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COUNTRY : THE NETHERLANDS
REGISTRATION NUMBER : 618

GROUP REF. : C2
PREF. SUBJECT : 2
QUESTION N° : 2.5

In just a few years' time, large parts of the Dutch transmission and distribution grids got congested. Both for loads and generators, the remaining hosting capacity is becoming scarce, if available at all.

Where TSOs/DSOs used to design their networks for rather predictable loads and have the required reinforcements in place on time, the world could not be (come) more different. The climate issues force customers to go about their energy use in a different manner, resulting in (rapid) increases in electrical loads (e.g. electric heating and mobility) and generation (e.g. solar and wind) on the distribution networks. At least, that what is the case in the Netherlands.

Although an adoption of PV systems was to be expected, where these solar farms would be built specifically and what their installed capacity would be was unknown. And since a solar farm can be built much quicker than the grid can be reinforced, congestion was the result – especially in rural areas. Likewise, a transition to electric modes of transportation (cars, buses, ferries, etc.), phasing out internal combustion engines, burning fossil fuels and electric heating (heat pump, infrared panels, electric boilers, etc.), phasing-out gas heating (over 90% of the current households) was to be expected at some point in time. Combine the load growth with strong economic growth, and the grid reinforcement need due to generation in rural areas, and short-term congestion is inevitable.

This disaster calls for drastic action. The natural reflex of TSOs/DSOs might be to ramp up the grid reinforcement programmes. And so they should. Electricity grids may have to be doubled or tripled in capacity, depending on how the Netherlands transitions to climate neutrality. As one may understand, this involves serious investments. In addition, shortages in staff and materials do not allow for timely reinforcement. Furthermore, low full load hours (e.g. for PV) raises the question if all reinforcements would be cost effective. These developments require the TSOs/DSOs to grow into their system operator role: more and more they can (due to more DERs) and need to (due to capacity constraints) communicate with the customers on the state of the grid and the behaviour that is expected from the customer.

In the Netherlands, several steps are being taken to involve customers more in solving the short-term (congestion) and long-term (affordability) system issues.

One of the ways customers are involved in alleviating grid constraints is through GOPACS. GOPACS is a market platform used for solving both active and expected constraints in the electricity grid. Since 2018, it brings together system operators with congested grids and customers offering flexibility. Bids inside and outside congested grids are combined to make sure the overall system balance is not disturbed. At the same time, being a joint development of the Dutch TSO and DSOs, GOPACS makes sure that solving congestion for one of the system operators does not cause congestion for another.

Aside from market-based innovations, more alternatives have been sought to make capacity available to customers (sooner). Some recent examples:

- The grids' backup capacity has been made available to generators. On average, this increases the available capacity by 30%, reducing the need for network reinforcements.
- The Dutch network code on congestion management has been revised, enabling a wider application of congestion management. As a result, more capacity will become available in congested areas soon while the network reinforcement is underway.
- Autonomous voltage-based power control for generators has been developed. In areas with voltage constraints, this may serve as a last-resort alternative to a full capacity restriction.
- Non-firm capacity contracts are being developed. These give customers the opportunity to reduce their network costs by giving up parts of the 24/7/365 certainty of capacity availability. The first group these contracts will be made available to customers with battery storage.

Meanwhile, a lot more diversified contract forms are under development.

A key instrument in communicating with customers on grid status and flexibility requirements is the recently developed real-time interface by Netbeheer Nederland (the collaboration of the Dutch TSO and DSOs). The interface does not only fulfil the requirements of the EU Network Code on Requirement for Generators, but also allows the development of a wide range of use-cases (non-exhaustive, and most):

- Day-ahead or intraday communication on additional or reduced available network capacity (e.g. when using non-firm capacity contracts for flexible charging of EVs or when flexibility contracts are in place)
- (Day-)ahead communication of maintenance schedules (relevant for customers who did not contract redundant grid capacity)
- Intraday capacity reduction requests due to lost redundancy (e.g. requesting customers to reduce their (net) generation)
- Intraday capacity reduction due to frequency excursions
- Emergency intraday curtailment due to unexpected overloads (e.g. ordering customers to reduce their (net) generation/load)
- Validation of contracted congestion management services
- Communication of updated P(U) and/or Q(U) and/or power-factor setpoints for autonomous voltage-based controls
- Setpoint communication for controlled grid restoration after a blackout
- Communication of measurement values from the customer to the DSO (net active, reactive and apparent power, voltages, currents, etc.)

It is only through services like this, that we will move to an affordable, reliable and sustainable energy system.