

Power-to-gas-externaliteiten Noordzee

Publieke samenvatting / Public summary

On the North Sea, two clear trends evolve in the energy landscape: on the one hand the process of gradually decommissioning the about 600 oil and gas installations, and on the other hand the massive investment from all North Sea countries in offshore wind activity. This dual development raises the issue if there is scope for collaboration between the oil and gas and offshore wind operators. One potentially promising area in this regard is using oil and gas platforms that run out of operation for conversion and possibly storage of offshore wind energy to develop more economical ways for transport, storage, and use of this energy than if it would need to be transported to shore via new e-grid systems.

In this study, the perspective has been taken to relate the calculations and simulations to two platforms (G17d and D18a), and to take into account not only the conversion and storage costs and benefits, but also those related to the energy transport, even if the latter may be an externality to the operators' activities. For both platforms, two cases have been distinguished: one in which all wind energy is transported to the platform for conversion, so that a new e-grid connection between the wind farm and shore is no longer necessary (G-only case); and one in which the e-grid connection between the wind farm and shore still exists, so that operators have the choice to bring the wind energy to shore either by way of electrons, or, after conversion, by way of molecules (E+G case).

For the G-only case, it was analysed how much

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electrolyser capacity would optimally be used to service a wind farm of a certain capacity. Based on an economic model and given wind profiles, it turned out that the optimal ratio was about 78%.

With respect to the issue how much electrolyser capacity could be positioned on a platform, given weight and surface area restrictions, it turned out that a complete production platform (G17d) can host up to about 250 MW electrolyser capacity, based on the modern generation of electrolysers currently under development. A much smaller satellite platform such as D18a could host up to about 60 MW of electrolyser capacity.

With the help of a model developed to assess the economics of offshore conversion and related transport, it has been assessed what the net present value (NPV) would be under a range of assumptions with respect to input and output variables, OPEX and CAPEX of technical devices, and grid and gas treatment costs. Based on the available market data, different assumptions have been made on 'green' hydrogen prices, ranging between €1.56/kg and €4.67/kg.

In terms of optimal transport modes through the gas grid, it turned out that depending on the distance from the platform to shore, it was either optimal (e.g. for faraway North Sea locations) to admix the hydrogen to the natural gas flow and separate it once on shore, or (typically for near-shore locations providing significant volumes of hydrogen) to invest in a dedicated grid for hydrogen.

The results from the base case showed that even when taking into account the externalities, NPV values are negative for virtually all E+G cases (i.e. except from the case in which a limited electrolyser capacity is added to the still operational platform G17d, and hydrogen prices are at the top side of the range). The explanation is that the transport/grid costs obviously dominate this picture, because the net 'decommissioning bonus' is relatively small compared to the transport/grid costs.

For the G-only case, NPV values turned out to be

negative if prices for 'green' hydrogen would be at the low end of the range. However, if prices for 'green' hydrogen would move up towards the upper level of the range, then serious positive NPVs seem to be feasible.

The subsequent sensitivity analysis for a positive future scenario (assuming lower electrolyser CAPEX prices, lower power prices, a favourable EU ETS and subsidy regime, and modest WACC requirements) revealed moreover the following. If a combination of those four positive factors applies, all cases assuming an upper-range 'green' hydrogen price (both G-only and E+G cases) do show a positive, and sometimes substantially positive, NPV.

Overall, it looks like offshore conversion can economically indeed be very promising, but typically if the combination of a platform-for-conversion with a wind farm can fully replace the e-grid connection to shore, and/or if the 'green' hydrogen will receive a distinctly higher price than the current bulk-level market price for 'grey' hydrogen.

In the simulations for the G-only cases, we found break-even values for the offshore-produced 'green' hydrogen prices ranging between €2.84/kg and €3.25/kg for the positive future scenario. In other words, 'green' hydrogen prices will have to amount to somewhat less than double the currently assumed price level for bulk volumes of 'grey' hydrogen (€1.56/kg) in order to get break even in a future positive scenario. If, instead, the current business conditions (i.e. the base case, or for future developments a relatively pessimistic scenario) would still apply in the future, the break-even values of 'green' hydrogen for the G-only cases turned out to range between €4.26/kg and €4.63/kg.

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