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The missing money problem and capacity markets

2nd BAEE Policy Workshop
Renewable energy, price formation and policy challenges for electricity markets

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Overview presentation

- The ‘Missing money’ problem
  - What is the missing money problem?
  - Options to address the missing money problem.
  - Intermittent renewables and the missing money problem
- Quantitative analysis
  - The impact of more intermittent RES in the Netherlands / NW-Europe on generation capacity investment incentives
  - The impact of Germany unilaterally implementing some form of capacity mechanism on the Netherlands
- Policy discussion
  - What is the role of capacity markets with higher levels of intermittent renewables in the generation mix?

“Missing money” problem

- Lower revenues for peak capacity because of
  - Price restrictions
  - No or limited demand response
- Therefore less investment than optimal in peak generation capacity
- The missing money problem can result from
  - Non-price rationing (black outs without scarcity pricing)
  - Reducing system voltage
    - reduces system demand and therefore prices
  - Out-of-market contracts for operating reserves

Addressing the missing money problem

- Improving energy-only electricity market performance
  - Sufficiently high price caps (to reflect VOLL)
  - Allowing prices to rise to price caps when system operators take out-of-market actions during scarcity conditions
  - Increase real-time demand response: Smart meters/grids
  - Energy storage
  - Investing in cross-border transmission capacity to increase flexibility

- Capacity markets
  - Regulator sets reserve margin (peak generating capacity minus peak demand)
  - Auction for generating capacity

Effect of increasing levels of renewables

- Renewables (wind, solar, hydro)
  - Low or zero marginal costs
  - Intermittent supply
- Consequences
  - Lower electricity prices when renewable energy sources produce electricity
  - More back-up capacity needed
  - Less operating hours for back-up capacity

  => Missing money problem increases

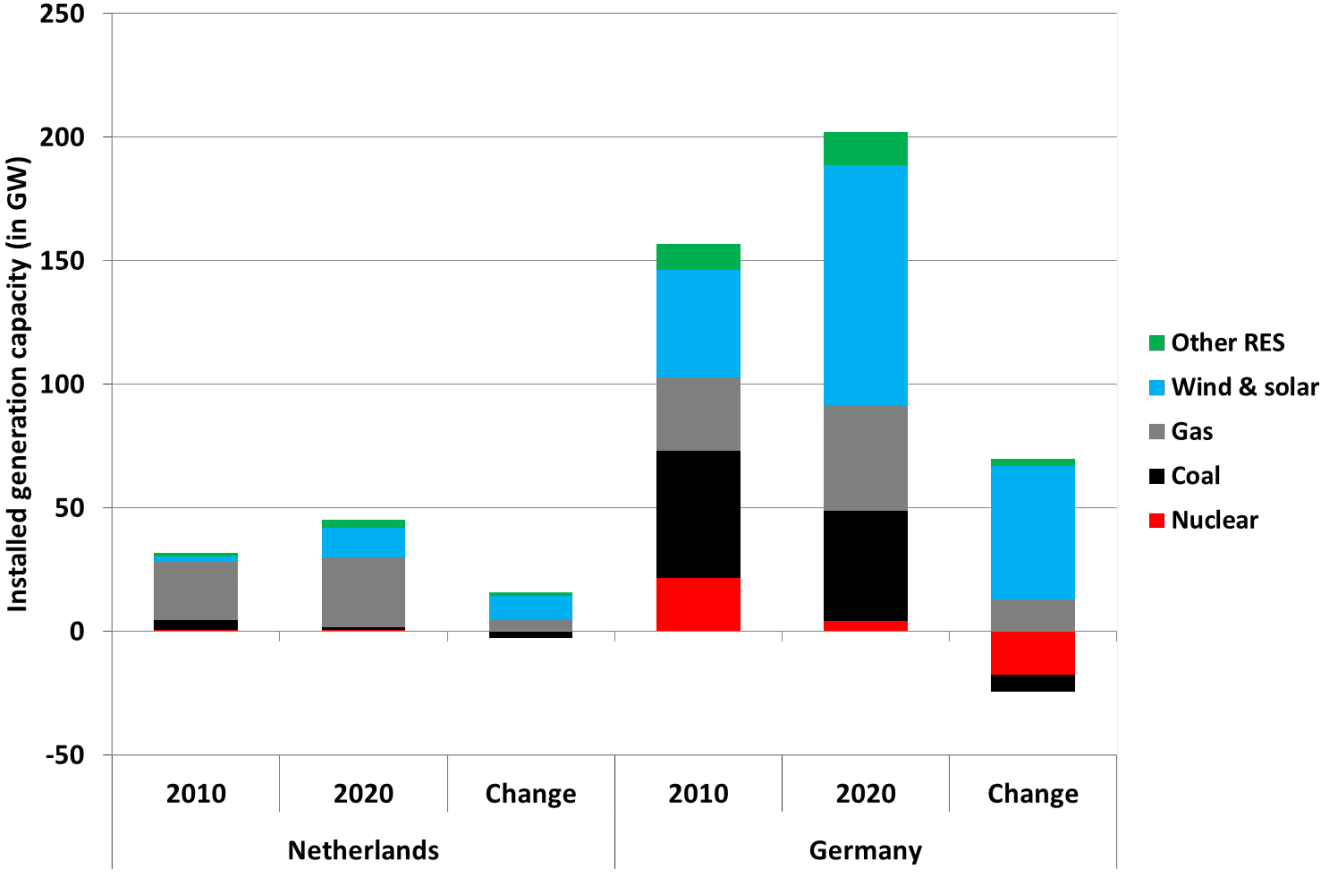
Research question 1:

The impact of more intermittent RES in the Netherlands / NW-Europe on generation capacity investment incentives

Modelling approach

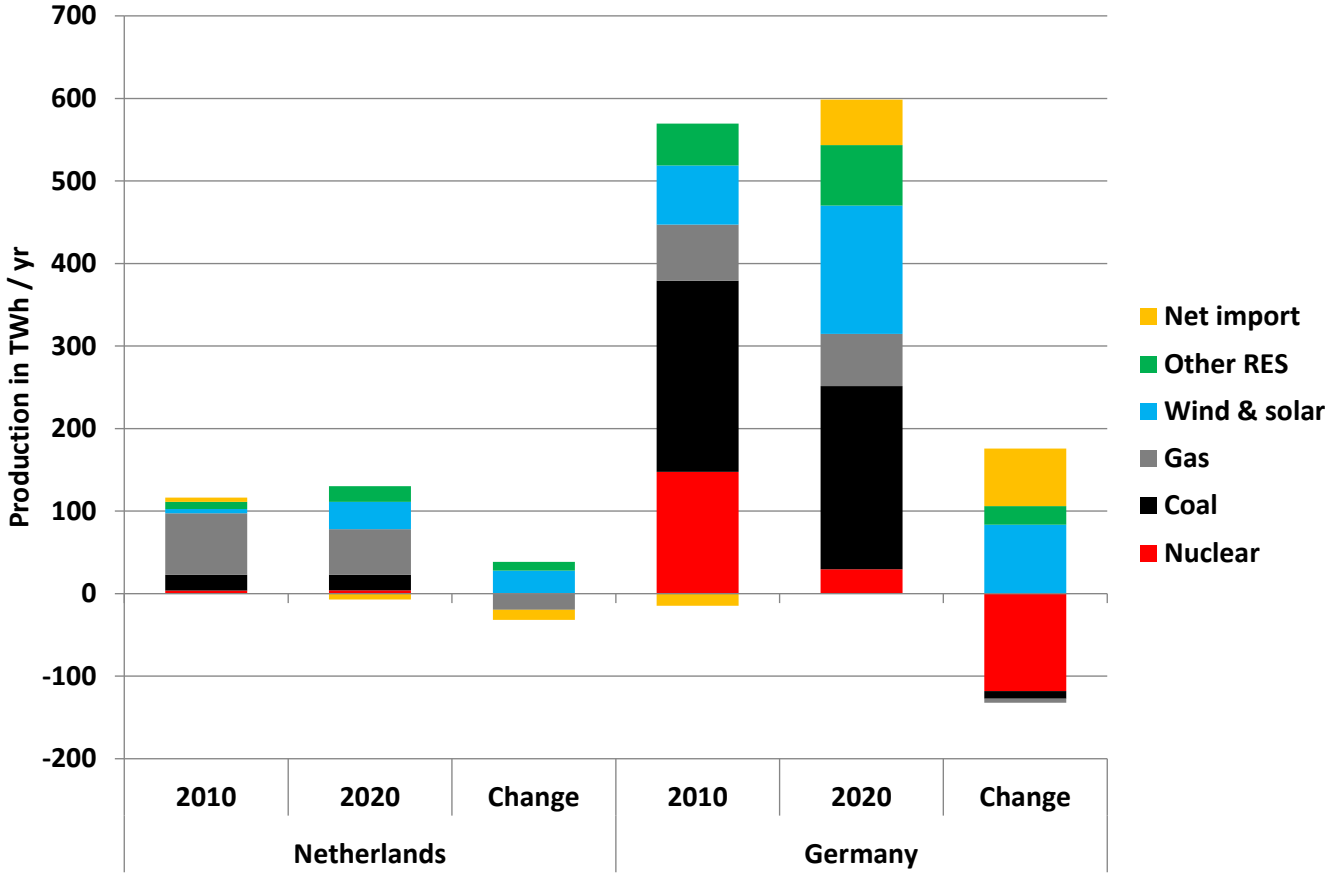
- Comparison of two market situations: 2010 vs 2020
- Validated 2010 data input and results
- Increased renewables penetration in 2020
  - Based on NREAP (Member State targets for 2020)
  - Conventional capacity development based on known investment & decommissioning plans
  - Cross-border trading capacities based on ENTSO-E TYNDP (2010)

Production capacity development Netherlands and Germany (2010-2020)



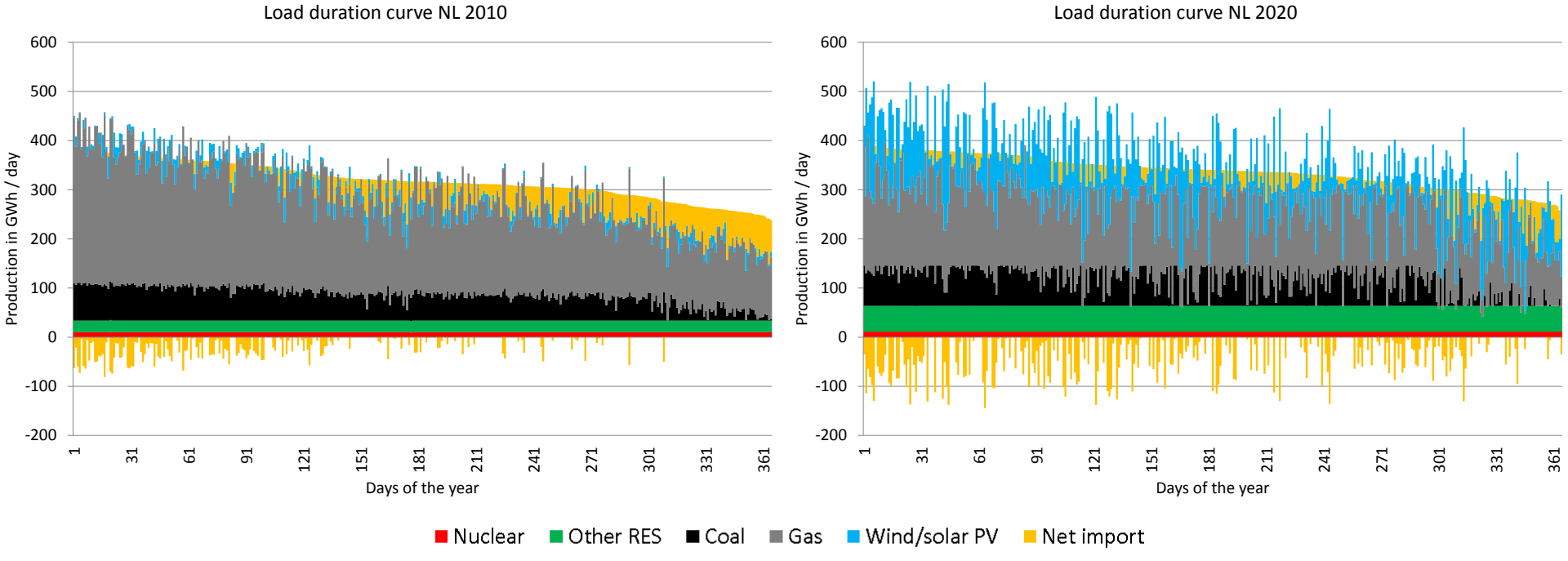
- Increase in wind & solar:
  - NL: +9.6 GW
  - DE: +54.3 GW
  - Total: +63.9 GW
- As % of total installed capacity:
  - NL: 7% → 26%
  - DE: 27% → 47%

Impact on electricity production in the Netherlands and Germany



- Increase in wind & solar:
  - NL: +27.6 TWh
  - DE: +111.2 TWh
  - Total: +138.8 TWh
- Increase penetration rate (% of demand):
  - NL: 5% → 27%
  - DE: 13% → 26%
- CO2 emissions increase in NL
  - (Demand NL↑ & Exports ↑)

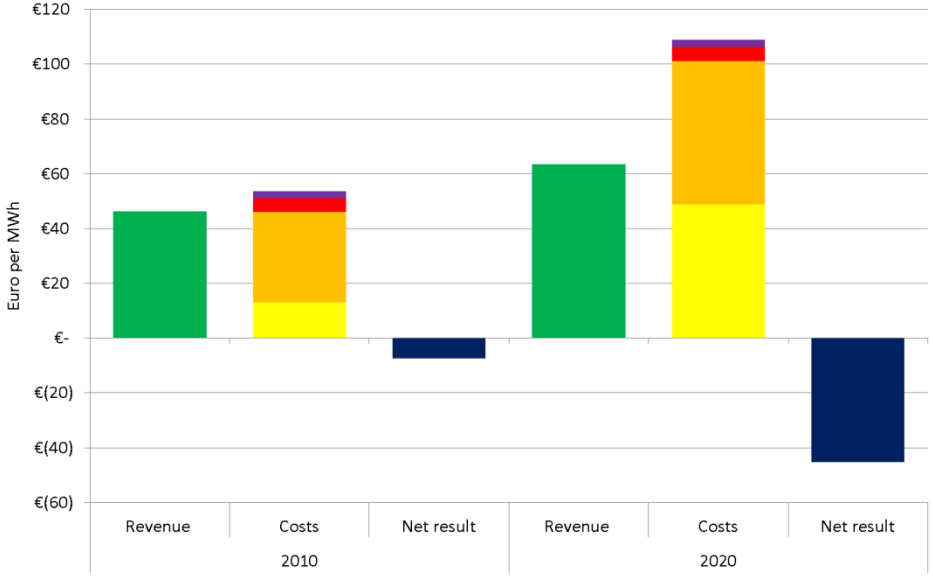
Impact on load duration curve NL



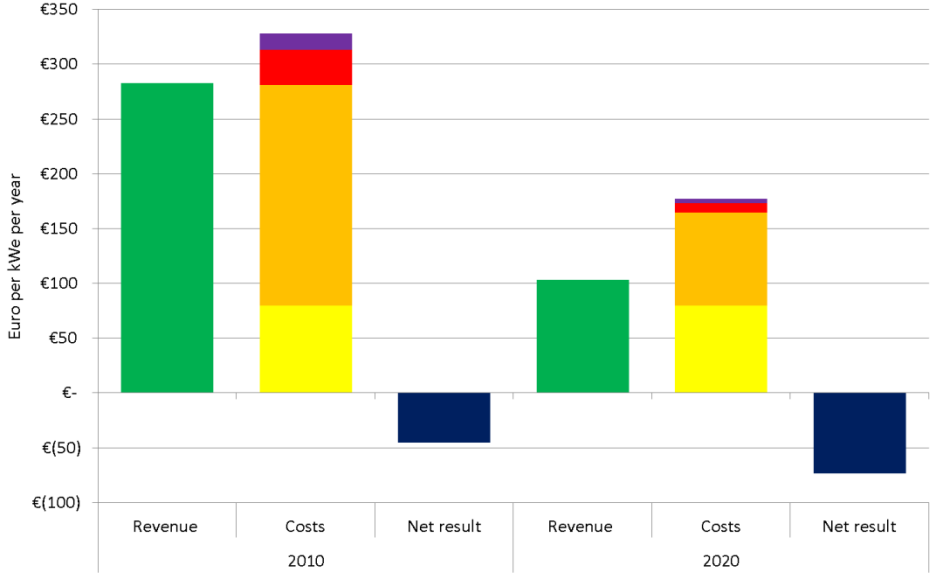
- Note that the flexibility of coal power plants is overestimated as no restrictions are imposed on hourly ramping up/down. Illustration of merit order effect only.

Cost / revenue of energy produced and capacity used in 2010 vs. 2020: *CCGT*

In Euro / MWh produced



In Euro / kWe installed



Investment cost | Fuel cost | CO2 cost | Variable O&M | Net result | Revenue

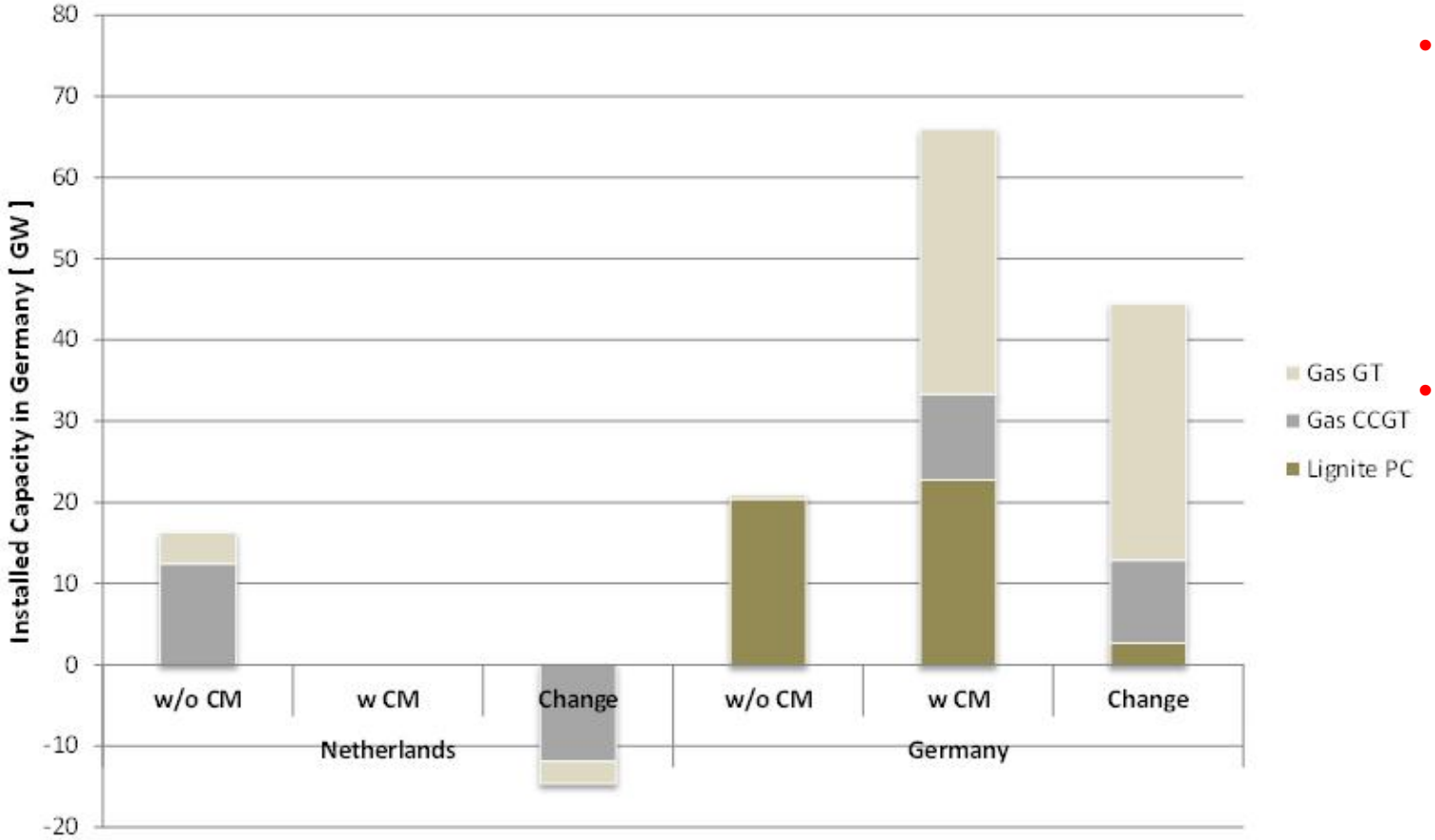
Research question 2:

The impact on the Netherlands of Germany unilaterally implementing a capacity mechanism

Modelling approach

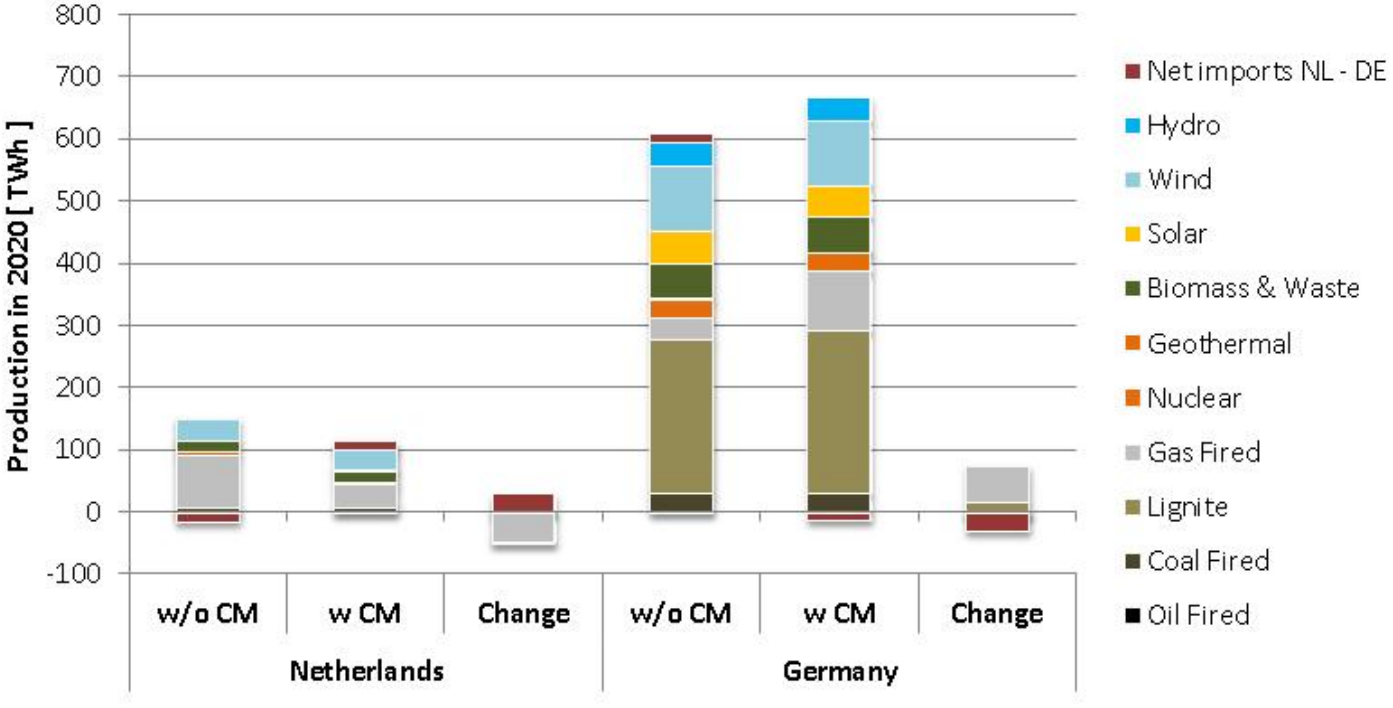
- Comparison of 2020 without capacity market vs. 2020 with capacity market
- Implementation of capacity mechanism
  - Unilateral implementation Germany, capacity located in Germany
  - Implemented option: capacity market with 15% reserve margin
  - Capacity credit wind 5% & solar PV 0%
  - Value of lost load 10.000 € / MWh
  - A central institution buys capacity long-term
- Impact
  - On investment in electricity production capacity mix in 2020
  - On market outcomes (prices, generation, cross-border flows)

Impact capacity mechanism on generation capacity investment



- Unilateral German capacity mechanism reduces investment in gas-based capacity in NL to zero
- Germany increases investment in gas and coal-based capacity

Impact capacity mechanism on yearly electricity generation



- The Netherlands becomes a net importer, Germany a net exporter
- Gas-based production in the Netherlands decreases with 57%

Other effects of capacity markets

- Electricity prices

  GERMANY
  - Lower average prices with CM because of reduced scarcity rent (less curtailment)
  - Merit order effect: new capacity influences merit order and therefore marginal cost pricing
  - Capacity payments have an upward effect on consumer electricity prices

  NETHERLANDS
  - Merit order effect: less new investment in Netherlands might have small (upward) effect on prices
  - Without CM, lower average Dutch prices compared to Germany because of cross-border transmission constraints

- Reduced Dutch electricity production and increased imports from Germany

Conclusions and policy implications

- Increase in intermittent renewables aggravates the missing money problem
- Measures are warranted to ensure investments in sufficient back-up capacity
- Are capacity markets the solution?
- Policy recommendations
  - Compare costs and benefits of CM with other options to accommodate renewables, (i.e. improving demand response, increased market integration, storage)
  - Coordinate the introduction and design of CM between Member States because unilateral implementation harms the internal market and is less efficient

Thank you for your attention …