. The seriousness of the current lack of grid capacity, however, was made

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² Jetten, R.A.A., Minister of Climate and Energy. (18 October 2023). Letter to the President of the House of Representatives of the States-General. <https://open.overheid.nl/documenten/fc7477f5-775b-4851-bdb3-30f89f1ad15a/file>

³ Government of the Netherlands. (2022). *Landelijk Actieprogramma Netcongestie*. [National Grid Congestion Action Programme]. <https://www.rijksoverheid.nl/documenten/rapporten/2022/12/21/landelijk-actieprogramma-netcongestie>

⁴ Jetten, R.A.A., Minister for Climate and Energy. (June 2023). Letter to Parliament. *Netcapaciteit, de versnelling van de energietransitie en de noodzaak van flexibiliteit*. [Grid capacity, the acceleration of the energy transition and the need for flexibility]. https://www.tweedekamer.nl/kamerstukken/brieven_regering/detail?id=2023D27812&did=2023D27812

clear by the Environmental Planning Agency in its 2023 climate and energy study.⁵ The study suggests that grid expansion will not be able to keep pace with new user requests and the grid congestion issues will not be solved before 2030.

The Netherlands has traditionally relied heavily on domestic natural gas for industrial, power generation and residential purposes. In 2019, the government decided to phase out its use: it announced that 1.5 million of the country's nearly 8 million dwellings would be heated without natural gas by 2030 and none from 2050 onwards.⁶ The Groningen gas field stopped operation in October 2023.⁷

No capacity for large grid users and increasingly tight for households

There has been a surge in grid demand from large energy users in the Netherlands, reflecting rapid economic growth and government incentives to reduce CO₂ emissions. In the country's south, this is mainly due to the electrification of industries.⁸ To avoid escalating gas bills, energy-intensive industries, especially those using lower-temperature processes, have been electrifying their operations earlier than planned. When transmission system operator (TSO) TenneT suspended new applications for connection in Brabant and Limburg in 2022,⁹ it laid bare the need for an urgent policy response — the National Grid Congestion Action Programme was the result. In addition, TenneT launched its own request for innovative technical solutions for managing grid congestion.¹⁰

Northern Holland has been experiencing grid congestion for years¹¹ due to the construction of new housing to meet a general shortage, coupled with migration to cities; the location of new data centres at the end of major intercontinental internet connections; and utility-scale solar PV attracted by relatively cheap land in the northeast. By now, the majority of the system cannot handle any new energy user with a grid connection above 3*80 A, i.e. non-small scale users (Figure 1).¹² In most provinces, the low-voltage grid can still serve small consumers, such as households, charging stations and small businesses, but its capacity will be filled up in two to five years.

⁵ Planbureau voor de Leefomgeving. (2023). *Klimaat- en Energieverkenning 2023 Deel 1: ramingen van broeikasgasemissies op hoofdlijnen*. [Climate and energy outlook 2023 Part 1: Estimates of greenhouse gas emissions outline]. <https://www.pbl.nl/sites/default/files/downloads/pbl-2023-klimaat-en-energieverkenning-2023-deel-1-5108.pdf>

⁶ Government of the Netherlands. (2019). *Klimaatakkoord* [National climate agreement]. <https://open.overheid.nl/documenten/ronl-7f383713-bf88-451d-a652-fbd0b1254c06/pdf>

⁷ Reuters. (December 2023). *Netherlands to end Groningen gas production by Oct 1*. <https://www.reuters.com/business/energy/netherlands-end-groningen-gas-production-by-oct-1-2023-06-23>

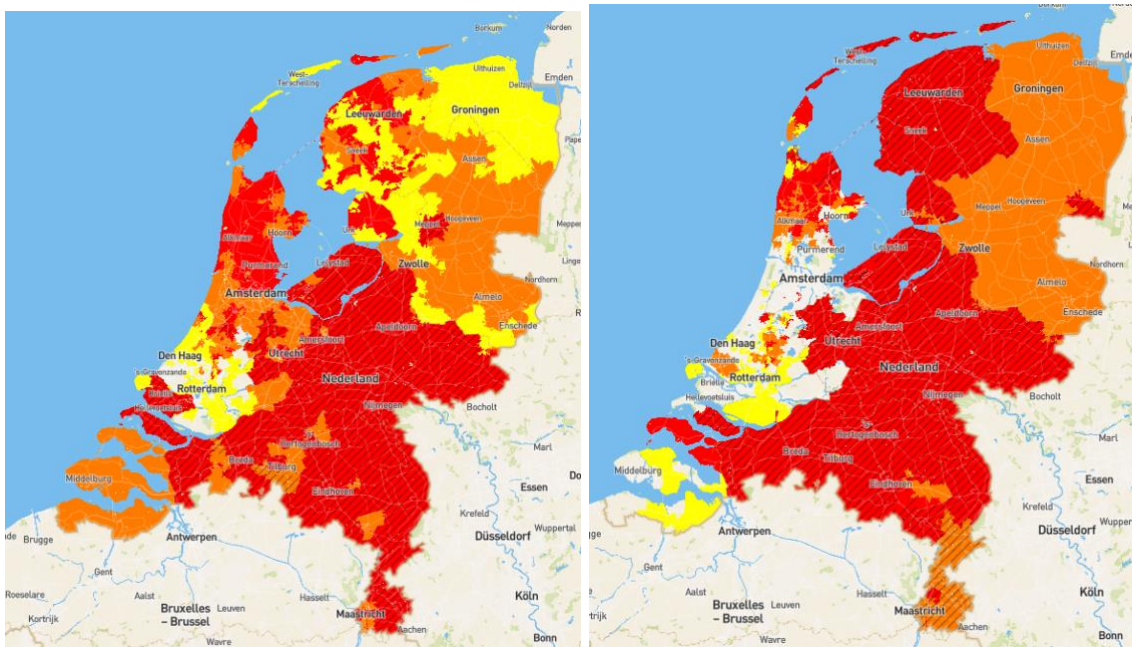
⁸ NOS. (December 2023). *Waarom is het stroomnet vol, en is er wat aan te doen?* [Why is the grid full, and can anything be done about it?] <https://nos.nl/artikel/2432057-waarom-is-het-stroomnet-vol-en-is-er-wat-aan-te-doen>

⁹ TenneT Holding B.V. (2022). *Integrated Annual Report 2022*. https://annualreport.tennet.eu/2022/downloads/6ce487d1-c425-4d77-a64e-e77b480d3398/TenneT_IAR_2022.pdf

¹⁰ TenneT Holding B.V. (May 2023). *Open Innovatie Programma: Drie ideeën naar de laatste fase* [Open innovation programme: Three ideas to the final stage]. Nieuwsbrief netcapaciteit [grid capacity newsletter]. <https://magazines.tennet.eu/netcapaciteit-nieuws-mei-2023/open-innovatie-programma>

¹¹ Liander. (December 2023). *Transportcapaciteit Noord-Holland*. [Transport capacity North Holland]. <https://www.liander.nl/grootzakelijk/transportschaarste/beschikbaarheid-capaciteit/noord-holland>

¹² Netbeheer Netherlands [Grid Management Netherlands]. (2023, 20 December). *Capaciteitskaart invoeding elektriciteitsnet* [Grid feed-in capacity map]. <https://capaciteitskaart.netbeheernederland.nl>

Figure 1. Grid availability for new load (left) and feed-in (right) for users above 3*80 A

Meaning of the color codes

- Transparent: Transport capacity available
- Yellow: Limited transport capacity available
- Orange: No transport capacity available for the time being pending the outcome of the congestion management study
- Red: No transport capacity available: congestion management cannot be applied

With congestion management:

- ▨ Transparent hatched: Transport capacity available based on application of congestion management
- ▨ Shaded yellow: Limited transport capacity available based on application of congestion management
- ▨ Shaded orange: No transport capacity available for the time being pending distribution of the released capacity over the queue based on congestion management. (it is still unclear whether and how much power will become available for new requests that are not yet in the queue)
- ▨ Shaded in red: No transport capacity available: the limits for the application of congestion management have been reached.

Source: Netbeheer Netherlands. (2023, 20 December). Capaciteitskaart invoeding elektriciteitsnet [Grid capacity map]

The Dutch solar explosion, resulting in the highest PV capacity per capita in Europe, accelerated the grid problem.¹³ The boom was triggered by a generous subsidy scheme¹⁴ for utility-scale PV (the Sustainable Energy Production and Climate Transition Incentive Scheme, or SDE++) and annual net metering¹⁵ for residential solar panels, with the growth illustrated in Figure 2.¹⁶ Net metering schemes mean that prosumers have no incentive to align generation and consumption.

According to the regulator, net metering “creates extra pressure on an already overburdened grid,” and prosumers are remunerated at a higher retail price for the electricity they inject in

¹³ Solar Power Europe. (December 2023). *Top 10 EU countries solar capacity per capita*. <https://www.solarpowereurope.org/advocacy/solar-saves/fact-figures/top-10-eu-countries-solar-capacity>

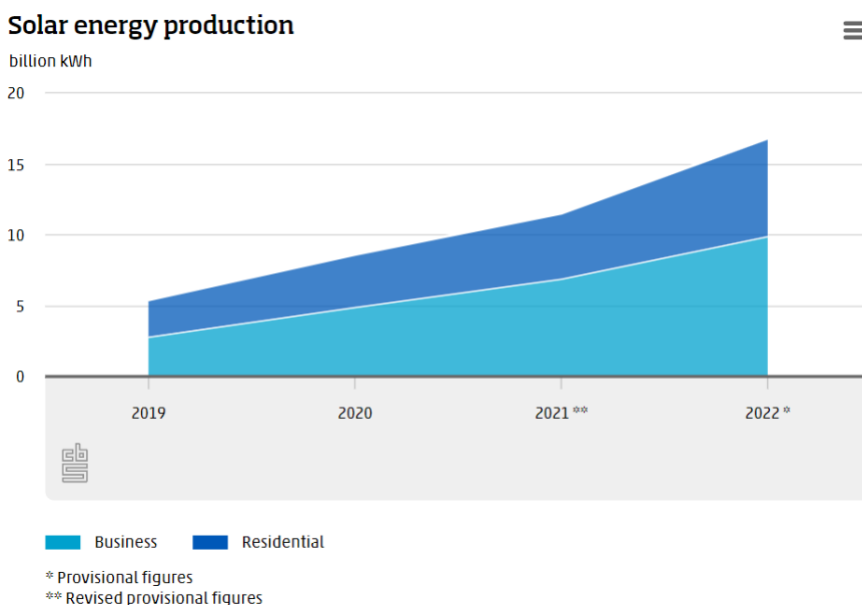
¹⁴ For the description of the SDE++ scheme see: <https://english.rvo.nl/subsidies-financiering/sde>

¹⁵ NOS. (December 2023). *Netbeheerder: 'Stroomnet te vol, stop met gunstige regeling zonnepanelen'*. [Grid operator: 'Power grid too full, stop favourable solar panel scheme']. <https://nos.nl/artikel/2413476-netbeheerder-stroomnet-te-vol-stop-met-gunstige-regeling-zonnepanelen>

¹⁶ Statistics Netherlands. (June 2023). *46 percent more solar energy production in 2022*. <https://www.cbs.nl/en-gb/news/2023/24/46-percent-more-solar-energy-production-in-2022>

peak solar periods when the value of electricity is lower.¹⁷ This raises the question of system fairness, as people who are not able to invest in solar PV must pay for the imbalance cost caused by excessive infeed. Energy supplier VandenBron has recently introduced a fixed daily charge for feeding power back into the grid, amounting to 10 to 20 euros per month on average, in an attempt to make the system more fair.¹⁸ Although the phase-out of net metering has been postponed until 1 January 2025 due to government change, it will be gradually reduced to zero by 2031, even though European legislation sets an earlier deadline.¹⁹

Figure 2. Solar energy production in the Netherlands, 2019-2022



Source: Statistics Netherlands (2023, 19 June). *46 percent more solar energy production in 2023.*

Since gas has traditionally been used for cooking and heating, low-voltage grids were planned to carry a load of approximately 1.5 kW per household, yet the standardised connection capacity limit is 8 kW (1-phase power supply) or 17 kW (3-phase power supply). The right to such a sizable connection capacity means that each household can potentially add a large load without distribution system operator (DSO) consent.

What's the plan?

When grid congestion spurred the government to create a national action programme, policymakers set out three goals:

- Faster grid construction.

¹⁷ ACM. (December 2023). ACM supports proposal for dismantling the net metering scheme. <https://www.acm.nl/en/publications/acm-supports-proposal-dismantling-net-metering-scheme>

¹⁸ Business Insider Nederland. (December 2023). *Energieleverancier Vandebron gaat klanten met zonnepanelen €10 tot €20 per maand rekenen voor terugleveren stroom.* [Energy supplier Vandebron will charge customers with solar panels €10 to €20 per month for feeding back electricity]. <https://www.businessinsider.nl/energieleverancier-vandebron-gaat-klanten-met-zonnepanelen-e10-tot-20-per-maand-rekenen-voor-terugleveren-stroom/>

¹⁹ Zonnenfabriek. (December 2023). *Changes in the net metering law postponed until 2025.* <https://www.zonnenfabriek.nl/en/news/changes-in-the-net-metering-law-postponed-until-2025>

- Stronger incentives for more efficient grid use.
- Increasing the flexibility of grid users.

The national action programme on grid congestion — prepared together with DSOs and TenneT following a stakeholder consultation — defines a list of actions under each goal. Most actions were to be completed by the end of 2023. The Ministry of Economic Affairs and Climate Policy and the provincial governments are responsible for action programme implementation, aided by working groups for each goal; these include network operators, network users, central government, provinces and the regulator. The following section describes the actions presented in the plan.

Table 1. Objectives of the Dutch National Grid Congestion Action Programme

GOALS			
	Faster grid construction	Stronger incentives for more efficient grid use	Increasing the flexibility of grid users
ACTIONS	<ul style="list-style-type: none"> • Governance moved from local to regional level • ‘Integration teams’ of local governments and network companies • More efficient planning • Reforming network company remuneration • Compensation for local communities 	<ul style="list-style-type: none"> • Amending the Network Code on congestion management, contacting and sharing • Network tariff reform • Upgrade of grid operation plans • Priority lanes/use it or lose it 	<ul style="list-style-type: none"> • Annual national market consultation • Facilitating DSF • Energy hubs

Each main goal demands both quick fixes and longer-term actions. Some build on the current regime and can be taken and reinforced quickly, while others entail making more fundamental changes to better suit a renewables-based distributed power system.

Quick fixes

One avenue towards more efficient use of grid capacities involves governance changes to **speed up the connection process**: moving responsibility for permits from the municipal to the provincial or regional level to avoid confusion about remit (national action programme), changing the process so sequential elements work in parallel, clustering the buildout of grid connections within the same area to economise on workforce, and standardising applications and assessment.

Making better use of existing grids is not only a quick fix but part of the long-term solution, as this permanently reduces the need for construction of new grid capacity. The Dutch Electricity

Network Code includes some network **congestion management** options, and will be updated regularly based on close monitoring of its effectiveness. The main options are discussed below.

Tightening mandatory participation in congestion management

Network operators have often refused to establish new connections, claiming that applicants are “not prepared to limit production on an incidental basis.”²⁰ Following an agreement between network operators and renewable energy organisations including NWEA, Energie Samen and Holland Solar, network operators can request that grid users in congested areas with a connection capacity above 1 MW participate in congestion management (the previous threshold was 60 MW). Reducing peaks in grid use will allow for the connection of more grid users from the application queue, mainly solar and wind producers. Obligated companies must demonstrate how much of their contracted capacity can be used flexibly, and have to offer a price at which they are willing to limit their in-feed or load. Grid operators then choose the cheapest bid at peak times.²¹

The network operator defines congested areas and the time(s) and volume of expected congestion. The regulator then sets a limit on what the operator can spend each year on congestion management in a given area, including all payments to grid users for flexibility services. This is currently set at 1.02 euros per MWh. The network operator has to allocate this amount efficiently enough to mobilise the flexibility of grid users while remaining within operational limits. The Dutch National Regulatory Authority also set a technical limit allowing 10% overbooking of the capacity of the grid (50% for flexible assets) — beyond which it is no longer obliged to apply additional congestion management, and therefore can refuse connection.

Capacity limitation contracts

Another solution is the limitation of existing firm connection capacity rights. Limitation and compensation terms can be defined in a capacity limitation contract (*capaciteitsbeperkingscontract*, or *CBC*) which is separate from the 24/7 firm connection capacity contract (*aansluit- en transportovereenkomst*) between the power producer and the network operator. At a minimum, the CBC must include:

- The maximum transport capacity to be used.
- Whether the reduction is permanent or only for agreed periods.
- The price in euros per MW for the agreed reduction.
- The location of the connection.
- The contract period.

The network operator may request a capacity limitation by midnight on the day before physical congestion is expected (this is the time at which the day-ahead market closes). The

²⁰ Energie Samen (December 2023). *Congestiemanagement traag op gang*. [Congestion management slow to get going]. <https://energiesamen.nu/nieuws/3426/congestiemanagement-traag-op-gang>

²¹ Jetten, R.A.A., Minister for Climate and Energy. (October 2023). Letter to Parliament: Nieuwe maatregelen netcongestie. [New grid congestion measures]. https://www.tweedekamer.nl/kamerstukken/brieven_regering/detail?did=2023D42932&id=2023Z17707

grid user has to inform its balancing-responsible party about the activation. This measure can be applied anywhere, including outside predefined congestion areas. Congestion can also be dealt with through other market and nonmarket-based instruments. Market-based redispatch is organised via the GOPACS platform.²²

Several DSOs already offer contracts of this kind to both consumers and producers, and the first CBCs have been concluded.²³ Further improvement is needed to standardise contracts and fees to enable flexibility to be used more swiftly and on a larger scale.

Non-firm connection contracts

CBCs assume that congestion-related limitations are removed once the issue they're addressing is solved structurally. By contrast, a non-firm connection has a different starting point, as the network operator and user consciously opt for more flexible and limited grid use, trading flexibility for lower network tariffs. A number of standard non-firm grid connection models are being developed, which include firm capacity that varies by the hour, instead of a fixed value 24/7; contracts with an energy guarantee, so the capacity profile always allows for enough energy transport; and minimum availability guarantees.

Connection sharing

Until now, only solar and wind units could share a single connection point. In the future, connection sharing can include local storage, conversion unit and load, to maximise the portfolio effect of the different profiles. This connection sharing is limited to four grid users in close proximity.

Another new connection and transport capacity contract being developed is the group transport contract. This would facilitate the creation of local 'energy hubs' (i.e., areas with locally coordinated energy use and generation, mostly in industrial sites or business clusters)²⁴ by standardising statutory data exchange and setup processes. The Energy Hubs Incentive Programme will disburse 166 million euros between 2024 and 2030 for, among other things, the appointment of hub managers and the development of data sharing standards and contracts among hub members.²⁵

'Priority lanes'

The Ministry of Economic Affairs and Climate Policy is in the process of establishing a list of priority projects for which swift grid connections are of national importance, such as offshore wind parks, industrial decarbonisation plans, or projects with a social function (housing, security, healthcare or schools).²⁶ Priority in congested areas can also be based on, for

²² The GOPACS platform is a congestion management platform of Dutch network operators linked to EPEX Spot. It enables flexibility by allowing network operators (both the TSO and the DSOs) to request a drop or rise in demand or production from customers in order to resolve a specific congestion. See: <https://en.gopacs.eu>

²³ See for example, Enexis. (December 2023). *Capaciteitsbeperkingscontract voor congestiemanagement*. [Capacity limitation contract for congestion management]. <https://www.enexis.nl/zakelijk/netcapaciteit/flexibele-oplossingen/alle-oplossingen/capaciteitsbeperkingscontract>; Information on the progress with contracts in general in Jetten, R.A.A., October 2023.

²⁴ For Schiphol Trade Park example, see: <https://www.sadc.nl/en/first-companies-connected-to-unique-virtual-power-grid-at-schiphol-trade-park>

²⁵ Jetten, R.A.A., October 2023.

²⁶ ACM. (June 2023). *ACM geeft extra mogelijkheden om bestaande stroomnet efficiënter te gebruiken*. [ACM provides additional options to use the existing power grid more efficiently]. <https://www.acm.nl/nl/publicaties/acm-geeft-extra-mogelijkheden-om-bestaande-stroomnet-efficiënter-te-gebruiken>

example, willingness to participate in congestion management by offering flexible capacity during a transport peak, the size of the requested capacity, or a customer's potential contribution to easing congestion. The position in the queue could also be determined by how advanced the project is (first-permit, first-served principle).

Releasing unused contracted capacity ('use it or lose it')

As grid users pay different network tariffs for contracted and actual peak capacity, industrial consumers often apply for higher capacity than they actually need, to allow for future load growth. Network operators now have the right to limit unused contracted capacity to allow for new users to connect to the grid. The grid user must demonstrate that the capacity is necessary, and will be used within two years.²⁷ The market for the released connection capacities will provide a good indication of the tightness of grid capacity.

Market facilitation and renewable support conditionality

A dedicated website, slimmetstroom.com, has been created to support network users. It includes a tariff calculator for large industrial users (Industrial ValueFlex Tool), which can increase flexible capacity offers. The website provides clear information about the available grid capacity, how queues are managed, and the steps and timelines in the process between applying for a connection and getting online. Participation in the renewable support scheme SDE++ can also be made conditional on providing flexibility in the future.

Compensation for local communities

The compensation payment for building infrastructure assets – to secure the support of local communities – would be part of the eligible cost and hence recoverable in the network tariff. The use of the compensation would be managed by the local government.

Longer-term actions

Relaxing reliability standards

Currently, high-voltage grids (110 kV and higher), and the transformers connected to them, must comply with the N-1 rule for demand.²⁸ This limits the capacity that can be awarded for demand users. Some facilities are exempted from this rule (meaning they can be connected even if violating the N-1 rule), but its scope should be extended to include, for example, grid users with storage and/or conversion that could be connected under N-0 conditions.

Requiring more transparent network development plans

Network operators are required by European law to deliver their network development plan every two years. These plans, approved by the national regulator, analyse how much capacity and flexibility will be required over at least the next 10 years under a range of scenarios. Planned improvements include:

²⁷ ACM, June 2023.

²⁸ The N-1 rule is an operational standard for electricity supply. The standard ensures the security of the grid, even in the event a component, such as a transformer or a circuit, fails.

- Clarifying the reasons for current investment delays to avert them in the future.
- Showing the gap between what is feasible and what is required, and the actions needed to close the gap.
- Investigating wider use of concepts such as dynamic line rating and the right to take the initiative to speed up connection construction. This means that applicants can contract an installer (certified by the network company) themselves if they can prove that this will bring the grid element online quicker.

Reforming network company regulation

The National Regulatory Authority plans to review the current regulatory framework to make sure that it is sufficiently forward-looking and adheres to the goals of affordability, security of supply and sustainability. This includes supporting the timely construction of new grids required for renewable-based supply and electrification of demand. Critical questions for the upcoming regulatory period beginning 1 January 2027 include:

- The need for stronger monitoring of the predictability and timely realisation of grid expansions.
- How to assess the efficiency of network operators.
- How to drive innovation and the smart and flexible use of the energy system.

Network tariff reform

The action programme states that the current tariff structure does not incentivise users to avoid using the grid in peak hours. Producers do not pay for network use, except a small lump-sum payment for metering and administrative costs. The capacity charge paid by consumers (the higher the connection voltage, the bigger the share of the capacity charge) does not incentivise use of the grid according to available capacity, as it is the same regardless of the volume and timing of electricity imported from or exported to the grid.

The Dutch government will consider revising the network tariff structure in conjunction with the development of new forms of contract or connection. Key changes that will be considered include:

- Introducing time-of-use network tariffs for consumers.
- Introducing network tariffs for producers.
- Reducing tariffs for non-firm connections.

Grids can be early barriers to decarbonisation

Power grids in the Netherlands were designed for modest residential load but have since had to cope with electrification coupled with growing renewable generation. The Dutch experience shows how grids can quickly become key barriers to decarbonisation even before electrification impacts overall power consumption.²⁹ As the Minister of Climate and Energy rightly noted, “15,000 substations need to be expanded by 2030 and 80,000 kilometres of

²⁹ Government of the Netherlands. (December 2023). Aanbod en verbruik van elektriciteit, 1990-2022. [Supply and consumption of electricity, 1990-2022]. <https://www.clo.nl/indicatoren/nl0020-aanbod-en-verbruik-van-elektriciteit>

additional cables will be required by 2050. So we don't just have to speed up the pace of grid construction, but also make better use of what we have.”³⁰

Postscript

The race to come up with measures — defined in October 2023 as ‘unorthodox’ by the Minister for Climate and Energy — is in full swing. Some proposed additional ideas:³¹

- Enabling municipalities and provinces to proactively designate land for electricity grids, batteries and electrolysers, based on TSO/DSO grid development plans.
- Giving municipalities a ‘first right’ to buy land to site grids.
- Allowing TenneT to start construction of high-voltage grids at major bottlenecks before the permit has entered into force (i.e., still open for appeal), or even without a permit.
- Encouraging integrated spatial and energy systems planning.
- Instituting the notion of a right to fully flexible grid connection by replacing ‘right to connection’ with ‘right to firm connection’ in the network code, and by treating 24/7 guaranteed capacity at the transmission level as a premium product.³²
- Basing flexibility tenders from 2024 on long-term flexibility needs as defined by the network operator, to incentivise investment into flexible assets such as battery storage.
- Introducing mandatory participation in congestion management for load, for a standard fee and with minimal customisation.

Will these measures be enough to close the Dutch grid capacity gap by 2030, as the national climate strategy assumes? Or is there a need for more fundamental reforms, such as splitting the Dutch bidding zone or moving to nodal pricing?³³ Time will tell – and soon.

³⁰ Jetten, R.A.A., June 2023.

³¹ Jetten, R.A.A., October 2023.

³² Autoriteit Consument & Markt. Draft Decision ACM/22/180165. (28 September 2023). <https://www.acm.nl/system/files/documents/ontwerp-codebesluit-non-firm-ATO-2023-09-28.pdf>

³³ On ACER's bidding zone review, see: ACER. (2022). *ACER has decided on alternative electricity bidding zone configurations*. <https://www.acer.europa.eu/news-and-events/news/acer-has-decided-alternative-electricity-bidding-zone-configurations>; on nodal pricing: <https://blueprint.raonline.org/locational-marginal-pricing>



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