POWER SYSTEM SCENARIOS FOR AN EU COAL EXIT BY 2030

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Methodology & scenarios

SCENARIO DESIGN
- Definition of political scenarios
- Basis for power market modeling

ASSUMPTIONS
- Techno-economical parameters
- RES, coal trajectories
- CO_2 prices

POWER MARKET MODELING
- Power plant dispatch & investment up to 2030

RESULTS
- Incremental generation costs* (ICG)
- Investment volumes
- CO_2- and other emissions

MODELING APPROACH

40 % reduction scenario

40 % "Policy mix" (40 % PM)

Policy mix – "40 % Scenario" represents the former EU 2030 carbon mitigation ambition level. No significant market based coal exit or RES expansion. CO_2 price based on EC Reference 2016 sc. (35 €/t in 2030).

55 % reduction scenarios

55 % "Policy mix" (55 % PM)

Policy mix - complete **coal exit until end of 2030** and increased, policy-driven RES expansion as well as elevated CO_2 prices (54 €/t in 2030 based on TYNDP2020).

55 % "Market based coal exit" (55 % MCE)

Market based coal exit - coal exit trajectory resulting from relying on an economic decommissioning of all coal plants driven by the CO_2 price. RES expansion remains policy-driven.

55 % "market based coal-to-clean" (55 % MCTC)

Market based coal exit and RES expansion - further explores the requirements and implications of a CO_2 price-driven coal-to-clean transformation.

SCENARIOS

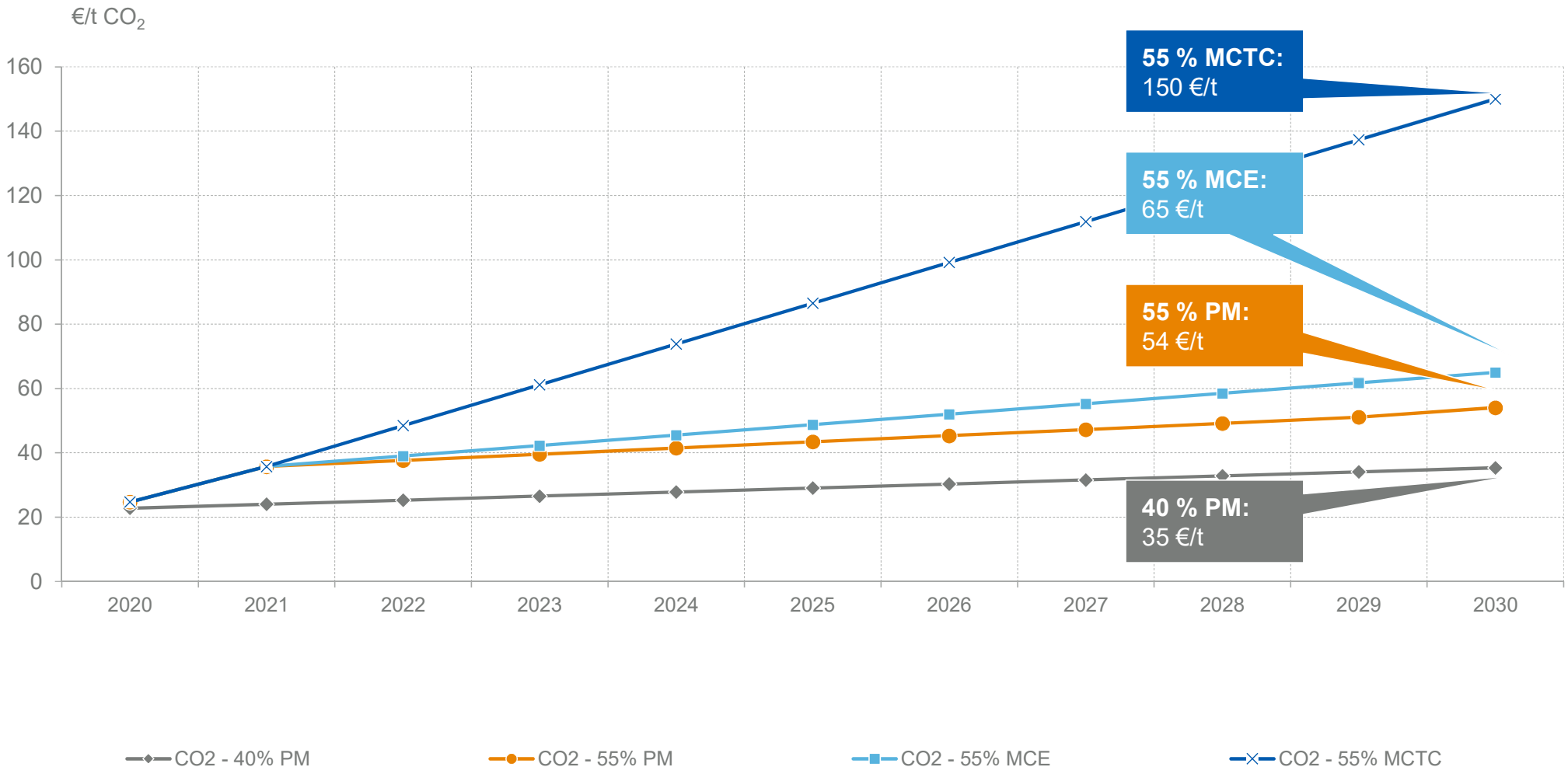
EU-27 countries aggregated and major coal-countries as focus group („Coal-6"): BG, CZ, DE, PL, RO, SI**

REGIONAL SCOPE

* For an economic comparison of scenarios the differences in generation cost are of main relevance. This study looks at an indicator called "Incremental generation costs". ** excl. island markets of Malta, Cyprus.

Scenarios & CO_2 price* trajectories

40 % and 55 % PM scenario trajectories based on projections in reference sources (EC2016 Ref / TYNDP DE sc.). 55 % MCE & 55 % MCTC trajectories result from modelling

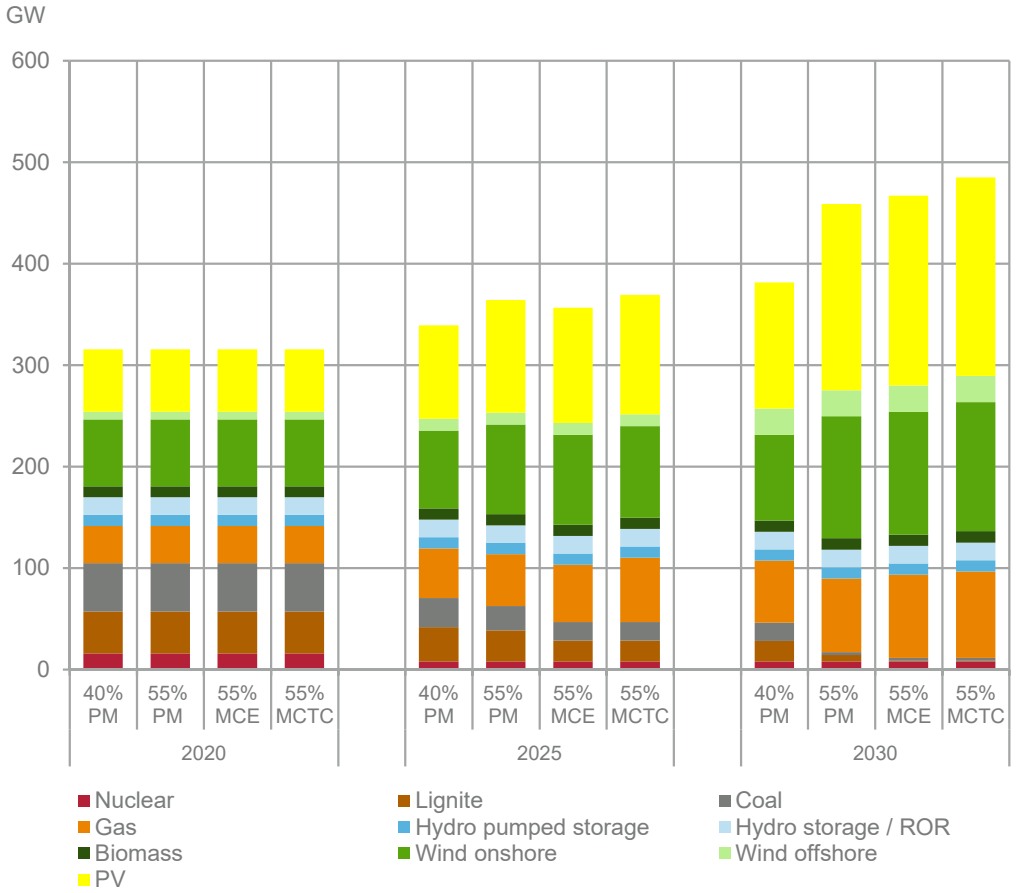


* real 2021 prices

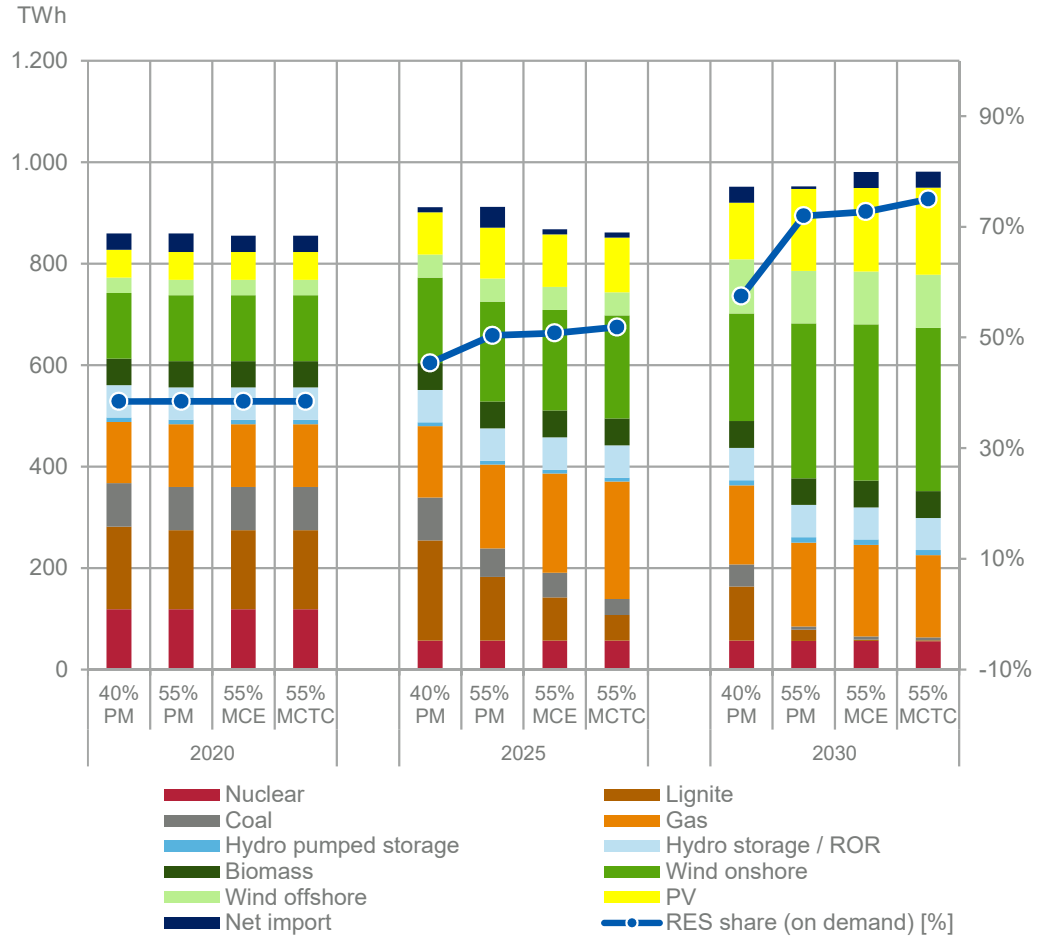
Capacity & generation (Coal-6)

Compared to the 40 % PM scenario, the 55 % scenarios see an earlier decommissioning & accelerated reduction of remaining coal capacities which are substituted over time with a mix of wind onshore, PV & gas units (flexibility demand). The generation mix of the Coal-6 cluster becomes less carbon-intensive & RES shares increase by over 15 percentage points compared to 40 % PM in 2030.

Capacities



Generation

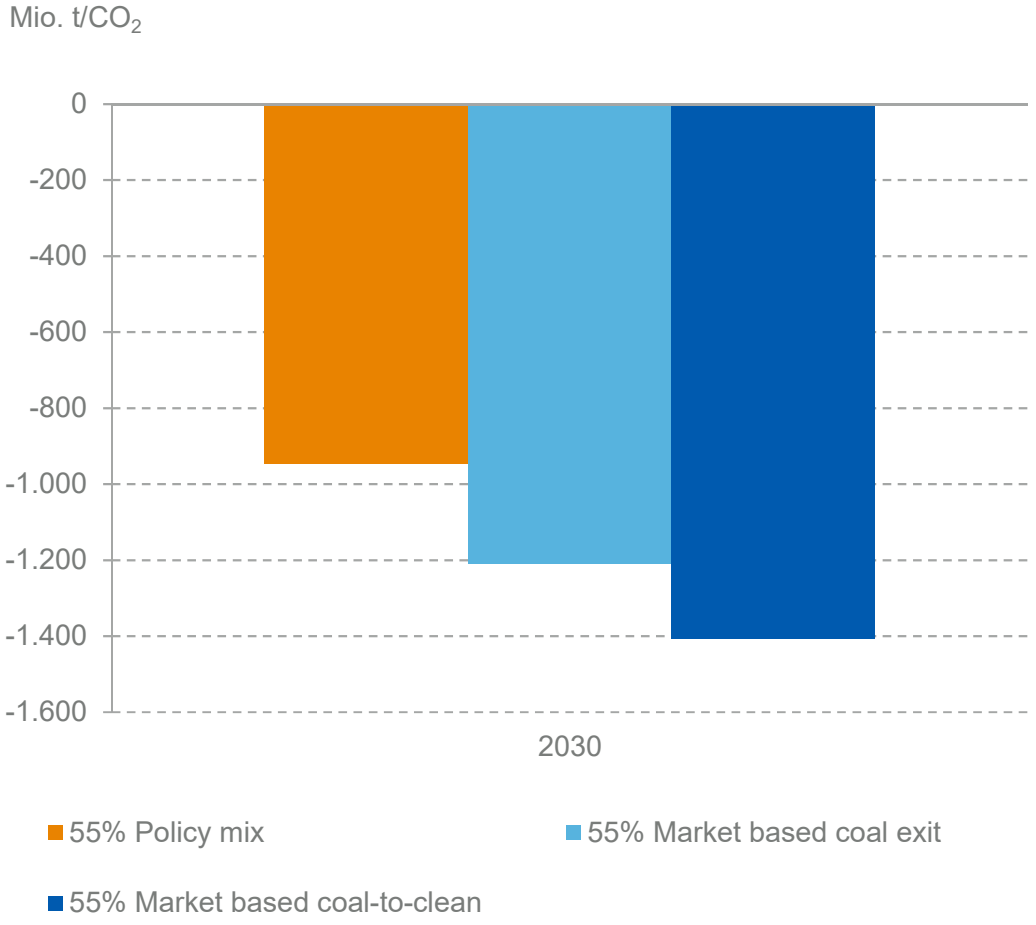


PM = Policy mix; MCE = Market-based coal-exit; MCTC = market-based coal-to-clean

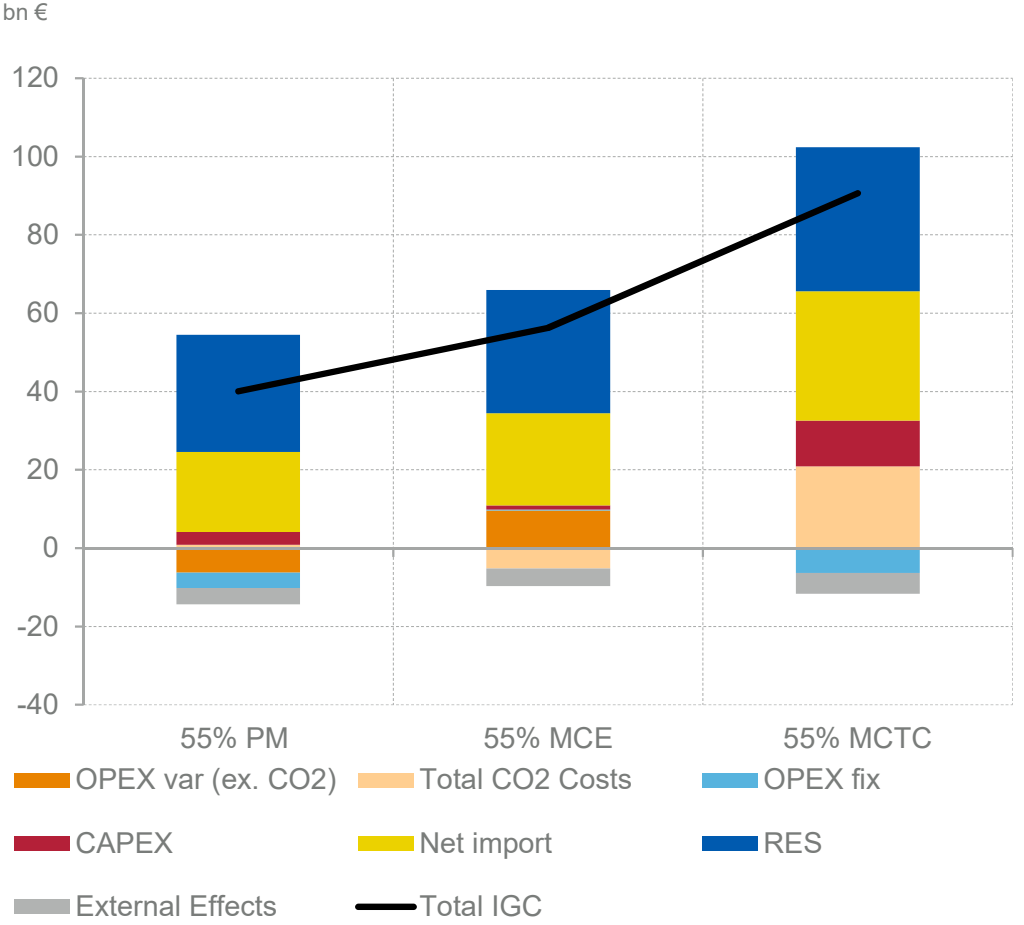
Effect on emissions & generation costs (Coal-6)

All coal-exit scenarios result in significant reduction of CO_2. Incremental effects of higher CO_2 prices are diminishing as coal capacity is decreasing. Additional IGC are in a similar range in the 55 % PM and 55 % MCE scenarios, while higher CO_2 price in 55 % MCTC drives up IGC

Total CO_2 emissions (2020-2030) Deltas minus 40 % PM



Total IGC* (2020-2030) Delta minus 40 % PM

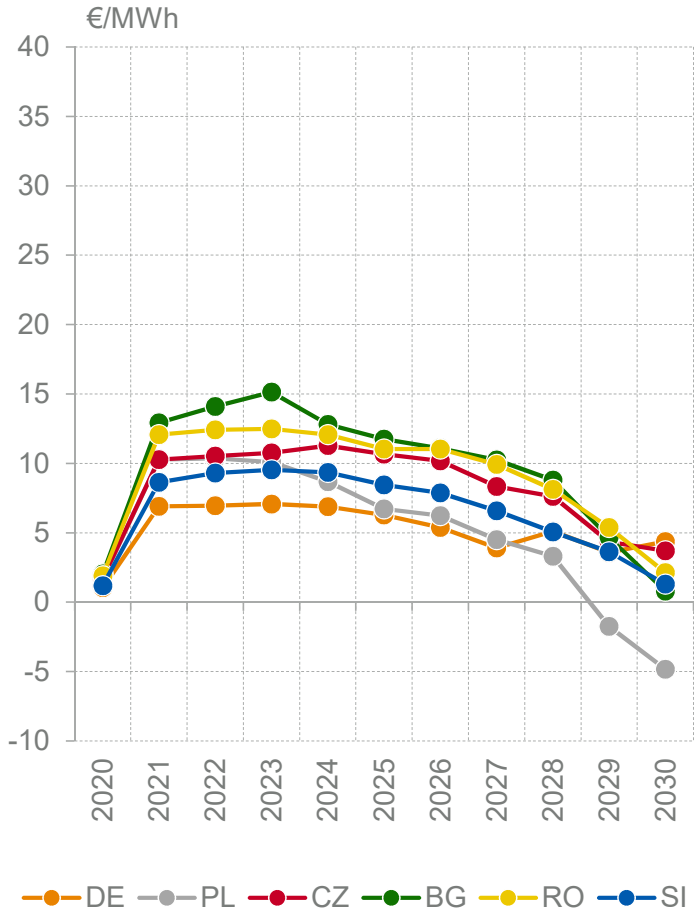


* For an economic comparison of scenarios the differences in generation cost are of main relevance. This study looks at an indicator called “Incremental generation costs”.

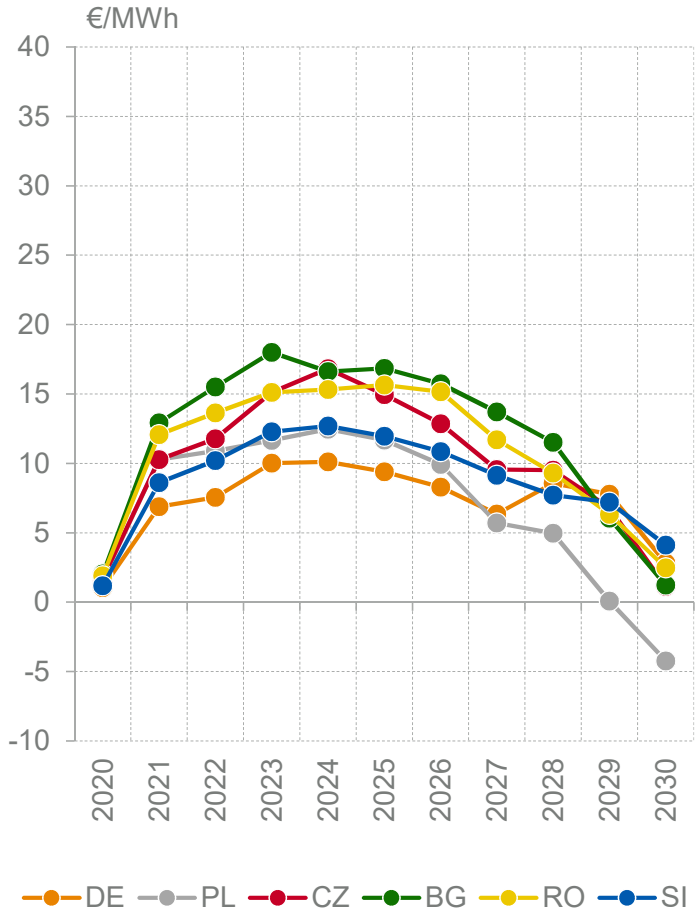
Effect on Wholesale power prices (Coal-6)

A initial impact on wholesale prices can be observed in all 55 % scenarios, which is reduced towards 2030 as the generation-mix becomes less carbon-intensive. The increase levels out at below 5 €/MWh in the 55 % PM & 55 % Market based coal exit scenario 55 % PM has the lowest impact on price levels, due to the lower assumed CO_2 prices.

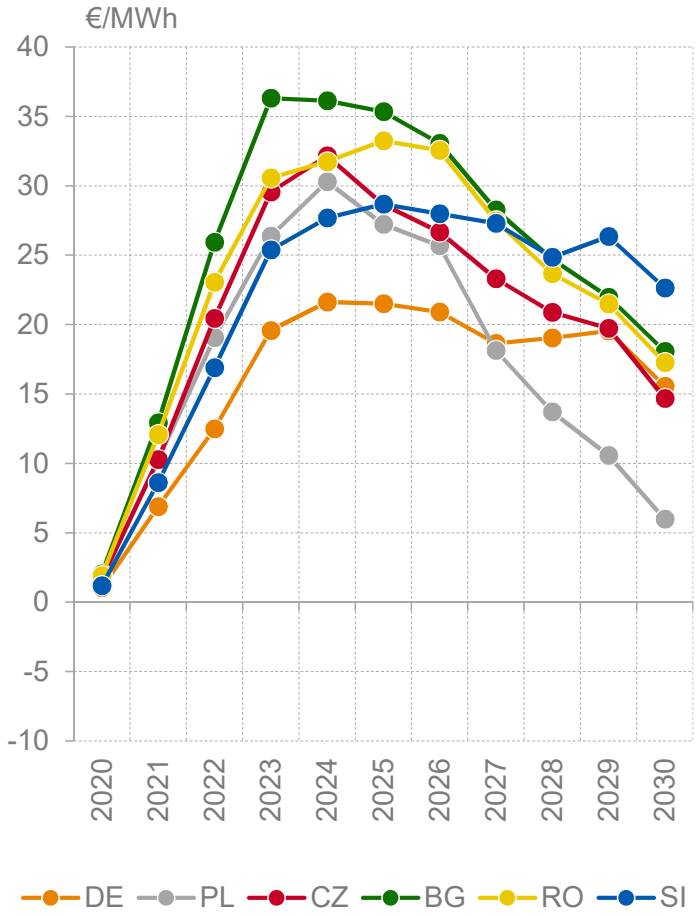
55 % PM



55 % MCE



55 % MCTC

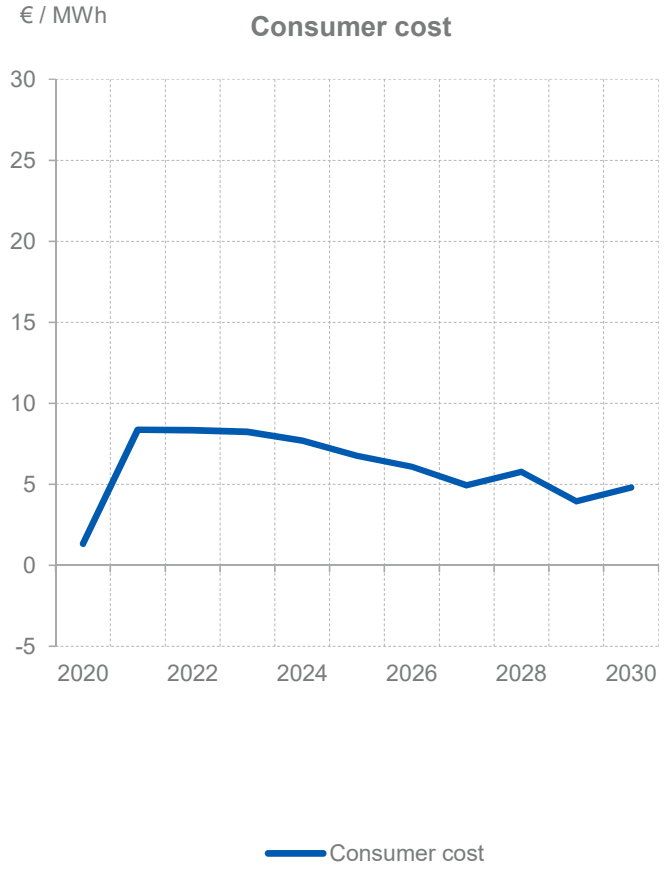


Note: Graphs depict scenario differences to the 40% PM scenario (e.g. 55 % PM minus 40 % PM). PM = Policy mix; MCE = Market-based coal-exit; MCTC = market-based coal-to-clean

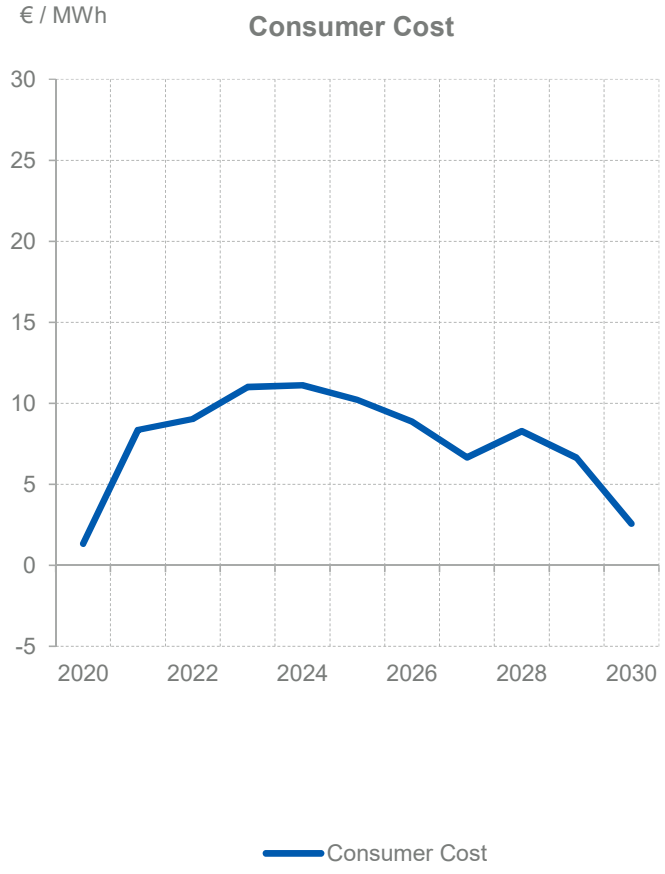
Effects on Consumer costs (Coal-6)

Costs to consumers increase in all 55 % scenarios for the Coal-6 cluster due to higher wholesale price levels, partly driven by higher CO_2 prices and net-imports. The effect is mitigated with increased availability of carbon-free renewable generation towards 2030.

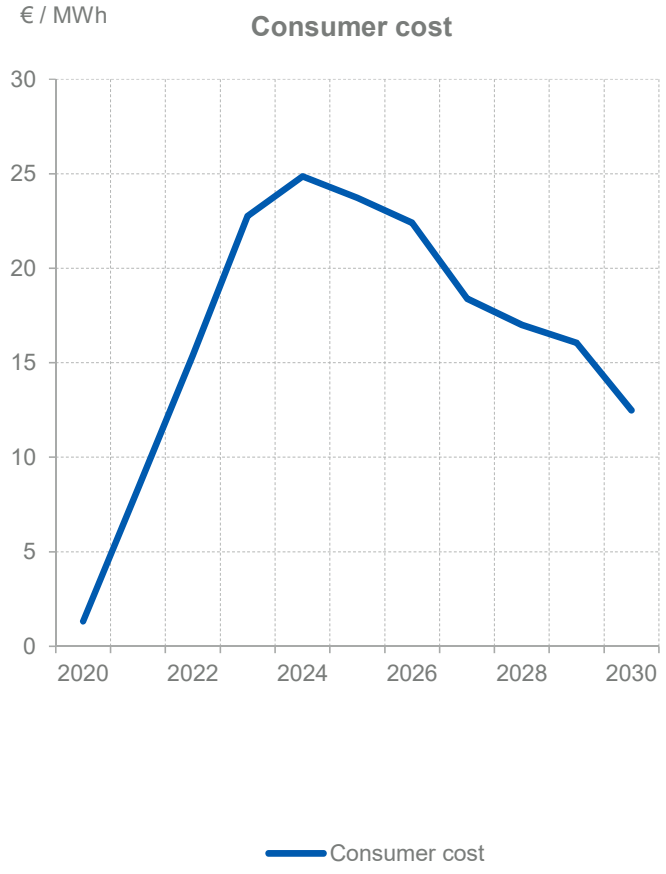
55 % PM



55 % MCE



55 % MCTC

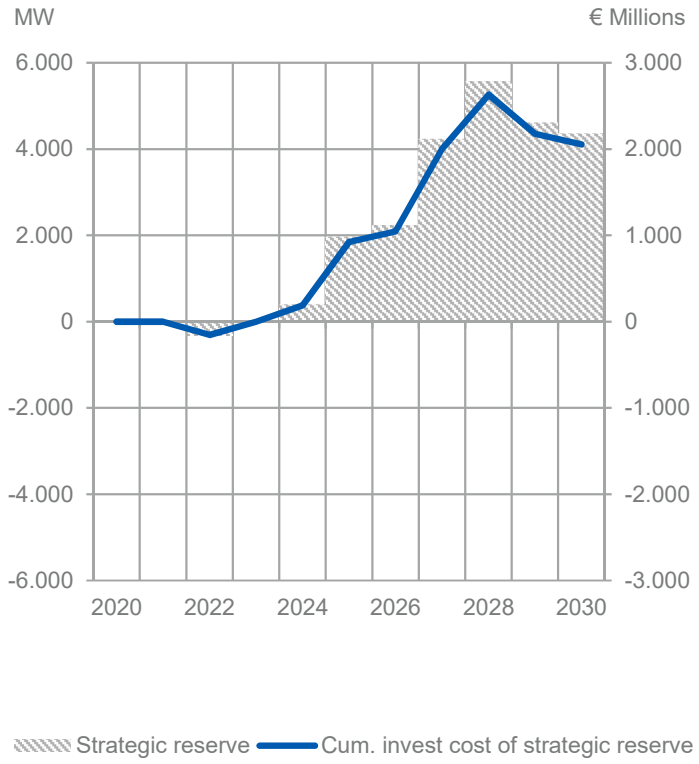


Note: Graphs depict scenario differences to the 40% PM scenario (e.g. 55 % PM minus 40 % PM). PM = Policy mix; MCE = Market-based coal-exit; MCTC = market-based coal-to-clean

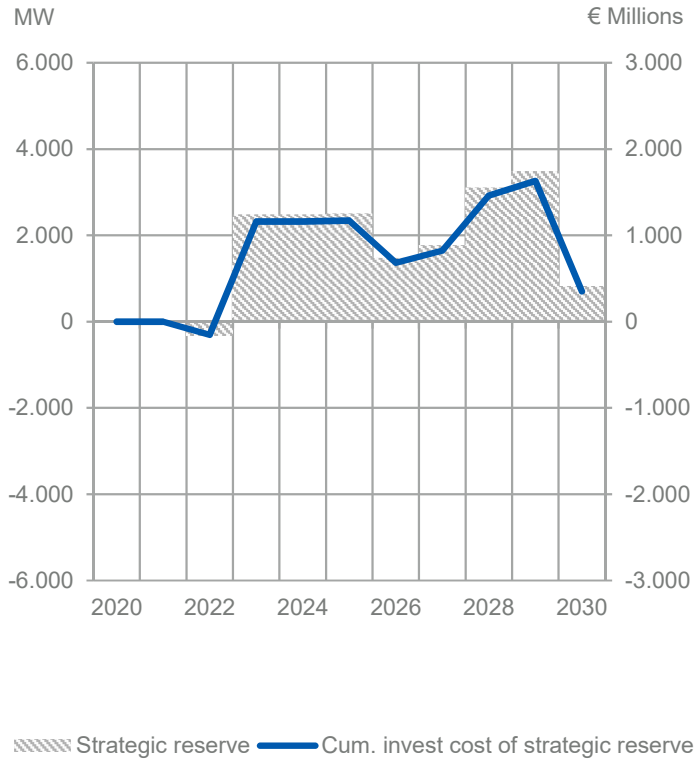
Effects on Strategic reserves (Coal-6)

In comparison with the 40 % PM scenario, the 55 % scenarios see additional strategic reserve needs* in the Coal-6 countries from the mid-2020s onwards. In the 55 % Market based coal-to-clean scenario, this trend changes, and by the end of the decade (2028 onwards) lower strategic reserve capacities are required due to additional gas & (partially) wind onshore in the power systems.

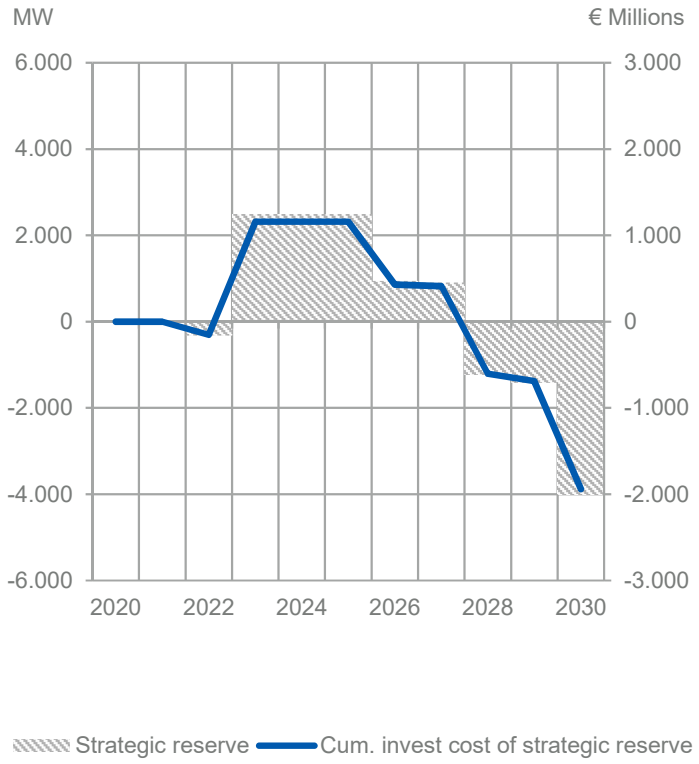
55 % PM



55 % MCE



55 % MCTC

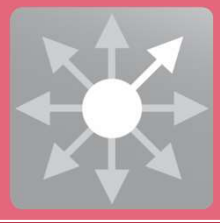


Note: No net demand for newly built strategic reserves is caused if hard coal units decommissioned in the 55% scenarios can be utilized as reserves. Hence costs depicted in this slide represent the costs of reserves if the capacity had to be provided by newly built gas units (OCGT) and hence would be lower in case decommissioned coal would be used instead.

Note: Graphs depict scenario differences to the 40% PM scenario (e.g. 55 % PM minus 40 % PM). PM = Policy mix; MCE = Market-based coal-exit; MCTC = market-based coal-to-clean

Main results of scenarios for Coal-6

Scenarios & CO2 Prices



- Four different power market scenarios where modelled: one representing a baseline scenario, three presenting different policy scenarios to reach -55% target.
- The modelling indicates that sustained prices above 65 €/t alongside the necessary RE expansion could lead to a market-driven coal phase-out. Without any additional policies, CO2 prices of 150 €/t would be necessary.

Capacity developments

- In the modelling a phase-out of 38 GW coal capacities (in 2030) is met with 100 GW additional wind and PV.
- Across scenarios, additional 11 to 24 GW of gas capacities are deployed
- Across scenarios, additional 3 to 6 GW of strategic reserves would be deployed if peak load is to be met mostly domestically. This could be newly built units or decommissioned coal units.

Costs and prices

- -55 % scenarios cause an increase of power prices, especially if driven by CO2 prices. Increases lie in between 5 to 10 €/MWh in the 55% PM, 7 to 13 €/MWh in the 55% MCE and 18 to 27 €/MWh in the 55% MCTC.
- Additional costs to the consumer versus the baseline remain limited in the range 6-10 €/MWh (PM & MCE).
- To put these effects into perspective, gas prices have increases power prices by more than 50 €/MWh.

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