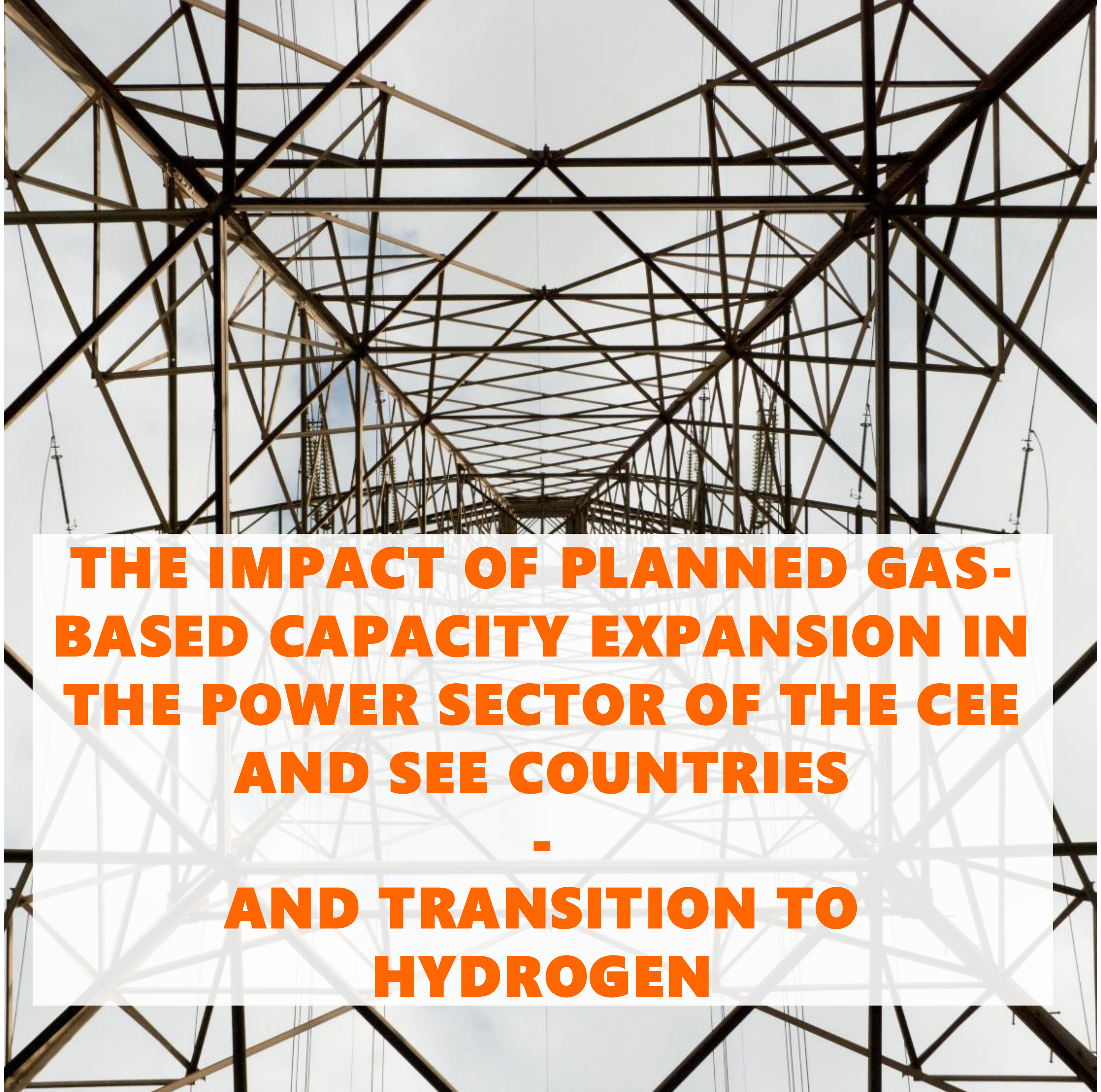

THE IMPACT OF PLANNED GAS-BASED CAPACITY EXPANSION IN THE POWER SECTOR OF THE CEE AND SEE COUNTRIES - AND TRANSITION TO HYDROGEN

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REKK

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Research questions

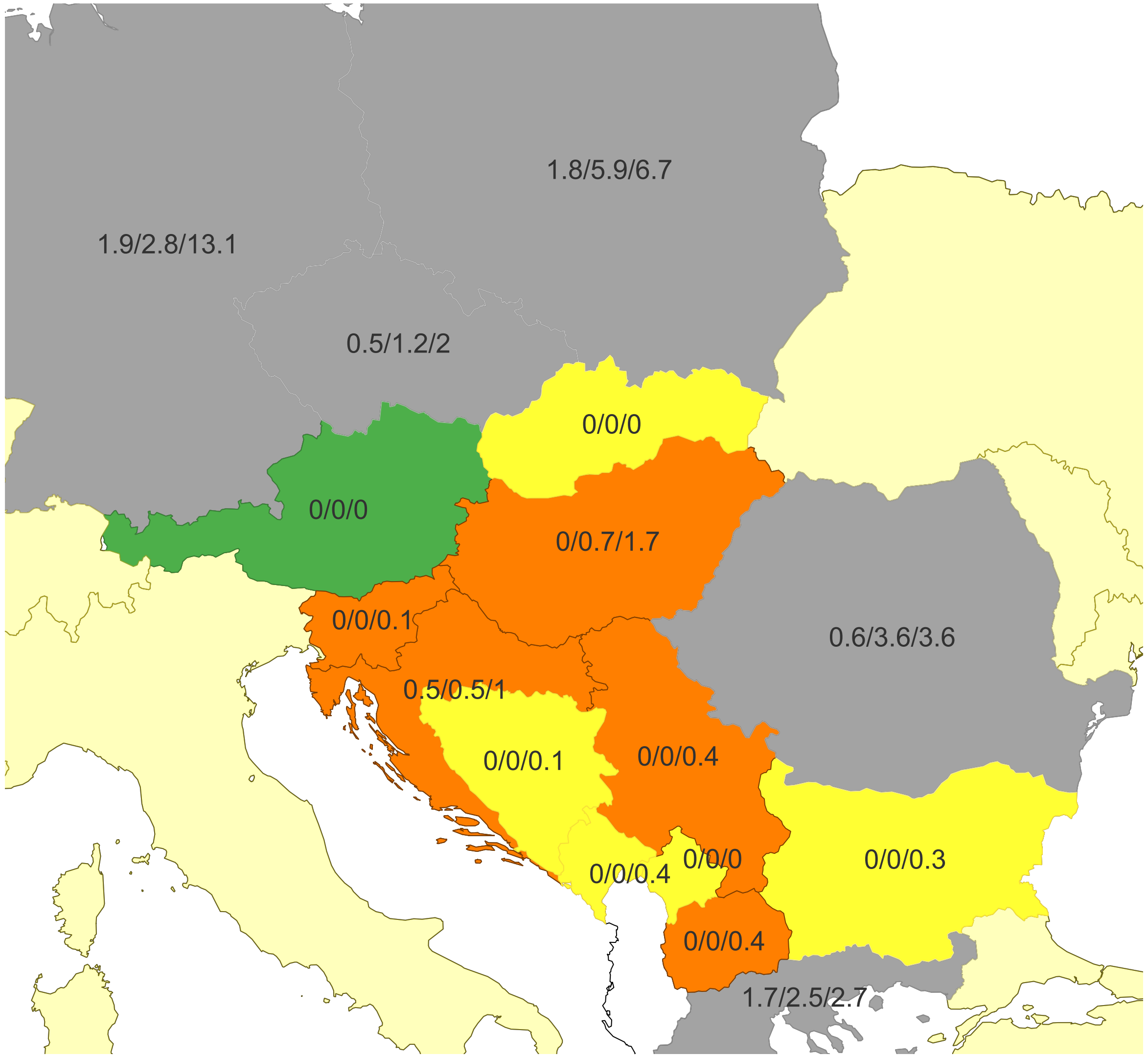
- In Central and Eastern Europe significant gas power plant capacity expansion is planned in the period of 2025 and 2040. (7-37 GW)
- This raises several questions:
  I. **Are the planned gas power plants needed from a flexibility point of view?**
  II. How can zero GHG emissions in the power sector by 2040 be reached with these new capacities?
  III. **What would be the impact of switching the gas plants to hydrogen?**
  IV. What is the minimum gas capacity required in the system?
- To answer these questions a model-based analysis was carried out by REKK
  - European Power Market Model (EPMM) of REKK
  - Time horizon: 2030, 2035, 2040

ARE THE PLANNED GAS POWER PLANTS NEEDED FROM A FLEXIBILITY POINT OF VIEW?

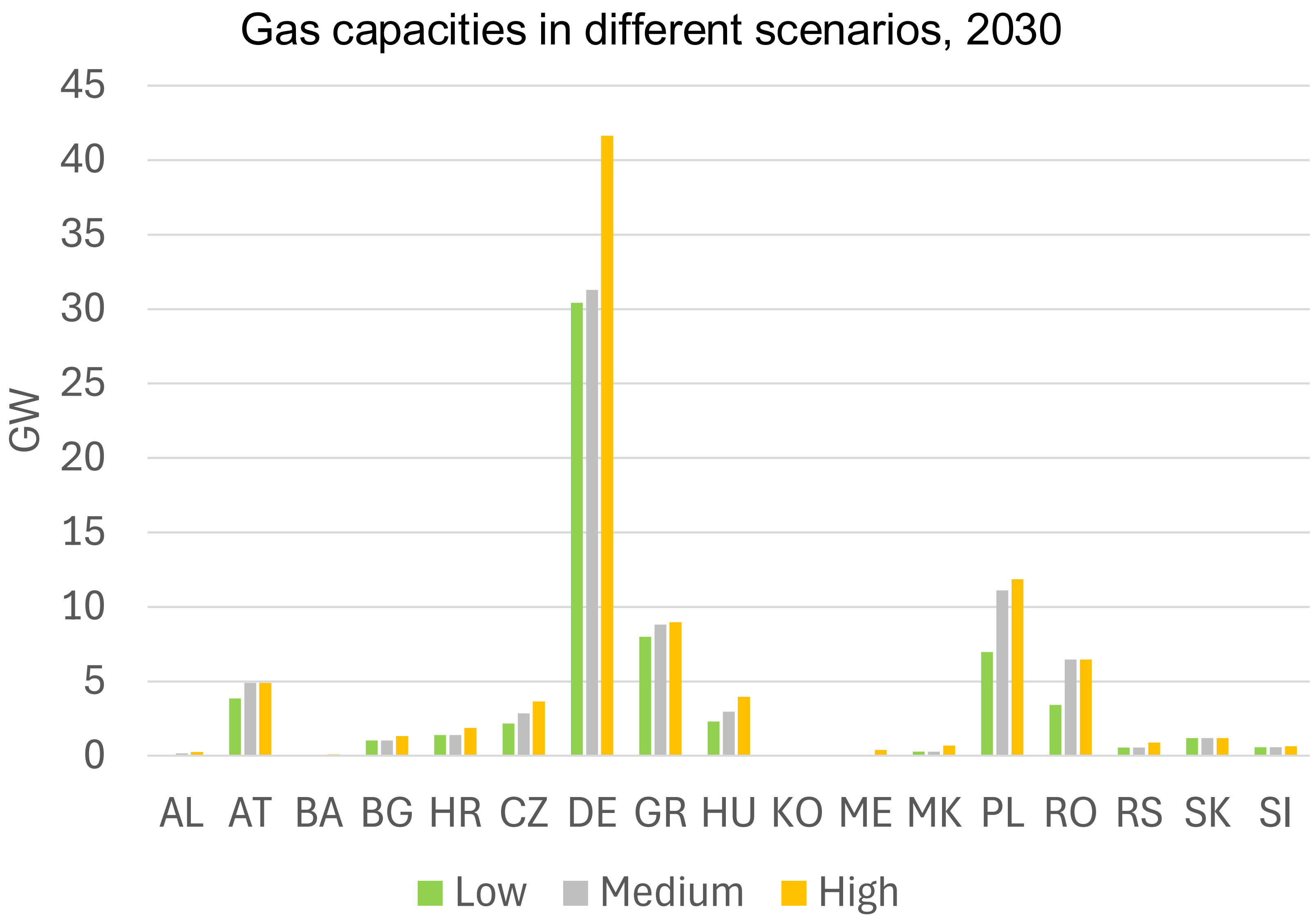
Scenario set-up I.

- Three main scenarios analysed with sensitivities based on the amount of newly built gas power plants
  - **Low:** Each country finishes only those gas power plants, **that are already in construction** (physical construction works already started)
  - **Medium:** The scenario considers those new gas power plants that based on the current progress are **likely to be built** in the future.
  - **High:** The **most ambitious plans** of the countries based on their NECP or as the sum of individual project plans (whichever is higher)
- In these reference scenarios no hydrogen-based PP operation or CCS is considered
- In 2030 7.0 GW of new capacities are assumed in the low scenario,17.3 GW in the medium scenario, and 32.5 GW in the high scenario
- For 2040, these figures are 7.0; 17.3 GW and 37.3 GW in the three scenarios

New gas investments in the three scenarios, GW, 2030



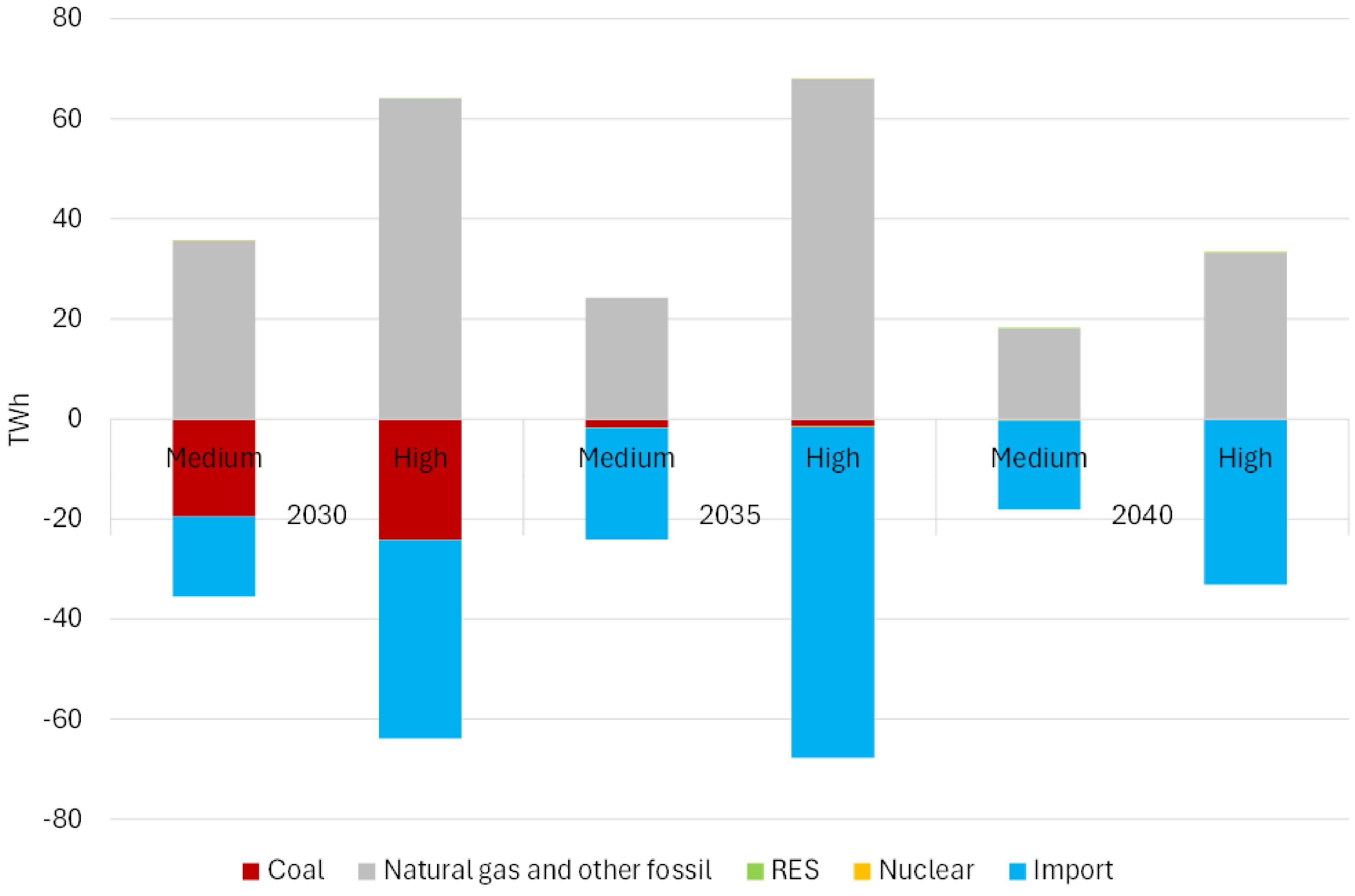
Scenario set-up II.



- In the low scenario, approximately the same capacities are present in 2030 as in 2023 (60 GW), with decreasing capacities in 2040 (56 GW)
- In the medium gas and the high gas scenarios installed gas capacities increase to 74/89 GW in 2030, and 68/88 GW in 2040.
- Germany has a very large impact on the total capacities of the region, where planned installations remain uncertain

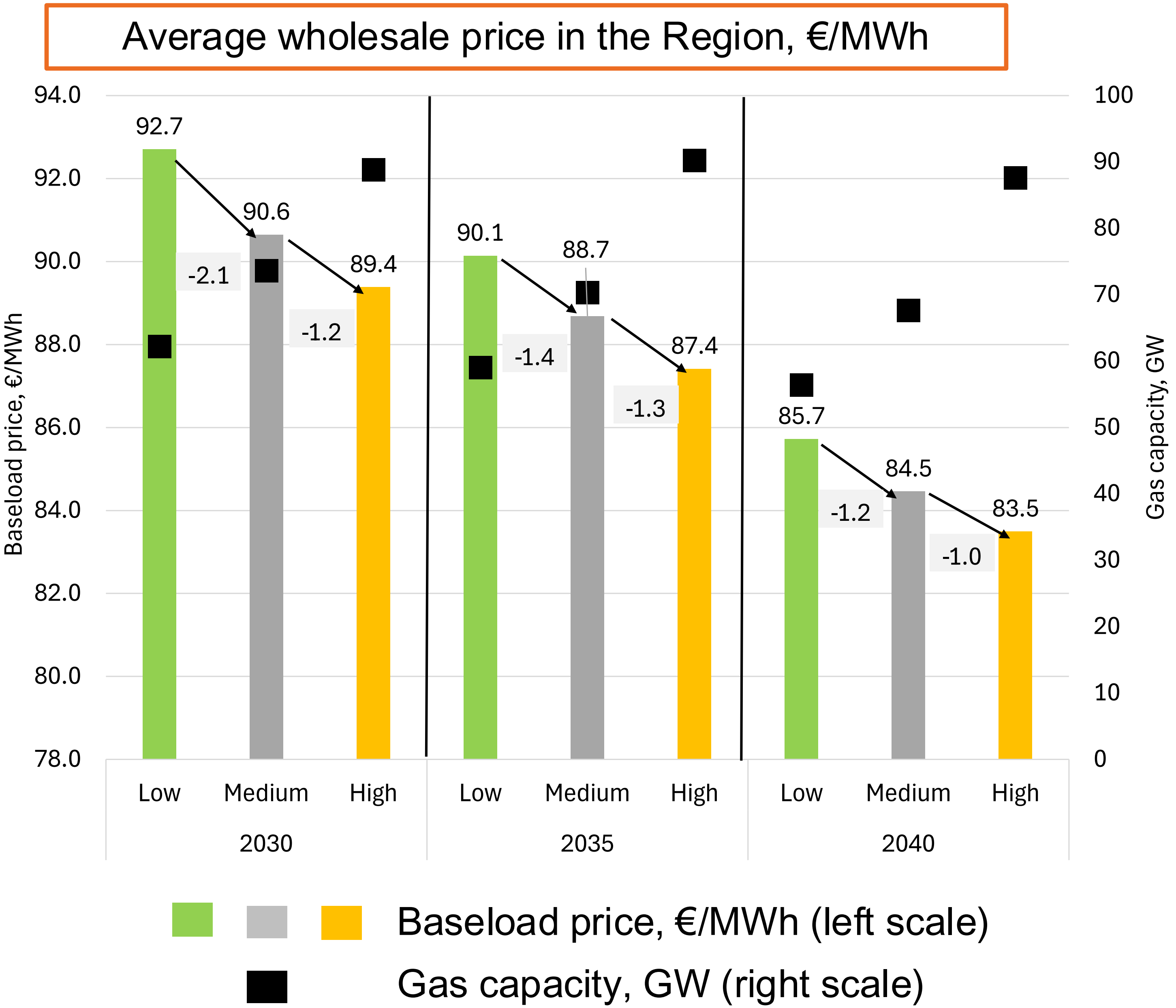
Subsitution of coal in short-term, import in long-run

Change of electricity mix compared to the low scenario



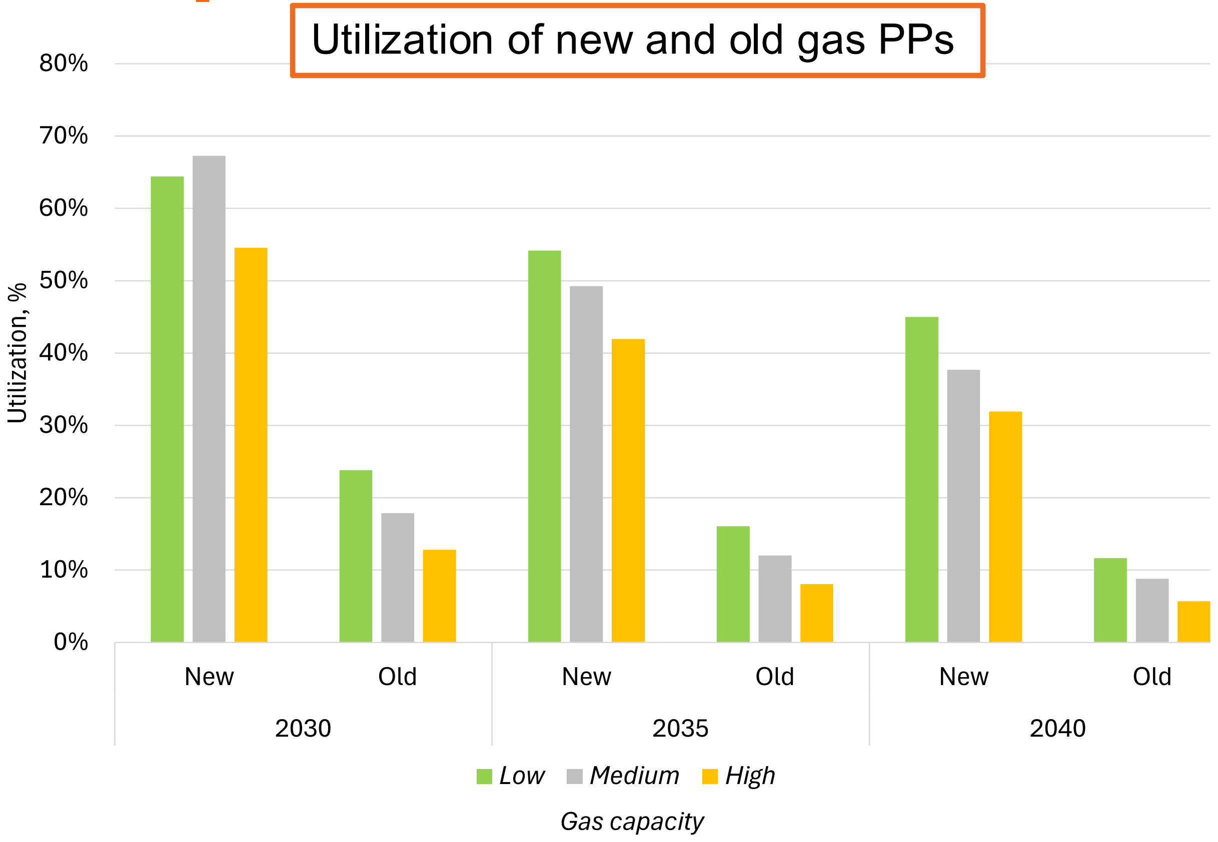
- In 2030, the increase in gas production partly displaces coal-based production and partly imports. By 2040 the increase in gas production displaces imports entirely.
- At EU level, the expansion of gas capacity can still replace coal, especially in the short term - as capacity increases, CO2 emissions decrease.
- In 2035 and 40, new gas PPs will replace the old ones, and CO2 emissions will fall slightly because they are more efficient.

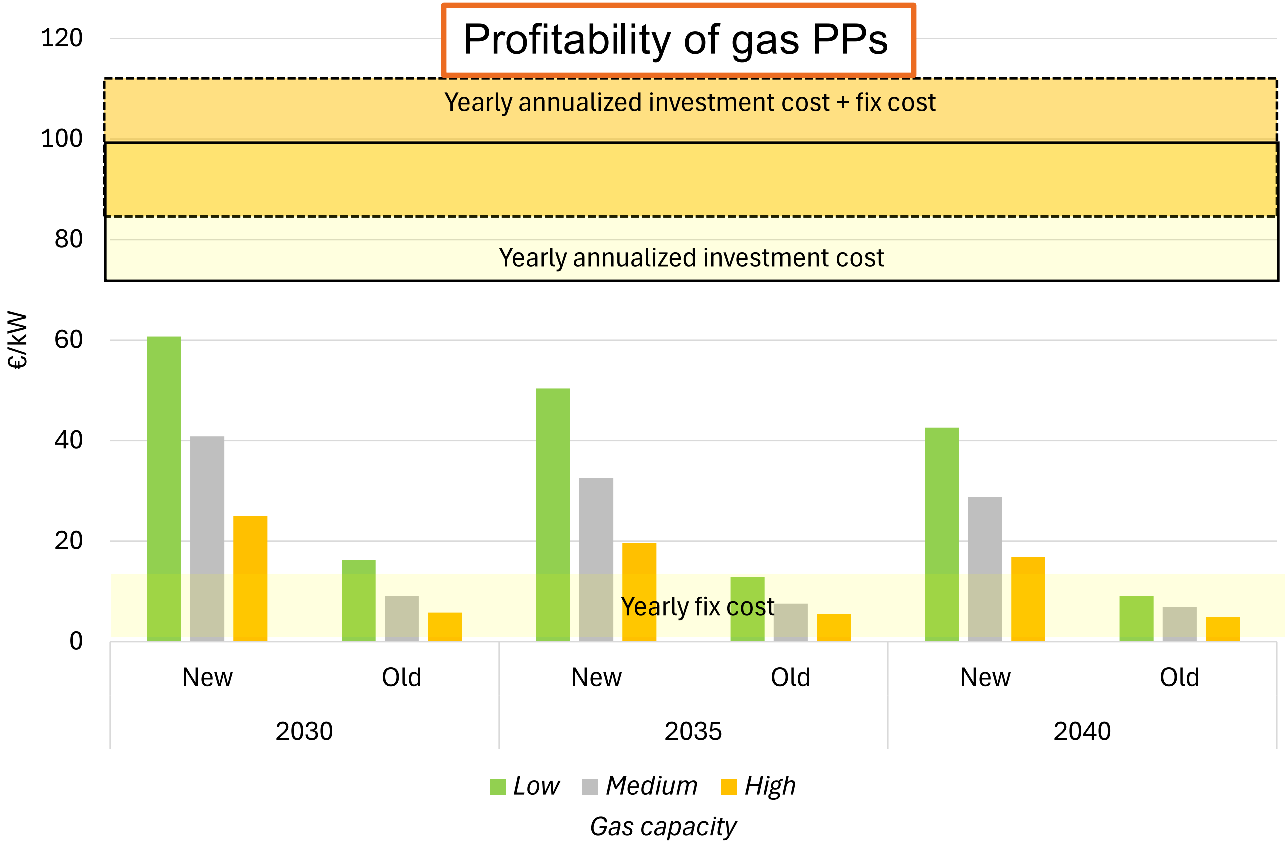
Limited price effect in average, except in Poland



- In 2030, at regional level, there is 12 GW more gas capacity in the medium scenario (and 30 GW in the high scenario), but this results in an average price reduction of only 2.1 and 3.3 €/MWh respectively
- Poland is an exception, higher (almost 10€/MWh impact observable)
- By 2040, the price impact is even smaller
- The impact of capacity increases is spread across the region, with price changes not proportional to capacity increases

Gas plants are far from break even





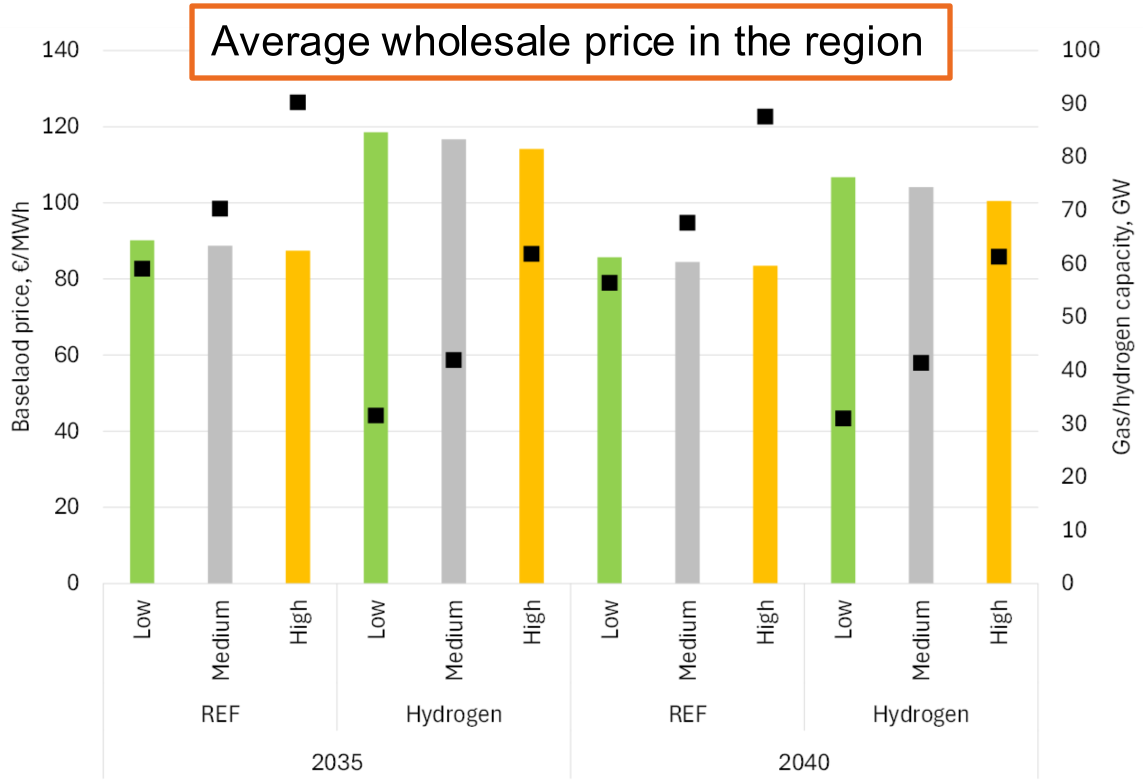
- The increase in gas capacity reduces the utilization of both new and old gas-fired power plants.
- On average across the region, the revenue per unit of capacity does not match the costs
- Only in Poland in the low capacity scenario it is profitable to build additional gas power plants.

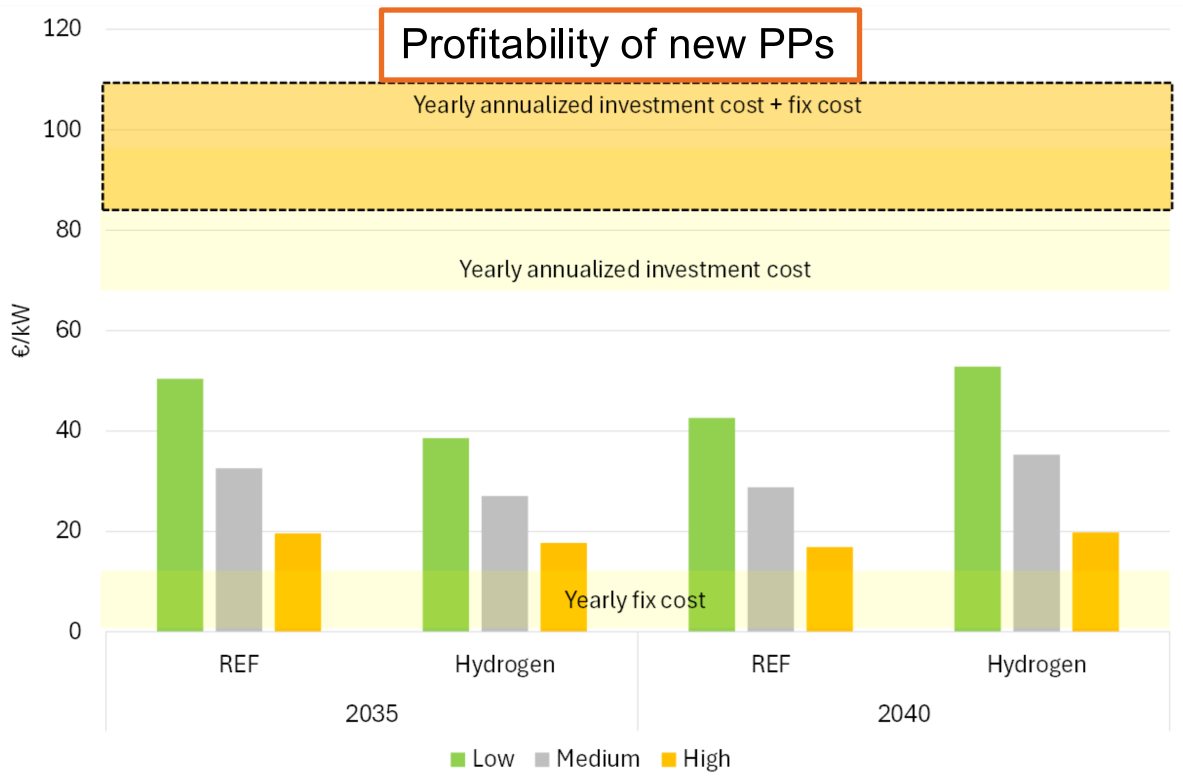
WHAT WOULD BE THE IMPACT OF SWITCHING THE GAS PLANTS TO HYDROGEN?

Scenario description

- 2035 and 2040 are the modelled years
- Main assumption: by 2035 the gas power plant built after 2010 switch to hydrogen
- Coal and other fossil generators are the same as in the low-medium-high scenarios
- Three hydrogen scenarios:
  - Low-hydrogen: 31 GW hydrogen-based power generation in the Region
  - Medium-hydrogen: 41 GW hydrogen-based power generation in the Region
  - High-hydrogen: 61 GW hydrogen-based power generation in the Region
- The assumption on green hydrogen price: 80 €/MWh
- Battery storage stays at 44 GW in Europe in 2030 (12.4 GW in the Region) , which grows to 105 GW by 2040 (43.4 GW in the Region)

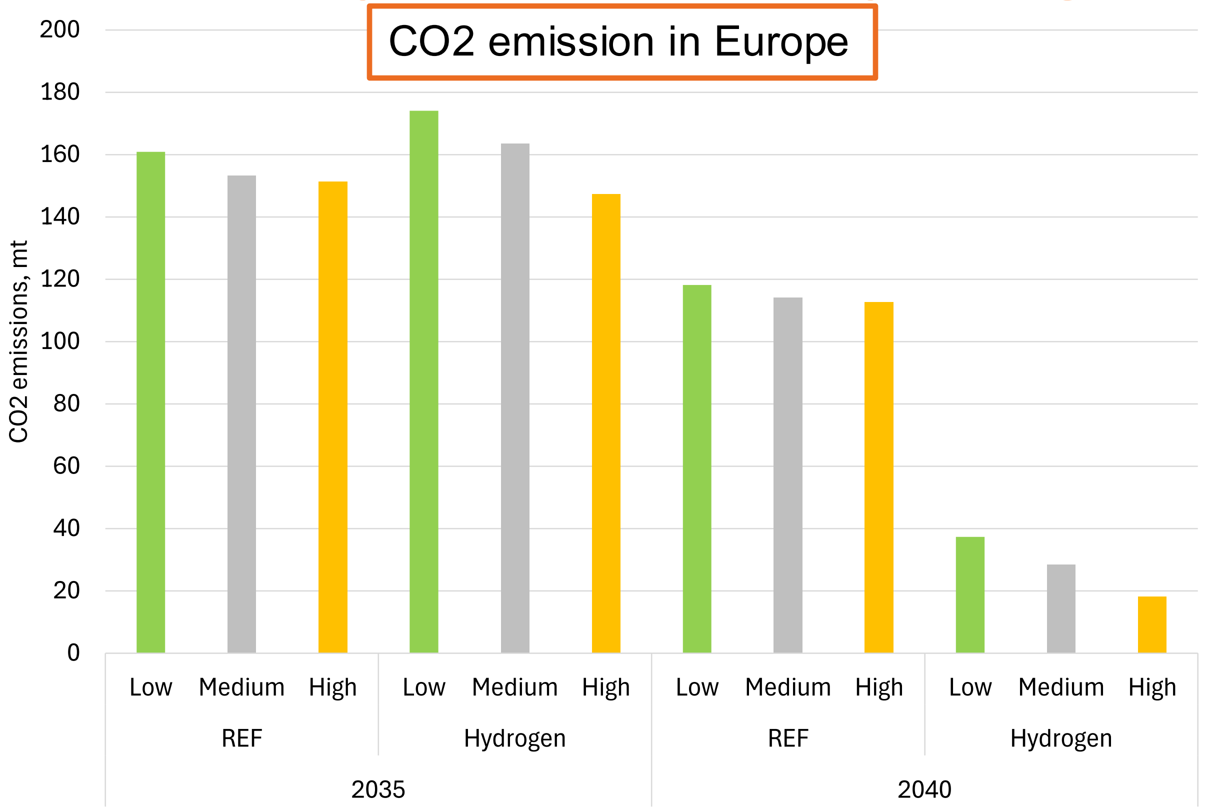
Switching to hydrogen is feasible but at higher prices

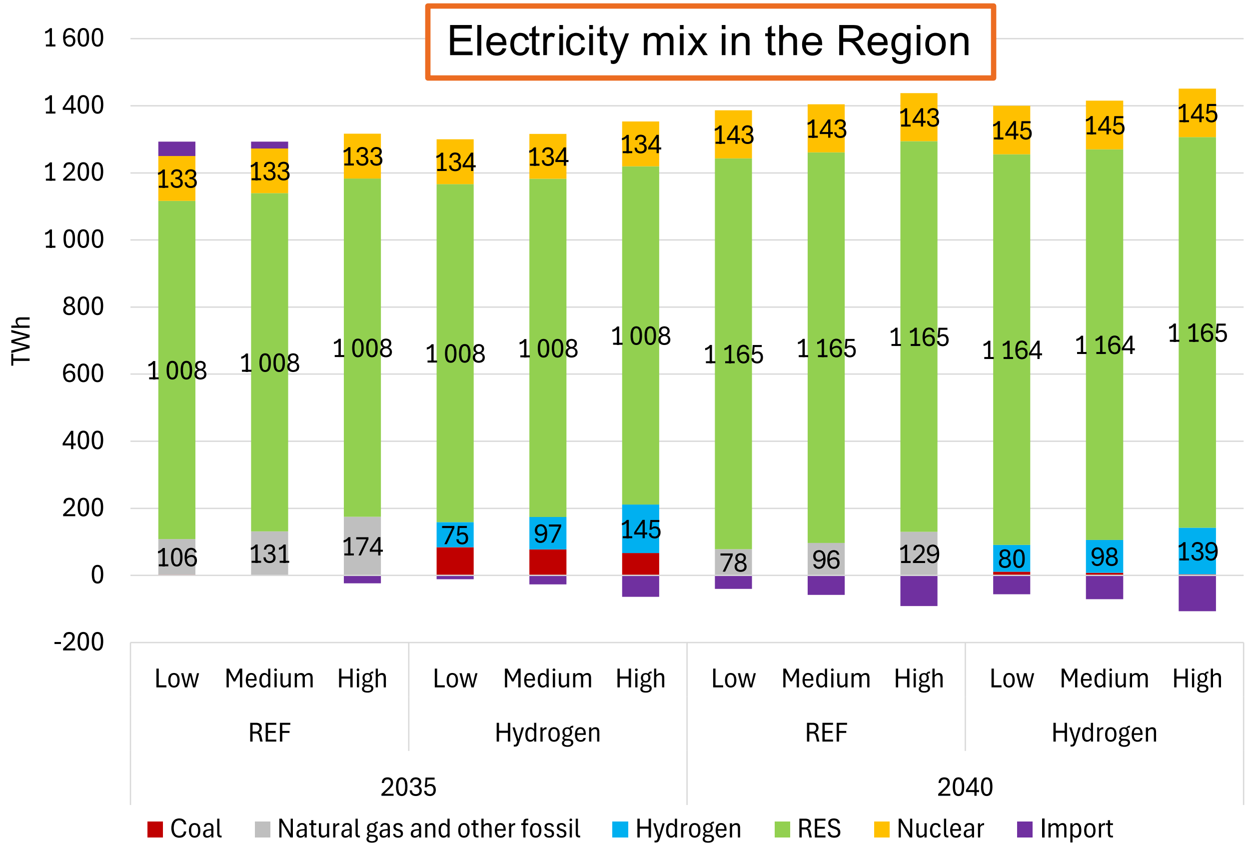




- Switching to hydrogen is a feasible solution, but at higher prices.
  - The wholesale price increases by 20-25% as hydrogen is more expensive than natural gas.
  - Price spikes are larger and more frequent (mainly in Germany) because there is less capacity.
- The profitability of hydrogen-based power plants does not decrease substantially (i.e. their subsidy needs do not increase), their profitability even increases in 2040.
- The RES and nuclear curtailment is roughly 5-20 % of the total hydrogen use in the power sector in the Region

Too early switch to hydrogen increase GHG emissions





- If coal-fired power plants are not phased out, missing CCGT capacity will be largely replaced by coal production, and CO2 emission will increase compared to the Reference scenario.
- Reduced gas production due to the switch to hydrogen will be replaced by coal production to a greater extent in the region in 2035, and to a lesser extent by imports, and almost entirely by imports in 2040.

Conclusions

- Hydrogen switch from gas-based power generation is feasible, but at a higher price level, depending on the price of green hydrogen
- Utilisation of the hydrogen-based plants under the assumed scenarios is not sufficient to break even, subsidies are needed to maintain the hydrogen-based power plants
- If there are remaining coal-based power plants in the system at the energy transition phase, they would increase production. Therefore, when transiting to hydrogen, coal plants should be phased out.
- Otherwise, this could have non-desired impacts, e.g. increase in GHG emission from coal plants
- The curtailed RES and nuclear production could cover only 5-20% of the power generation, depending on the RES uptake

Thank you for your attention!

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