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SCENARIO ANALYSIS  
FOR THE GERMAN  
POWER PRICE TO 2030

By Marcus Ferdinand, Matthew Jones and Vlasias Megaritis

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## SCENARIO ANALYSIS FOR GERMAN POWER PRICES TO 2030

**ANALYSIS BY MARCUS FERDINAND, MATTHEW JONES AND VLASIS MEGARITIS  
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In March 2018, the German government put forward plans for the set-up of a commission on growth, structural change and employment in its coalition contract. The commission, tasked with putting forward a timeline for exiting coal generation within a socially acceptable framework, started work on 6 June 2018. The final results of the expert group are scheduled to be published by the end of the year. This ICIS White Paper provides an insight into the working principles of the commission and evaluates four coal phase-out scenarios with regards to their impact on capacity development and German power prices to 2030.

### WORKING PRINCIPLES OF THE GERMAN COAL PHASE-OUT COMMISSION

In order for Germany to phase out coal-fired power generation, the government has set up an expert commission, consisting of:

- Four commission leaders
- Eight representatives of federal ministries (economy, environment, internal affairs, labour, transport, finance, agriculture and education)
- Six representatives of federal states (North Rhine-Westphalia, Brandenburg, Saxony, Saxony-Anhalt, Lower Saxony and Saarland)
- Three members of parliament without voting rights (CDU, CSU and SPD)
- 24 experts (political groups, research institutes, associations, NGOs and the private sector)
- The secretariat, with seven people, is hosted within the economy ministry

The 24 expert members and four commission leaders have equal voting rights. The commission has decided to split into two working groups. The “economic development and jobs in the region” working group is headed by Stanislaw Tillich (CDU), the former state premier of lignite mining state Saxony, and Matthias Platzeck (SPD), the former state premier of Brandenburg. The “energy industry and

climate goals” group is led by Ronald Pofalla (CDU), the former chief of the Chancellery, and Barbara Praetorius, the former deputy director at German think-tank Agora Energiewende. Both groups have different angles from which to approach the same task, which will create a conflict in itself with regards to the speed of the phase-out.

The plenary and both working groups are scheduled to meet once a month and all members can freely decide which of the groups, if not both, they want to join. The working groups are a means to prepare decisions in the plenary.

The meeting schedule is not public. The secretariat confirmed that the next plenary meeting will be held on 18 September. A leaked meeting calendar suggests the following upcoming dates, which may shift depending on the commission’s progress.

**TABLE 1: INDICATIVE TIMELINE FOR MEETINGS OF THE GERMAN COAL COMMISSION**

Plenary	Working Group “energy industry and climate goals”	Working Group “economic development and jobs in the region”
<b>18 September</b>	24 September	26 September
<b>11/12 October</b>	25 October	24 October
<b>15/16 November</b>	26 November	28 November
<b>11 December (final meeting)</b>		

## AIMS OF THE COMMISSION

In the coalition treaty of March 2018, the German government tasked the coal commission to:

- Recommend options for closing the gap to Germany's 2020 climate target of reducing the country's CO2 emissions by 40% compared to 1990. Latest studies by the German Environment Ministry revealed that the gap is likely to be around eight percentage points
- Identify measures to ensure Germany meets its 2030 climate target by reducing emissions from the energy sector by 61% to 62% compared with 1990 levels, including a holistic impact assessment
- Agree on a step-wise reduction and phase-out of coal-fired power production, including a phase-out date
- Make proposals for ensuring financial security for the required structural changes in the affected regions and a fund for structural changes financed by federal pots
- Apart from questions over emissions reduction, employment and supply security, the commission's final

report will assess the phase-out's impact on power prices and competitiveness

## TIMELINE FOR DECISION-MAKING

The commission's work will help the government to produce a Climate Protection Act in 2019. The law is supposed to set the rules for achieving and monitoring progress towards the 2030 target.

**End of October 2018:** As an interim step, the commission is tasked with putting forward recommendations for measures regarding social and structural developments of the lignite mining areas, as well as financial planning

**Ahead of international climate negotiations (3-14 December 2018):** Recommendations for measures in the power sector to close the gap towards the 2020 target (40% of CO2 emissions reduction compared with 1990)

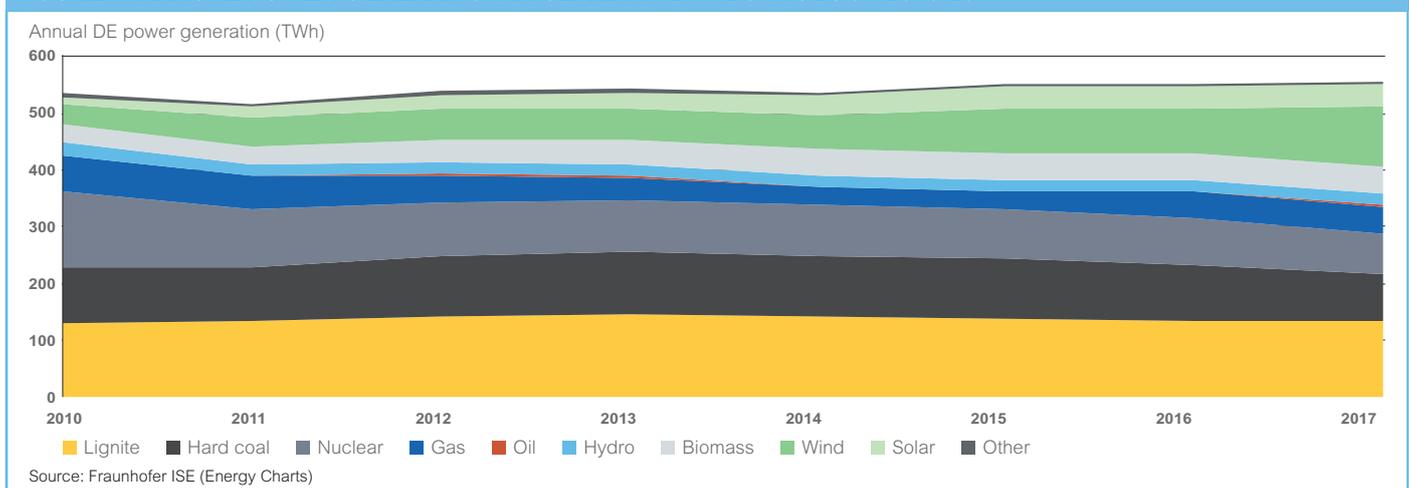
**End of 2018:** Final report of the commission to be published, which might be delayed to early 2019, according to media reports

## GERMANY'S COAL GENERATION AND INSTALLED CAPACITY

At the beginning of 2018, 22.7 GW of hard coal and 20.0 GW of lignite capacities were available to the market, according to the German regulator Bundesnetzagentur. In addition, 914 MW of lignite are currently placed in the lignite reserve, which will grow to 2.7 GW by 2019. A further, 2.3 GW of hard coal and 3.0 GW of lignite generation are part of the grid reserve to ensure grid stabilisation using redispatch. These power plants are not available to the market.

Lignite accounted for 24.2% (134.0 TWh) of Germany's power production in 2017, while hard coal contributed 14.8% (81.7 TWh). Total production in Germany in 2017 was 554.09 TWh. Combined, lignite and hard coal generation was responsible for over 80% of emissions in the power sector. Power generation as a whole produced about a third of Germany's total emissions in 2017.

FIGURE 1: ANNUAL POWER GENERATION IN GERMANY BY TECHNOLOGY 2010-2017



## COAL PHASE-OUT SCENARIOS AND IMPLICATIONS FOR POWER PRICES

In order to assess the impact of different coal phase-out scenarios for the German power price, we simulated four scenarios assuming a different speed of reduction of lignite and hard coal capacities. We used the ICIS Power Horizon model to estimate the impact of these scenarios on changing generation margins and the power price. Although we looked into the impact of capacity reduction, we did not speculate on political measures towards capacity reduction such as regulatory enforcement via command-and-control policies, carbon price floors or full load hour limitations.

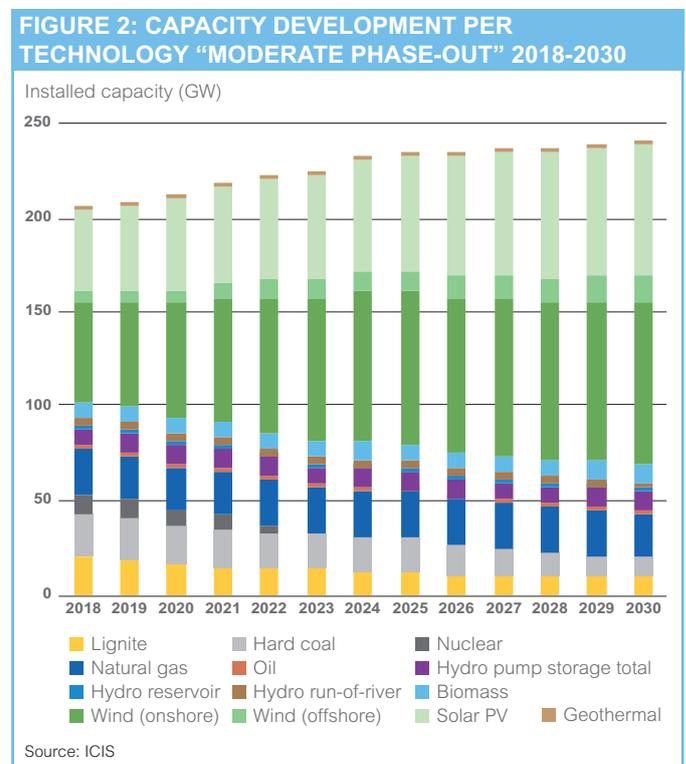
The following four scenarios are assessed and described in more detail below:

- **Moderate phase-out:** We assumed a lifetime of around 45 years for older lignite and hard coal plants, which decreased slightly over time. In 2020, 4.5 GW of capacity was closed to reduce the gap towards the 2020 emission reduction target
- **Slow phase-out:** A slow phase-out of both lignite and hard coal which assumed a 55-year lifetime for lignite and a 50-year lifetime for hard coal plants
- **Speedy phase-out:** A rapid phase-out of both lignite and hard coal which assumed a 30-year lifetime for the plants
- **Lignite-only phase-out:** We assumed a reduction of lignite capacity to zero in 2030, while hard coal remained in the system, and the lifetime approach of the slow phase-out scenario

All scenarios used a lifetime approach for hard coal and lignite to simulate the phase-out pathway, which varied per technology and scenario. In addition, in most scenarios, we assumed that the coal commission had demanded an initial capacity reduction as a gap filler towards the 2020 targets. On top of that, we smoothed out the lifetime approach for

some scenarios, as described below, in order to avoid too drastic a capacity change towards 2030.

Besides changing capacity pathways, we decided to keep all other parameters unchanged for all four scenarios in order to enable a ceteris paribus analysis. Nuclear capacities were reduced to zero by 2023 in line with the announced phase-out plan. Natural gas capacity accounted for additions and closures, resulting in 24.5 GW in 2025 and 24.2 GW in 2030. Hydro pump-storage increased only slightly from 9.5 GW in 2018 to 9.8 GW in 2030. The development of capacities is displayed for the “moderate phase-out” scenario in Figure 2.



# Germany is phasing out coal.

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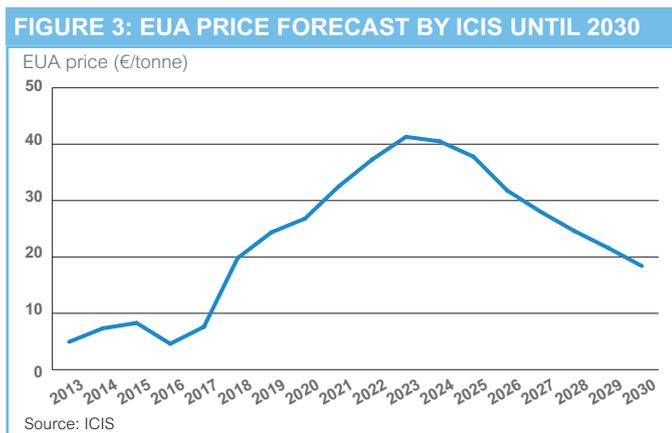
For the development of renewable capacities we considered:

- Wind onshore: the results of auctions resulting in capacities accounting for different building times for energy citizen projects until 2024, and a slightly downward-adjusted corridor as suggested by the 2017 Renewable Energy Act (EEG). In addition, we assumed that a share of the capacity dropping out of the subsidy scheme would remain available to the market for a certain time period before being de-constructed. This resulted in a capacity of 81 GW in 2025 and 85 GW in 2030

- Wind offshore: Slightly downward-adjusted corridor as suggested by the 2017 Renewable Energy Act (EEG). This resulted in a capacity of 10.8 GW in 2025 and 14.8 GW in 2030

- Solar PV: A similar approach to onshore wind - auction results until 2022 and downward-adjusted EEG corridor adding capacity as of 2023. This resulted in 60.6 GW of installed capacity in 2025 and 69.6 GW in 2030.

For carbon price developments, we assumed the ICIS long-term carbon price forecast until 2030, as shown by Figure 3. We believe that the market stability reserve (MSR) will trigger a significant price increase as of this year. Fuel-switching will only soften the price increase during the period 2019 to 2021 before the EUA price will rise to levels above €40/tonne. This will trigger investments in more costly industry abatement projects. Together with a relaxing market balance following a reduction of the MSR withdrawal rate as of 2023, this resulted in a declining EUA price development over the second half of phase 4.



### MODERATE PHASE-OUT

In the moderate phase-out scenario, we assumed a staggered lifetime approach for lignite plants as described

by Table 2. We assumed that half the lignite plants that would have ended operations before 2020 with the lifetime approach will instead maintain operations until a regulatory forced shut-down in 2020. The other half will be phased out over a five-year time period until 2025, in addition to the ongoing lifetime-based reduction. This resulted in a combined lignite and hard coal capacity fall of 4.5 GW towards the 2020 target. By 2030, lignite capacity will decrease to 9.3 GW and hard coal to 10.0 GW - slightly more than half compared to 2018 levels.

**TABLE 2: LIFETIME ASSUMPTIONS FOR LIGNITE AND HARD COAL GENERATION IN “MODERATE PHASE-OUT” SCENARIO**

(years)	Built until 1985	Built until 1995	Built until 2005	Built after 2005
Lignite	45	40	35	30
Hard coal	44	40	30	25

The political debate suggests to us that the “moderate phase-out” scenario reflects the current political debate best, and in our view has the highest likelihood of being implemented. The environmental and climate-related arguments in favour of a speedy coal phase-out are counterbalanced by a strong lobby for securing jobs in mining areas, pointing to a planned approach regarding structural changes in these regions. Therefore, we believe our “moderate scenario” is the most likely of the four scenarios as it combines the call for early closures by 2020 with a more long-term oriented, relatively steady but non-aggressive phase-out towards 2030.

### SLOW PHASE-OUT

In the slow phase-out scenario, we assumed a delayed phase-out with a lifetime of 55 years for lignite and 50 years for hard coal capacities. This results in a steadily declining capacity at a very slow pace. By 2030, lignite capacity will decrease to 14.1 GW (a 29% reduction compared to 2018), and hard coal to 17.9 GW (a 20% reduction compared to 2018).

### SPEEDY PHASE-OUT

In the speedy phase-out scenario, we assumed a lifetime restriction of 30 years for both lignite and hard coal generation assets. In addition, we assumed that half the plants that will end operations before 2020 with the lifetime approach would instead be in operation until a regulatory forced shut-down in 2020. The other half will be phased-out over a five-year time period until 2025, in addition to the ongoing lifetime-based reduction. This resulted in a combined lignite and hard coal capacity drop of 10.5 GW towards the 2020 target. By 2030, lignite capacity will decrease to 5.6 GW (minus 72% compared to 2018), and hard coal to 7.8 GW (minus 65% compared to 2018).

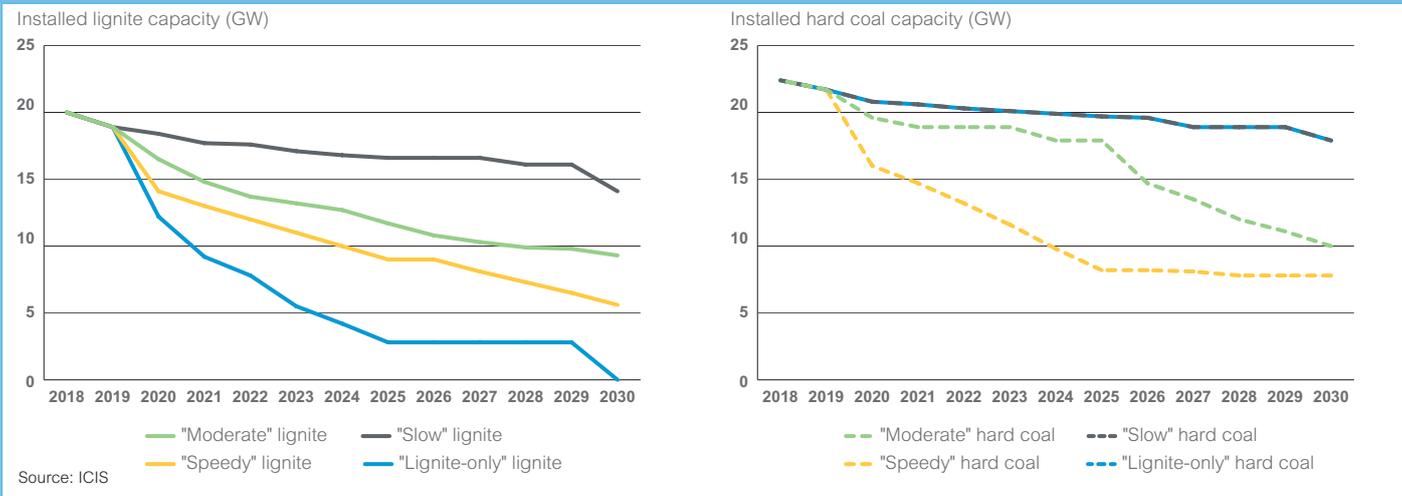
### LIGNITE-ONLY PHASE-OUT

The lignite-only phase-out assumed a rapid decline in lignite capacity as of 2020, while hard coal capacities declined in line with the pathway described in the “slow phase-out” scenario. To model such a scenario for lignite we assumed a lifetime of only 20 years. We also assume that half the lignite plants that would end operations before 2020 with such a lifetime approach will instead be in operation until a regulatory forced shut-down in 2020.

The other half will be phased-out over a ten-year time period until 2030, in addition to the ongoing lifetime-based reduction. This resulted in a lignite capacity drop of 6.7 GW towards the 2020 target. By 2030, lignite capacity will decrease to zero while hard coal remained at 17.9 GW.

Figure 4 summarises our scenario assumptions for lignite and hard coal capacity developments between 2018 and 2030.

**FIGURE 4: SCENARIO-BASED DEVELOPMENT OF HARD COAL AND LIGNITE CAPACITIES IN GERMANY 2018 TO 2030 [IN GW]**



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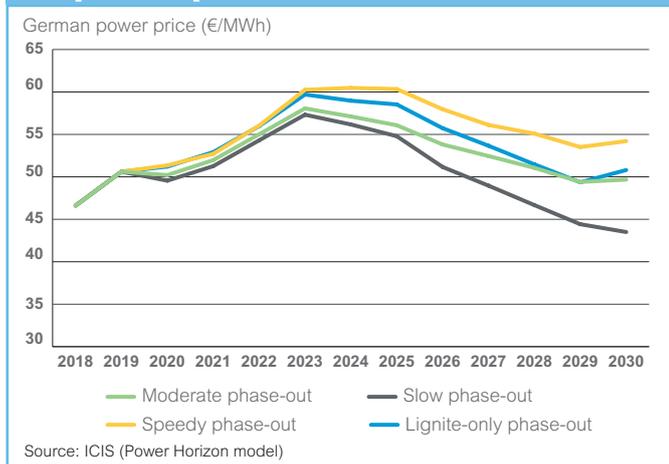
## IMPACT ON GERMAN POWER PRICES

Our modelling suggests that German spot power prices in the 2019-2023 period will be driven predominately by rising European carbon prices rather than by capacity closures. Prices will increase rapidly through to 2023 irrespective of the speed of the coal phase-out, with Germany becoming a net importer in 2023 under all four scenarios as coal to gas switching potentials are limited by the domestic power plant fleet. This explains why the price patterns of all four scenarios are relatively aligned during this timeframe.

Based on our expected softening of carbon prices after 2023, coal and lignite generation is incentivised to ramp up again. This resulted in the phase-out scenarios assuming a more rapid decline in coal/lignite capacities, and having a growing impact on German power prices as cheaper coal and lignite generation was not available due to the phase-out. This led to a widening price spread between the four scenarios towards 2030.

Our ICIS pan-European Power Horizon long-term forecasting model resulted in average annual power price patterns as displayed in Figure 5, and discussed in more detail below.

**FIGURE 5: GERMAN POWER PRICE FORECAST 2018-2030 [IN €/MWH]**



### MODERATE PHASE-OUT – LOWER COAL CAPACITY BUFFERED BY RENEWABLES, GAS AND IMPORTS

Under the moderate phase-out scenario, spot power prices reached a peak of €58.1/MWh in 2023, driven primarily by the EUA price reaching a peak in that year, but also due to capacity losses with nuclear generation being fully phased-out in addition to coal and lignite closures. Prices would

then fall to €49.7/MWh in 2030, driven by declining carbon prices and renewable capacity growth.

Under a moderate phase-out scenario, Germany would become a net importer between 2022 and 2024 due to the significant loss of 22.3GW of combined capacity by 2024, compared with current levels.

The share of coal and lignite within the generation mix falls from 34.7% in 2018 to 20.8% by 2023, before remaining around this level through to 2030. The share of gas increases from 10.0% in 2018 to a peak of 20.0% in 2023, due mainly to fuel switching, before falling to 13.1% in 2030.

### SLOW PHASE-OUT – GERMAN POWER PRICE DROPS BELOW CURRENT LEVELS IN 2030

Under the slow phase-out scenario, German spot power prices still rise rapidly to a peak of €57.3/MWh in 2023, driven primarily by higher EUA prices. German power prices then fall to €43.5/MWh in 2030 (below the 2018 price) as the EUA price softens.

Even in a slow phase-out scenario, Germany would briefly become a net importer in 2023 due to the shortfall in capacity.

The share of coal and lignite within the generation mix falls from 34.7% in 2018 to a low of 23% in both 2023 and 2024, before increasing to 29.9% in 2030. The share of gas will climb to a peak of 18.9% in 2023, before declining to 9.0% in 2030 (below the 2018 share).

### SPEEDY PHASE-OUT – GERMAN POWER PRICE PEAKS AT €60/MWH IN 2023

A speedy phase-out scenario sees spot power prices rising to €60.5/MWh in 2024, and reaching a peak slightly later than the other scenarios as capacity closures continue to push up prices even as EUA prices begin to fall. As with the other scenarios, prices then decline towards 2030 as renewable generation increases.

Germany becomes a net importer between 2022 and 2025 due to significant capacity closures, before reverting back to net exporter status as EUA prices soften and more renewable capacity comes online. Moreover, the country would see significant price spikes for some winter hours, suggesting a very tight energy system during the middle of the next decade, which would trigger additional imports from neighbouring countries.

The share of coal and lignite within the generation mix falls from 34.7% in 2018 to a low of 15.2% in 2025, before increasing slightly to 15.5% in 2030. Falling EUA prices lead to slightly higher coal/lignite generation between 2025 and 2030 despite 3.8GW of additional closures.

The share of gas in the generation mix increases to a peak of 21.9% in 2023, before falling to 13.6% in 2030.

### LIGNITE-ONLY PHASE-OUT – POTENTIAL FOR SIGNIFICANT PRICE SPIKES AT TIMES OF PEAK DEMAND

Under the lignite-only scenario, the German spot power price rises to €59.7/MWh in 2023 before flattening out and dropping to €50.8/MWh at the end of the next decade.

This shows the impact of sharply reducing the availability of a low marginal cost generation source, pushing the system in a high price environment first, while the continued availability of hard coal results in a lower power price towards 2030 as it displaces gas generation at times with a decreasing carbon price.

Germany becomes a net importer between 2022 and 2025. Similar to the speedy phase-out scenario, the modelling shows the potential for significant price spikes for some winter hours as displayed by Figure 6. This suggests a very tight energy system during the middle of the next decade, which would trigger additional imports from neighbouring countries.

The share of gas in the generation mix reaches the highest share of all scenarios, climbing to 21.9% in 2023, before falling back to 13.6% in 2030.

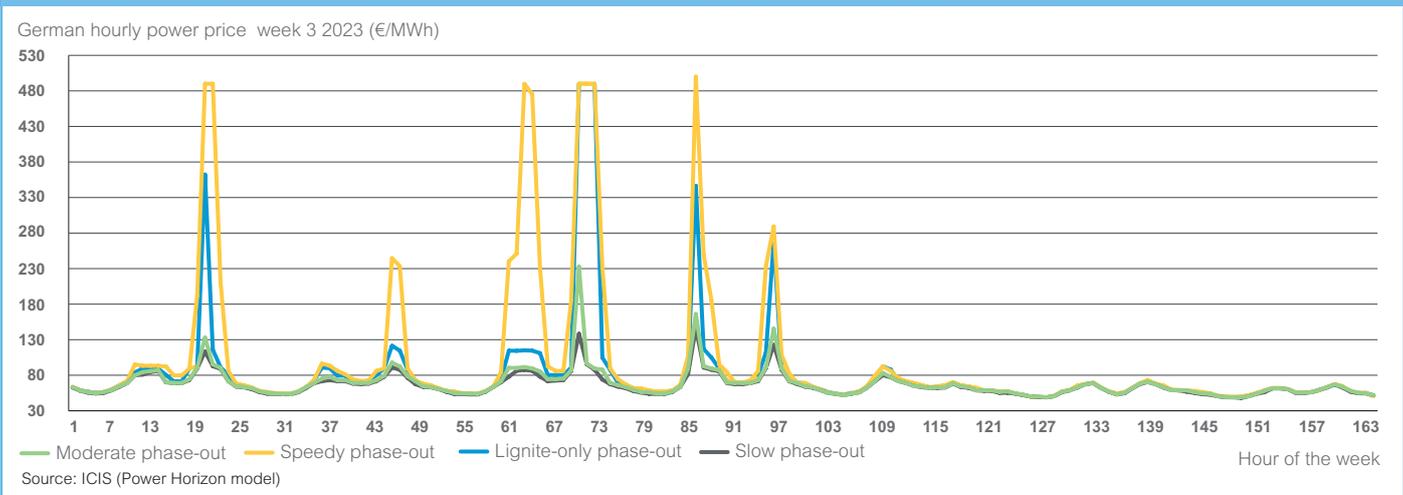
The share of coal and lignite within the generation mix falls to a low of 15.7% in 2024 and 2025 due to capacity closures and high carbon prices, before recovering to 19.6% in 2030 as EUA prices soften.

### POTENTIAL FOR HOURLY PRICE SPIKES WITH SPEEDY PHASE-OUT

Our hourly price forecast highlights an increasing number of hours, especially in winter time, when demand outstrips supply. There is not enough gas capacity available to buffer for decreasing coal/lignite capacity in times of low renewable availability given our scenario boundaries. Figure 6 compares the four scenarios on an hourly basis for the third week in 2023 to highlight the effect of the different scenario assumptions throughout the year despite a relatively similar annual average price for 2023 as displayed in Figure 5.

The model results show that with assumptions on a speedy and lignite-only phase-out, the frequency and level of the spikes is much more pronounced compared to the moderate and slow phase-out scenarios. This suggests a stronger tendency towards system shortages. When looking further out into the future, our model results show an increasing frequency as well as a higher level of peak prices as a result of a stretched German power system.

**FIGURE 6:**  
**HOURLY PRICE COMPARISON FOR EXAMPLE WEEK 3 IN 2023 FOR ALL FOUR SCENARIOS**



## CONCLUSION

Analysing the underlying price driver, our modelling suggests that the European carbon price has its main impact during the years 2019 to 2023, with the speed of coal capacity closures being buffered by changes to the import/export balance as well as fuel switching from coal to gas. As a result, according to our modelling, German spot power prices will increase rapidly to levels between €55 and €60/MWh through to 2023, with Germany becoming a net importer in that year in all four scenarios.

However, our modelling shows that the speedy phase-out and lignite-only scenarios have the potential to create supply shortages during times of high demand and low renewable generation, leading to significant price spikes during certain hours of the year. The frequency and magnitude of these spikes grows over time as coal and lignite capacity is reduced at rapid pace.

This suggests that additional generation capacity could be required to enable a speedy or lignite-only phase-out

without raising security of supply concerns. However, given the likelihood of expected low running hours for such additional capacity, it is not clear whether new plants could obtain financing without some form of subsidy. Therefore, if the government were to adopt a speedy or lignite-only scenario, we foresee some discussion on supporting policy elements to enable new gas-fired (or alternative) generation capacity to be built.

We conclude, on the basis of our modelling, that due to rising EUA prices, German coal and lignite generation is likely to decrease significantly over the next five years irrespective of the pathway chosen towards the long-term phase-out. This means that power sector emissions will be reduced mid-term even if the coal commission adopts a slow phase-out approach. However, as EUA prices begin to soften in line with our expectations, the chosen phase-out pathway will play a significant role in determining German power prices from 2023 onwards, as well as the level of long-term carbon emissions.

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