Related to congestion, a grid can be in one of three phases. During normal grid operation (phase 0), no congestion is present and all desired electricity transports can take place. When (a part of) the grid has no remaining hosting capacity, congestion management is considered (phase 1). Customers can provide flexibility services to limit the grid loading. These services may be contracted bilaterally or market-based. When congestion management is not possible or insufficient to facilitate all capacity requests, the grid is fully congested (phase 2). The grid cannot be loaded any further and the only option is to deny any requests for additional capacity. These requests will be put on a waiting list and will receive the desired capacity once the grid has been reinforced.

In all aforementioned phases, flexibility services may be used to optimise electricity transport, or to make them possible at all. The list below shows some recent Dutch examples of use-cases/products to unlock flexibility services:

- Phase 0: normal grid operation
    - The backup capacity of the transmission and distribution grids has been made available to generators. On average, this increases the available capacity by 30%, reducing the need for network reinforcements. Possible compensation during maintenance or following outages is still under discussion.
    - 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, are customers with battery energy storage systems. Simultaneously, several pilots are being conducted, e.g. with an industrial party who wants to use an e-boiler. The e-boiler can make use of those hours in the day when the grid loading is low, as long as the customer can be assured that throughout the day enough energy will be available to operate the e-boiler.
    - Another source of flexibility lies in the charging process of EVs. Pilots in which (non-firm) capacity is shared between charging-points are in an advanced stage, and seem to positively affect the grid loading while maintaining an adequate service level.
- Phase 1: active congestion management
    - Market-based flexibility services are contracted through GOPACS. GOPACS 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 – it 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. Several congestion management markets are currently active.
    - The Dutch network code on congestion management has been revised, enabling a wider application. As a result, more capacity will become available in congested areas soon while the network reinforcement is underway.
    - Next to market-based flexibility serves, bilateral flexibility contracts are in place in some areas to relieve grid constraints.

- Phase 2: full congestion
    - 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. (For details, see the contribution to PS2 Q2.6.)
    - Time-based contracts are developed, allowing transport during certain hours of the day, days of the week of months of the year. This might allow customers to already have a part of their desired electricity transports take place.

Meanwhile, a key instrument in communicating with customers on grid status and flexibility requirements is recently developed by Netbeheer Nederland (the collaboration of the Dutch TSO and DSOs). The developed real-time 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 flexibility-related use-cases (non-exhaustive):

- Day-ahead or intraday communication on additional or reduced available network capacity
- (Day-)ahead communication of maintenance schedules
- Intraday capacity reduction due to frequency excursions
- Emergency intraday curtailment due to unexpected overloads
- Validation of contracted congestion management services
- Communication of updated 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

The development of flexibility products/pilots have taught a few lessons.
First of all, that getting the financial incentives right is harder than getting the technical concept to work. In phase 2 (full congestion) this compensation is straightforward. The fallback scenario is a transport restriction. Any additional transport allowed by utilizing flexibility is in the direct interest of the customer. As such, he will not be financially compensated for providing the flexibility services. Also in phase 1 (active congestion management) the price forming is clear. The flexibility services may be contracted bilaterally or through a congestion market and the budget to do so may be maximised. In the Netherlands, this maximum budget is related to the congestion duration and the capacity of the substation involved. As long as the budget is not expected to be fully spent, additional flexibility may be contracted. It is phase 0 (normal grid operation) which is the hardest to determine a fair compensation for. The compensation must not be too low, as customers will not be sufficiently enticed to unlock their flexibility, but not too high either, effectively giving customers discounts on their network tariffs. With all aforementioned phase 0 products, these discussions are ongoing.

Secondly, only a limited amount of (phase 1) flexibility is (currently) available on most medium-voltage feeders. Consequently, reliably contracting flexibility services can be complex. The dependency on one customer to prevent overloads can become significant.

Finally, as more flexibility products are being defined, it gets harder to maintain the overview and determine the optimal mix. Do you compensate customers upfront (phase 0) or only when grids are congested (phase 1)? And can products be combined? Something we will have to keep in mind and discover in the years to come.