AURORA ENERGY RESEARCH

The German Coalition Agreement's impact on the power sector

Webinar

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Introducing Aurora's speakers

Hanns Koenig

Head of Commissioned Projects, Central Europe

hanns.koenig@auroraer.com

Casimir Lorenz

Principal

casimir.lorenz@auroraer.com

Linus Beer

Senior Analyst

linus.beer@auroraer.com

Julia Breuing

Analyst

julia.breuing@auroraer.com

Source: Aurora Energy Research

Agenda

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I. Executive Summary

II. Deep-Dives

1. Renewables Targets
   i. Deep dive Model Results
2. Renewables Reforms
3. Power Market Design
4. Coal and gas
5. Electricity demand drivers - Hydrogen and electrification in other sectors
6. Overall Climate Policy domestic, EU, international

III. Key Takeaways

New Coalition Agreement: Germany strongly raises its RES ambition, likely to compensate for lower emissions reductions in other sectors until 2030

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N Deep-dives in later slides

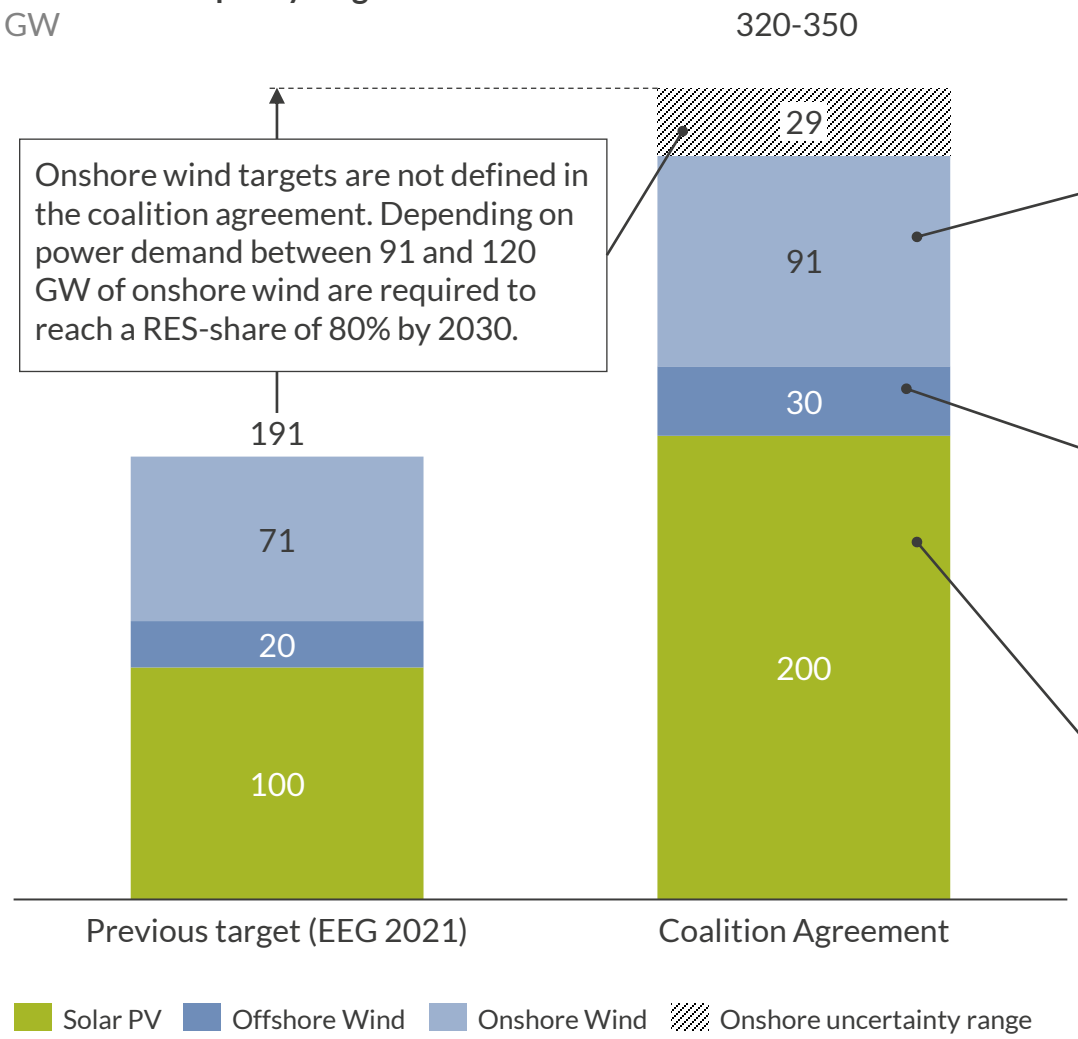
1	**Renewables Targets + Deep Dive power sector impacts** ❶ ❷ ❸	▪ Expected gross electricity demand of 680-750 TWh in 2030 ▪ 80% RES share in 2030: Solar capacity rises to 200 GW, offshore capacity reaches 30 GW in 2030 and 70 GW in 2050, no target for onshore wind, but 90-120 GW necessary depending on electricity demand
2	**RES administrative reforms and subsidies**	▪ Subsidy phase-out with termination of German coal exit (early 2030ies) ▪ EEG levy moved to federal budget by 1 Jan 2023. Removal of bureaucratic barriers and strengthening public acceptance ▪ Revision of solar auction capacity targets, small rooftop build-out limits[2] and auction obligation for large rooftop installations
3	**Power Market Design**	▪ New power market design (e.g. capacity and flexibility mechanisms) to be developed in stakeholder process ▪ Goal to support sector coupling, no details mentioned
4	**Coal and gas**	▪ Coal exit "ideally" completed until 2030, no binding mandate. Revision of coal exit scheduled for 2022 instead of 2026 ▪ New gas capacities to ensure security of supply, but required to be able to run on climate neutral fuels (H2-ready). Construction encouraged at sites of retiring coal plants ▪ No specific natural gas exit, but fossil fuel exit by 2045
5	**Electricity demand drivers - Hydrogen and electrification in other sectors**	▪ Strong demand increase driven by sector coupling & electrification: higher electrolyser, industry, transport & heat targets ▪ Electrolysers: 10 GW (vs. 5 GW) for 2030. Green H2 focus, initial technology neutrality to reduce costs, imports to consider climate impacts ▪ Electric vehicle target of minimum 15 million in 2030 and 50% of heat supply planned to be climate neutral by 2030
6	**Climate Policy, domes-tic, EU, International**	▪ Climate protection plan revision in 2022, multi-annual budget monitoring of sector targets. No details on stricter emissions targets ▪ Support for EU ETS2 to start in 2026 (heat + transport) possibly merged with ETS1 in 2030ies, minimum CO2 price of 60€ pursued

1) Nationally determined contributions 2) Albeit no further details are mentioned in the agreement, the mentioned build-out limits (to-be-revised) likely refer to the current "breathing lid" for rooftop installations <750 kW for which renumeration is adjusted downwards by up to 0.4% each month, in case that annual construction exceeds the current target corridor of 2.1-2.5 GW

Sources: Aurora Energy Research, UK COP26, IEA

Wind and solar rise to 320-350 GW in 2030: While solar will be dominant, onshore and offshore also see significant additions

Renewables capacity targets in 2030



Key measures to support build-out[1]

Onshore:
- 2% of land dedicated to onshore development
- Simplified permitting for repowering projects
- Reduced minimum distances & technical solutions for species protection

Offshore:
- Prioritisation of offshore over other use cases
- Promotion of offshore cooperation projects

Solar:
- Rooftop PV obligation for new commercial buildings and new rules for residential homes
- Renumeration adjustments, support for energy cooperatives and financial benefits for communities, agri and floating PV, faster administrative processes & grid connections

1) Beyond to be determined adjustments to EEG renumerations and auctioned capacities.

Sources: EEG 2021, German Coalition Agreement 2021 "Mehr Fortschritt wagen", Aurora Energy Research

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Power Sector Changes

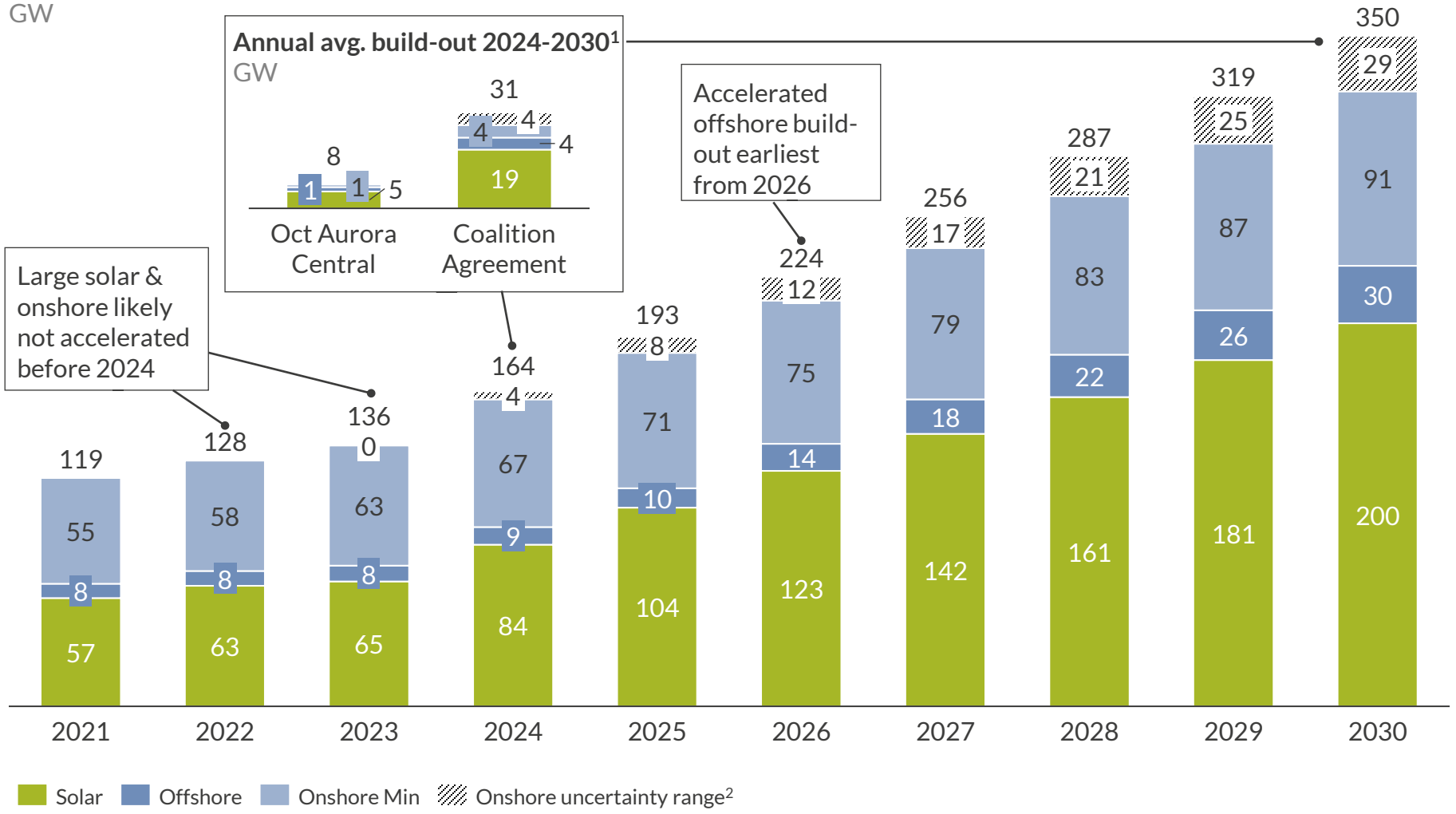
- Renewables share is targeted to rise to 80%, translating to 68-83% higher wind and solar capacities compared to EEG 2021
- Large EEG auction volumes can be expected in the next decade. If high RES buildout materialises, assets with merchant exposure will suffer from low capture prices due to high cannibalisation

Open Questions

- How will government enforce the 2% land dedication rule for onshore wind?
- What additional sea areas will be dedicated to offshore wind deployment?
- How can the massive solar buildout be achieved and what policies are planned?

To meet its 2030 targets, Germany needs to add 19 GW solar, 4-8 GW onshore, 4 GW offshore wind capacity p.a. from mid-twenties

Net RES capacity build-out in Germany to meet 2030 targets in coalition agreement



1) Shows annual net build-out, ignoring potential retirements i.e. of solar/onshore where repowerment may be required. For offshore, average build-out between 2026-30 is shown, new capacity would take 5 years to be realised 2) Represents the possible range between min. % max. annual onshore capacity required to meet 2030 RES target of 80% at 680-750 TWh gross demand

Sources: EEG 2021, German Coalition Agreement 2021 "Mehr Fortschritt wagen", Aurora Energy Research

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Conclusions

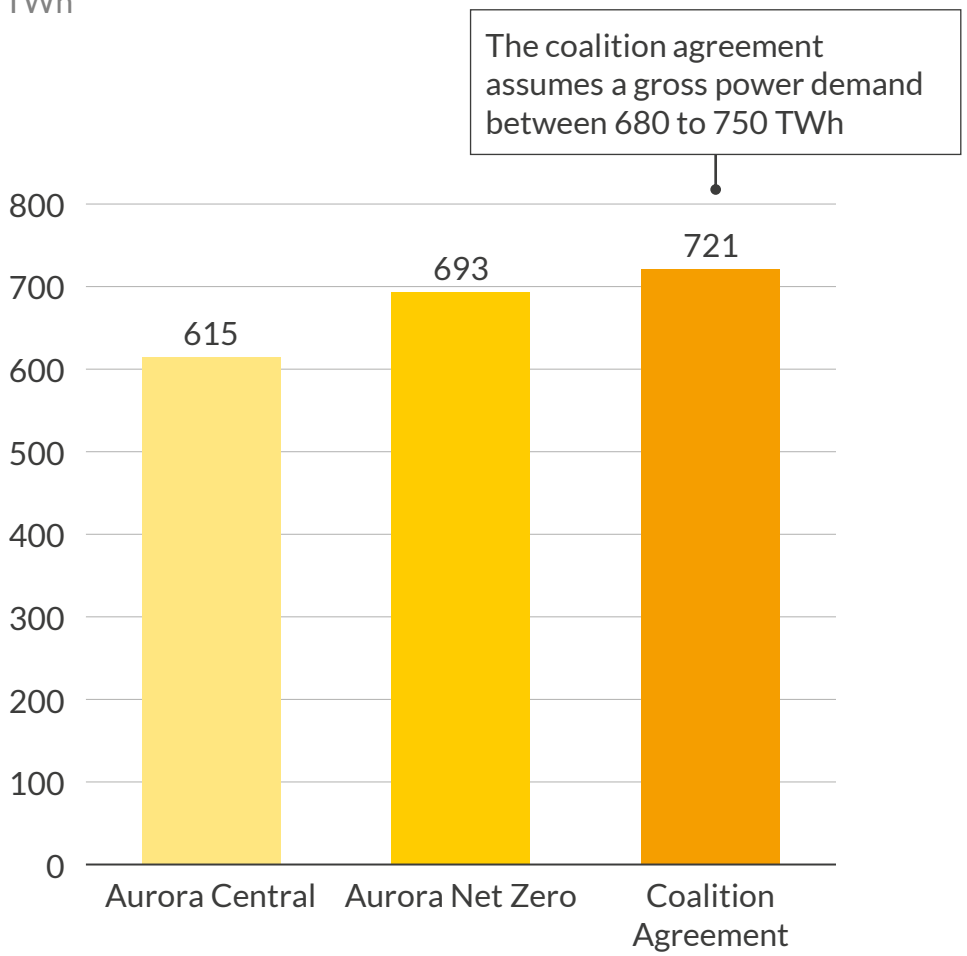
- To achieve 2030 RES share of 80%, Germany needs to add a net of 27-31 GW RES capacity p.a. from mid-twenties. Annual gross capacity build-out is even larger, and required to replace retiring onshore & solar capacity
- While solar plays a central role adding 19 GW annually, onshore capacity additions would need to rise 6-12 times to reach 2030 targets, offshore build-out doubles from 2026 onwards
- For additional solar & onshore auctions it would take min. until 2024, for offshore until 2026, to result in additional capacities

Open Questions

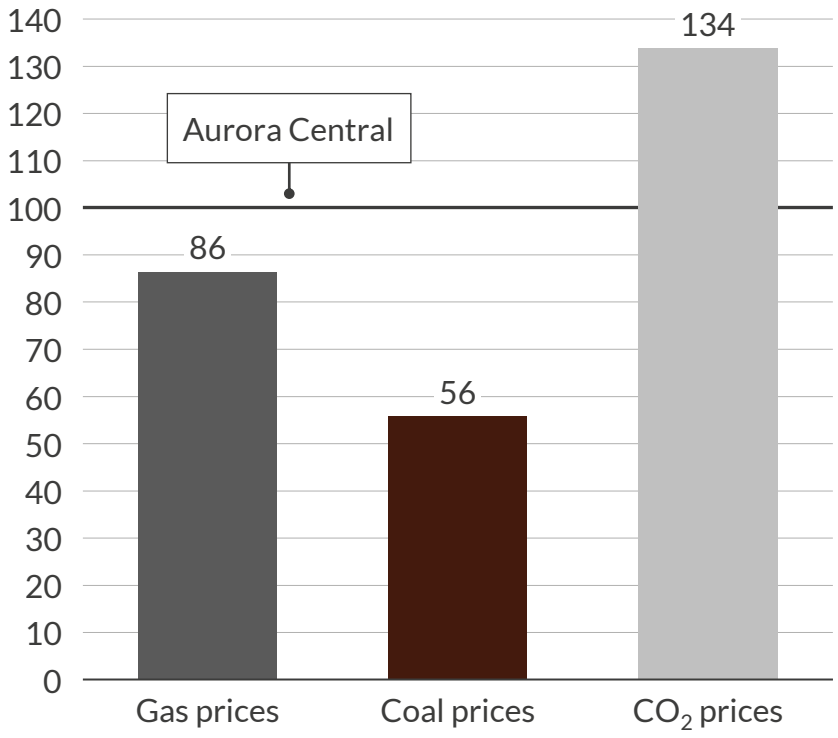
- How much capacity will be auctioned, how much is expected to be delivered by other support schemes, PPA, merchant buildout?
- How much onshore wind capacity build-out will the government aim for?

Modelling insight: Compared to Central scenario, Net Zero and Coalition Agreement Scenario see higher demand and CO_2-prices

Gross power demand, 2030
TWh



Commodity prices Net Zero & Coalition Agreement
% of Aurora Central



Background on scenarios

- Lowest demand in Aurora Central due to lower decarbonisation efforts in other sectors
- Due to higher number of electric vehicles and electrolyser capacity, power demand in Coalition Agreement scenario is 28 TWh higher than in Net Zero scenario[1]
- Same commodity prices in Net Zero and Coalition Agreement scenario assumed
  - Higher CO_2-prices than in Central scenario
  - Lower gas and coal prices than in Central scenario
- The coalition agreement may also contribute to higher carbon pricing across Europe (e.g. through increasing the likelihood of merging ETS1 and ETS2), which is not reflected here

1) The difference could be even larger, if the 50% RES-share in the heat sector is achieved by larger build-out of heat pumps than assumed in the Net Zero scenario.

Sources: Aurora Energy Research, German Coalition Agreement 2021 "Mehr Fortschritt wagen"

Modelling insight: With 115 GW onshore wind, new RES target of 80% is achieved in 2030 for a power demand of 720 TWh

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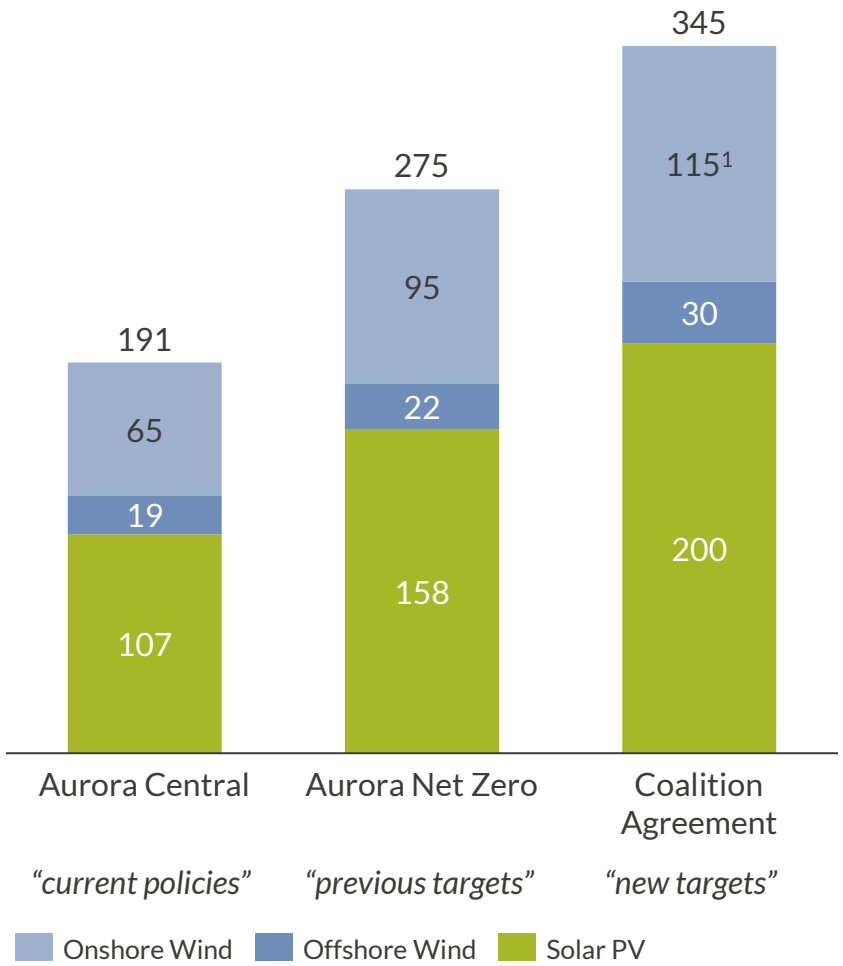
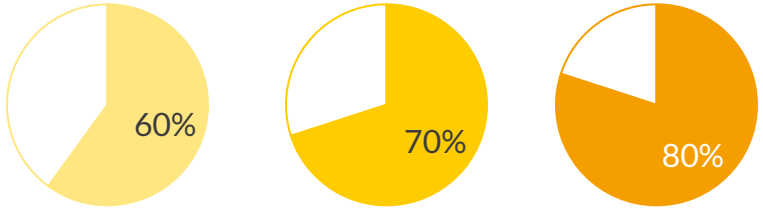
RES capacities 2030
GW

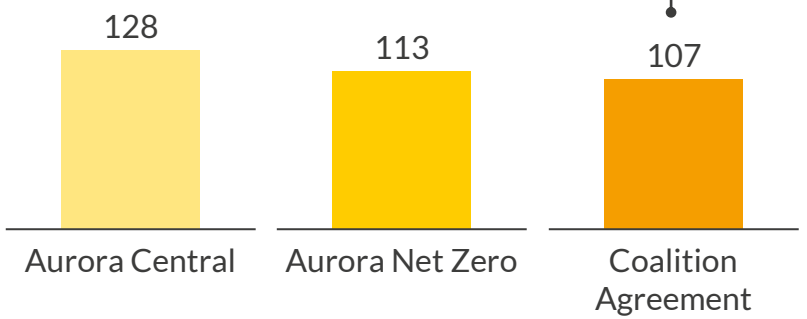


RES share 2030[2]
%



Power sector emissions 2030[3]
$MtCO_2$

Efficiency improvements and decarbonisation of CHPs and on-site industrial plants could lead to larger emission reductions



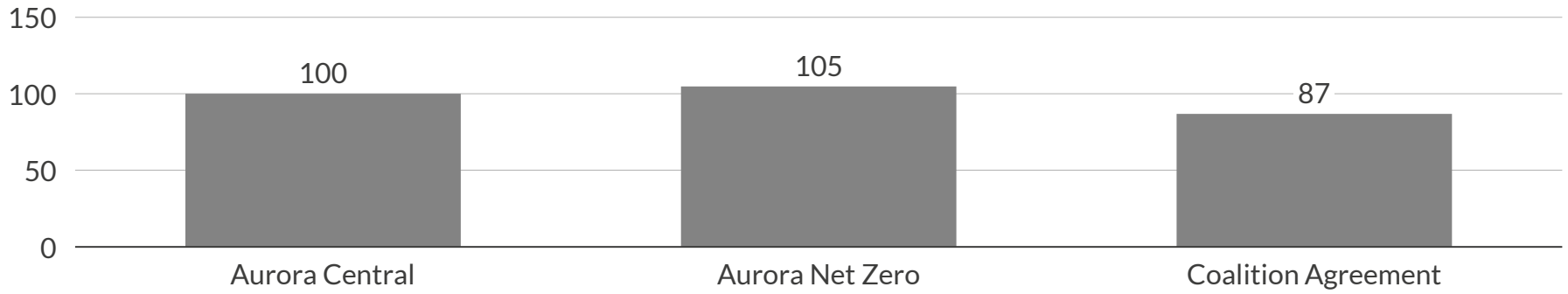
1) An onshore wind target is not defined in the coalition agreement, but 115 GW are required to reach an 80% RES-share with a gross power demand of 720 TWh. 2) Including hydrogen and biomass. 3) Not all emissions in the energy sector under the KSG are covered in the power sector model (refineries), while some industry emissions are included (industry CHPs).
Sources: Aurora Energy Research, German Coalition Agreement 2021 "Mehr Fortschritt wagen"

Comments

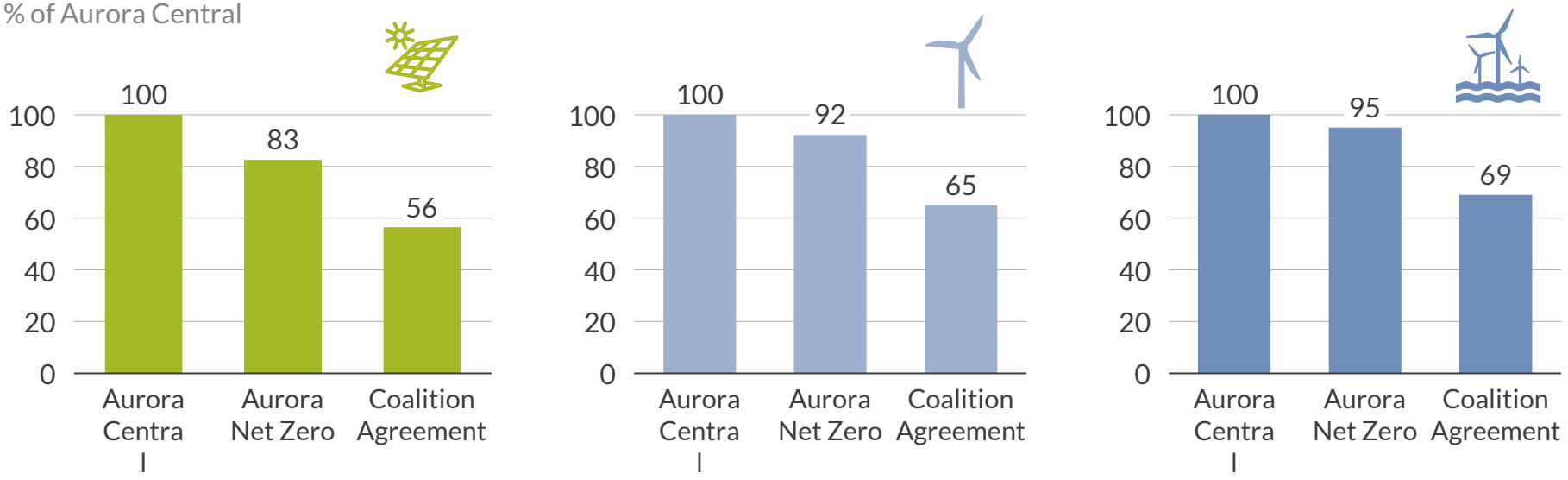
- In Aurora Central, former onshore wind target is missed by 6 GW due to slow approval processes and other hurdles
  - Low build-out of onshore wind and higher demand than anticipated by previous government lead to RES-share of 60%
- Under Coalition Agreement scenario, power sector emissions in 2030 are 6 Mt CO_2 lower compared to Net Zero, while RES-share is 10% higher
  - Higher expected power demand offsets some of the emissions savings from higher renewables share
- With 115 GW onshore capacity, RES-target of 80% achieved in 2030 in Coalition Agreement scenario

Modelling insight: Under coalition agreement targets, power prices in 2030 would be up to 13% lower than in Aurora Central

Baseload prices 2030
% of Aurora Central



Renewables capture prices 2030
% of Aurora Central



Sources: Aurora Energy Research, German Coalition Agreement 2021 "Mehr Fortschritt wagen"

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Impact on power market

- Baseload prices fall under Coalition Agreement scenario: High RES build-out compensates for price pressure from higher demand and carbon prices
- Renewable capture prices fall up to 44% compared to the Aurora Central Scenario under the coalition agreement due to significant price cannibalisation
- This assumes no change in carbon prices in the Coalition Agreement scenario compared to the Net Zero scenario, which, as outlined on slide 8, is conservative and could offset some of the decreases in capture prices
- Achieving 50% RES-share in heat sector by flexibilising CHPs and larger build-out of heat pumps could also stabilise capture prices

EEG support will end when coal exit is complete, while EEG levy will already be phased out by 2023

2021-2030 Removal of RES barriers EEG financing set onto a new footing | **Post 2030: EEG Phase-out**

Renewables build-out

- Removal of bureaucratic barriers by accelerating grid connection and certification processes
- Increasing public acceptance by strengthening citizen participation

Renewables financing

- Continued auctions set to be aligned with 2030 capacity targets
- Adjusting RES remuneration rates for rooftop PV, revise "breathing lid" and mandated auctions for large rooftop
- Strengthening the markets for Power Purchase Agreements (PPAs) and Guarantees of Origin (GoOs) (*no concrete measures mentioned*)

Public financing

- Simplifying and promoting direct usage of renewable power (*Mieterstrom*)
- EEG Levy no more paid by electricity consumers, plan to move into federal budget by 1 Jan 2023. Most funds will come from the Energy and Climate Fund, which receives the proceeds from Germany's national CO_2 price and from the sale of EU ETS certificates

Renewables financing

- Government plans to phase out renewable subsidies under the EEG with the termination of the German coal exit

Sources: Aurora Energy Research, German Coalition Agreement 2021 "Mehr Fortschritt wagen"

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Evaluation

- The coalition agreement addresses several important aspects that were hindering renewable build-out in past years
  - Given the extremely ambitious build-out targets, these are even more important
- Transferring financing of EEG levy from power price to federal budget can promote electrification due to lower costs
- Phasing-out renewable subsidies with termination of coal exit seems ambitious with the substantial drop in capture prices in mind
  - PPAs and GoOs might not be sufficient to ensure a market-based renewable build-out after 2030

Capacity & flex mechanisms beyond EOM may be introduced, sector coupling encouraged, but creating investor uncertainty in the process

Current market design: Focus on energy trading and balancing markets in hours of demand/supply mismatch

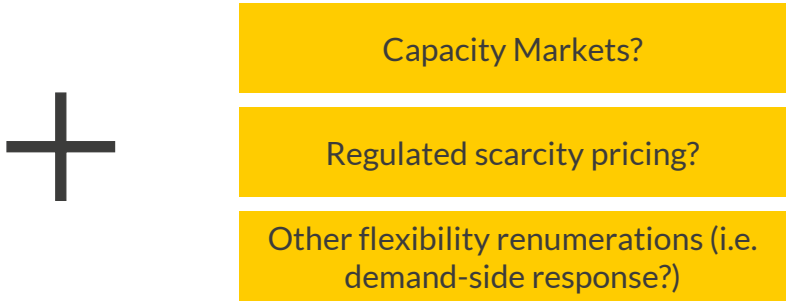
- **Power providers are remunerated only for energy sold** - there are no centralized capacity payments.
- Only **exception: balancing markets**, here provision of **standby capacity** is **compensated**, but **no long-term** capacity **contracts** exist
- To ensure security of supply **reserve capacities are held**. Plants **not allowed to participate in wholesale market to** avoid distorting price signals in the EOM
- Current security of supply monitoring signals no issues until 2030, but is **does not yet reflect greater climate ambition of coalition agreement**

Future design is unclear: May require capacity and flex mechanisms, lack of detail leads to investor uncertainty

- Rising electricity demand and high RES share likely require capacity and flexibility renumeration to ensure security of supply
- Government hints at flex and capacity mechanisms, but aims at determining future market design in a **new dialogue platform "climate neutral power system"**
  - **Investigates impact of technology-neutral capacity and flexibility mechanisms**
  - **Aims to build financial architecture that promotes sector coupling (i.e. adjustment of grid fees to enable decarbonization etc.)**

Current Market Design: EOM + reserves

Future Market Design: Capacity Markets on top or replacing part of the existing reserve?



1) In this case: a to-be-determined form of Capacity Market

Sources: Aurora Energy Research, German Coalition Agreement 2021 "Mehr Fortschritt wagen"

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Key takeaways

- Significant demand increase and phaseout of coal could require adjustment to energy market design
- Coalition mentions capacity and flex. mechanisms as possible answers and plans stakholder dialogue
- However, dialogue likely requires 1-2 years, time that leaves significant uncertainty for investors

Open Questions

- Will the there be a capacity renumeration scheme (CM[1]) that replaces THE current capacity reserve?
- If CM is introduced, are capacities required to be carbon neutral or provide a carbon neutrality perspective? (H2-ready gas plants, batteries, green H2)
- What other mechanisms will ensure sector coupling and ease local grid constraints?

Coal-phase out by 2030 not far from current expectations

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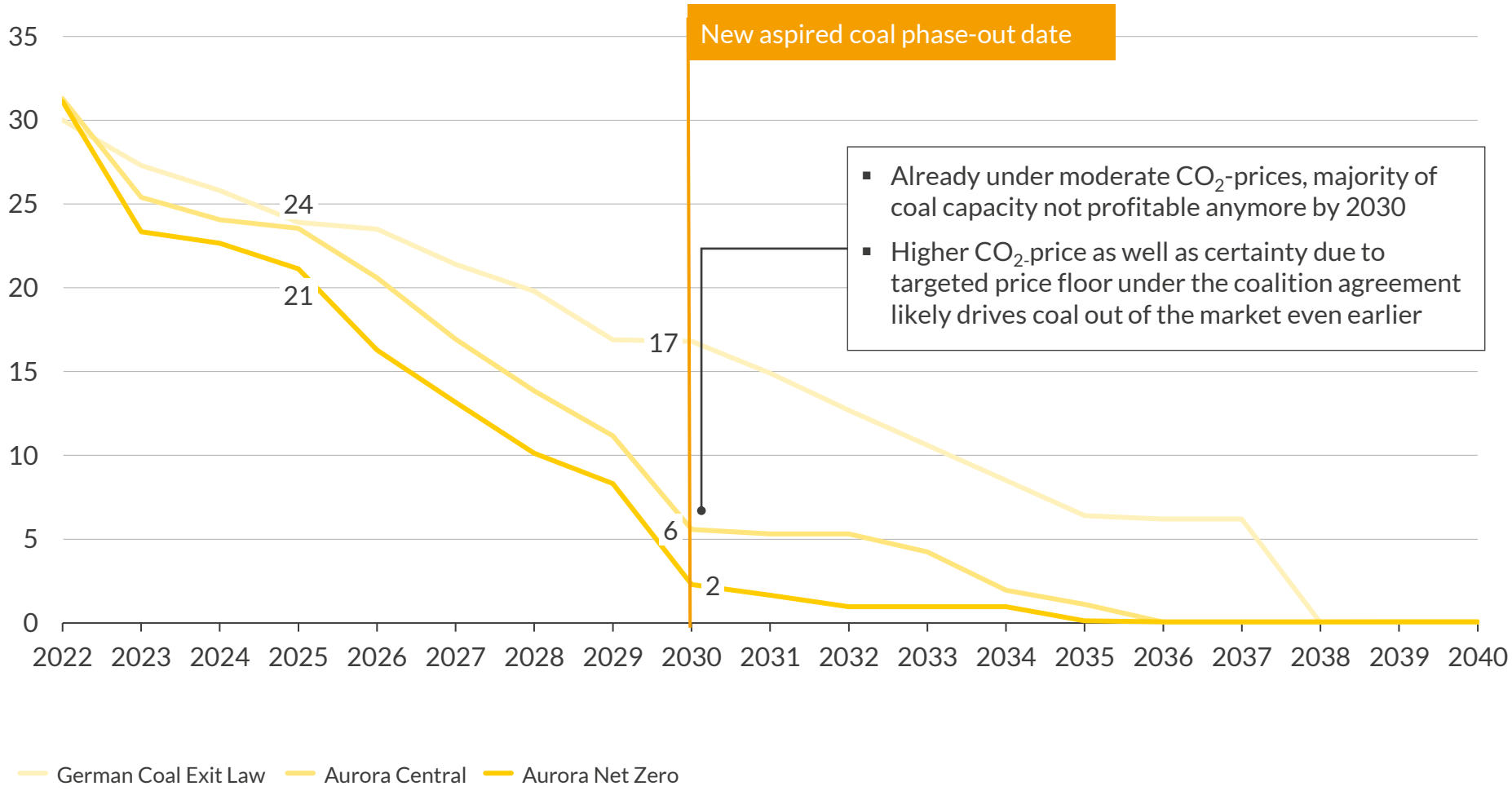
Coal capacities

GW



Proposed coal changes

- The government wants to revise final coal exit timeline in 2022, aiming for a phase-out until 2030, driven by significant RES build-out and a minimum carbon price of 60 EUR/tCO_2
- This would come eight years earlier than current coal exit law
- Aurora Central considers market-driven retirements pre-coalition treaty

Open Questions

- Will there be a phase-out date defined in 2022?
- Will compensation payments be revised?

Sources: Aurora Energy Research, German Coalition Agreement 2021 "Mehr Fortschritt wagen"

Demand is expected to rise to 680-750 TWh, driven by 10 GW electrolyser capacity, electrification in industry, heat and transport

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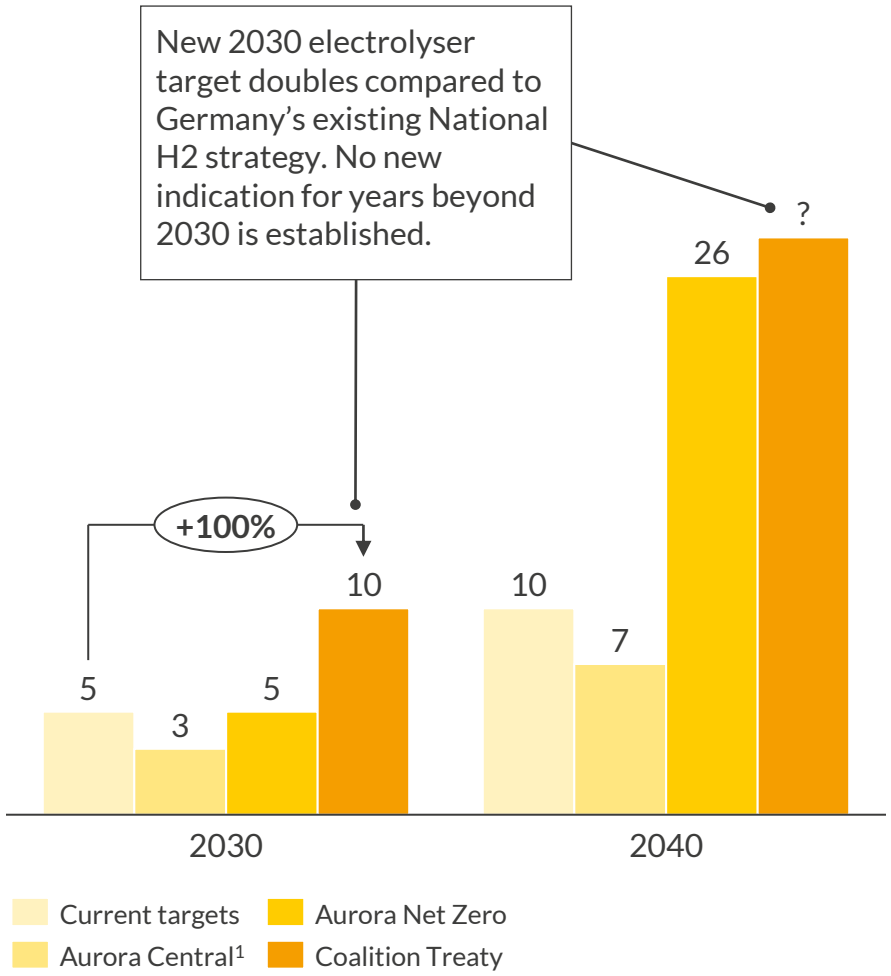
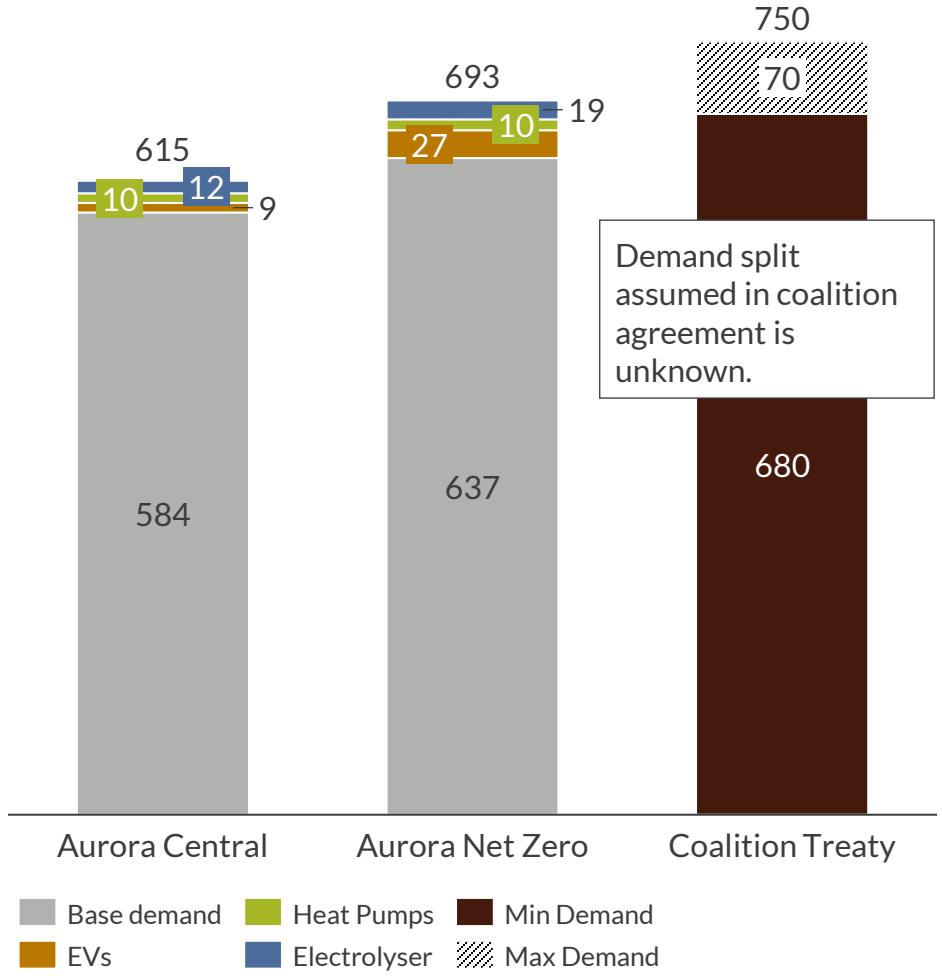
Comparison of German electrolyser capacity targets
GW



German gross power demand forecast for 2030
TWh



1) Aurora Central Hydrogen Capacity is based on National Hydrogen Strategy but lower, as it considers a lack of existing financial and infrastructure commitments required to achieve 2030 and 2040 capacity targets 2) Carbon Contracts for Difference also referred to as Climate Protection Contracts in the coalition agreement which shall mainly cover steel and basic materials industries

Sources: National Hydrogen Strategy, Aurora Energy Research, German Coalition Agreement 2021 "Mehr Fortschritt wagen"

Proposed demand changes

- New electrolyser target for 2030 is 10 GW. National hydrogen strategy is planned to be revised in 2022. Blue H2 is not mentioned but the phrase 'technology neutral regulation' suggests it might be used until green H2 is cost competitive.
- Gross demand in coalition agreement is assumed to be 680-750 TWh, above Aurora Net Zero of 693 TWh. Key drivers are rising electrification of transport (15 m EVs) , industry (CCfDs[2]) and heat (>50% climate neutral) until 2030

Open Questions

- What will be the role of blue hydrogen?
- What will the future H2 import strategy look like, beyond the "consideration of climate impacts"?
- How can the >50% climate neutral share for heat be reached by 2030?

Revision of climate targets in 2022: Coalition plans a multi-annual CO_2 budget approach and aims to achieve at least 60 EUR/tCO_2 price

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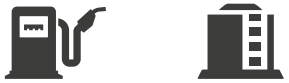
EU ETS to be strengthened by national or EU-wide minimum carbon price (at least 60 EUR/tCO_2)

- Coalition partners expect EU ETS prices not to fall below 60 EUR/tCO_2 until 2030 and will pursue introduction of a EU-wide carbon price floor at this level.
- If prices fall below 60 EUR, additional measures might be taken such as
  - domestic carbon price floor of 60 EUR
  - A cancellation of additional circulating certificates *(mechanism unclear, likely a very expensive option)*



ETS 2 (heat + transport) to be introduced in 2026

- No further increase planned for existing national CO2 price, mainly for social reasons due to currently high oil and gas prices
- From 2026 onwards, the coalition aims to introduce a EU-wide second ETS (ETS 2) for the residential heat and transport sector which would replace national carbon pricing and likely lead to a steeper carbon price rise thereafter
- The government aims to merge the ETS 2 with the existing ETS in the 2030ies, albeit investigations are pending
- This could lead to significant upward pressure even in the ETS1, if certificates can be banked

Revision of current climate protection plan might render new emissions accounting, no tighter targets

- Government plans revision of current climate protection plan in 2022
- Targets will be monitored through a multi-annual budget system with specific sector goals.
- This enables cumulative emissions accounting, but leaves room for over-/underdelivering on specific sector targets in individual years
- There is no specific goal to further tighten annual emissions targets

Open Questions

- Will certificates from subsidised industry decarbonisation be cancelled?
- Will a second ETS be created at EU level, substituting the national one?
- Will there be a possibility for sectors (and ministries) to offset over-/underachievement of emissions targets?

Sources: Aurora Energy Research, German Coalition Treaty 2021 "Mehr Fortschritt wagen"

Key takeaways

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1. Under the new government, the German energy transition is likely to **pick up substantial pace.**
2. A **very large investment opportunity in renewables** is emerging, but even if capital is mobilised, it will be challenging to hit targets, especially if grid expansion does not take place fast enough.
3. The large planned buildout will make it **harder to finance renewables subsidy-free** (solar revenues cannibalised >40%, offshore <30% below previous trajectory); continued renewables auctions will likely be required unless carbon prices and flexible demand rise rapidly.
4. The expected decisions on **future market design** were "**outsourced**" and **postponed** to a "Market Design Commission", causing uncertainty that is likely to affect the investment climate until proposals are finalised.
5. **Coal phase-out in 2030 realistic**, if coal plants close according to market-forces; for lignite, constraints with respect to associated mine closure and just transition of lignite regions need to be resolved.
6. The **large renewables share in the power sector** will enable the **decarbonisation in other sectors**. Though driving up power demand, ambitious targets for transport, heat and industrial sector will benefit the overall emissions balance.
7. A **minimum EU ETS1 price of 60 EUR/t** could support the decarbonisation in the ETS1 sectors by increasing investment security; however, the price level would not be sufficient to achieve the aspired decarbonisation targets without additional policies and measures
8. **Carbon pricing outside the ETS1 is the Agreement's weak point**; Germany's national carbon price could potentially be raised after current energy price crises ends

We offer Power & Renewable Market Intelligence Services across key markets and add-ons for flexibility

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	Power market	Renewable power	Flexible and distributed power	Gas market	H_2 market
	GB Power Market Service	GB Renewables Service	GB Distributed & Flexible Energy Service	European Gas Market Service	Hydrogen Market Service
	Ireland Power & Renewables Market Service		Ireland Flexibility Service		
	German Power Market Service	German Renewables Service	North-West European FCR Forecast		
	French Power & Renewables Market Service				
	Dutch Power & Renewables Market Service				
	Belgian Power & Renewables Market Forecasts				
	Iberian Power & Renewables Market Service				
	Italian Power & Renewables Market Service				
	Nordics Power & Renewables Market Service				
	Polish Power & Renewables Market Service				
	Romanian Power & Renewables Market Forecasts				
	Bulgarian Power & Renewables Market Forecasts				
	Greek Power & Renewables Market Forecasts				
	ERCOT Power & Renewables Market Service				
	Australian Power & Renewables Market Service		Australian Flexibility Service		

Source: Aurora Energy Research

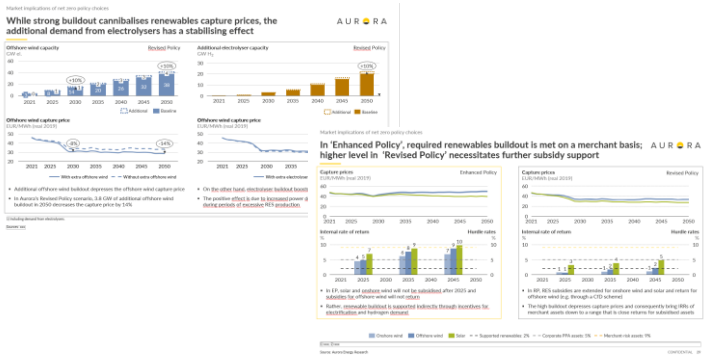
German Power Market Service: Key market analyses and forecasts for all participants in the German power market

Quarterly data and market reports to assess business models

- Yearly forecasts of **wholesale market prices along 4 scenarios** (Central, High, Low and Net Zero) until 2050
- **Price distributions**, capture spark spreads, peak prices
- **Capacity development**, generation mix, interconnector capacity, capacity buildout, exports
- **Capture prices** of technologies (CCGT, coal, onshore wind, offshore wind, solar PV)
- **Analysis of key sensitivities** (coal closures, Climate Action Plan target)
- EU-ETS carbon price forecasts
- ***Global Energy Market Forecasts***

Group Meetings and Strategic Insight Reports

- **In-depth thematic reports** on topical issues
- **Four multi-client roundtable discussions** per year in Berlin to discuss reports with actors across the German power market
- Past and future topics include
  - *Reserve market and business models for batteries*
  - *Coal exit auctions*
  - *Security of supply and weather risks*



Interaction through workshops and ongoing support

- **Bilateral workshops** at your office to discuss specific issues on the German market
- **Ongoing availability** (calls, access to market experts, modellers) to address any questions across European power markets
- Invitation to all Aurora events and discounted invitations to Aurora's annual **Spring Forum**

All intelligence for a successful business, based on bankable price forecasts

For more information, please contact
Antonia Kilavuz, Commercial Associate

antonia.kilavuz@auroraer.com
+49 (0) 30 120 84969

German Renewables Service: Renewable-specific analysis for all actors in the German renewables space

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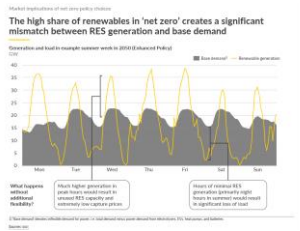
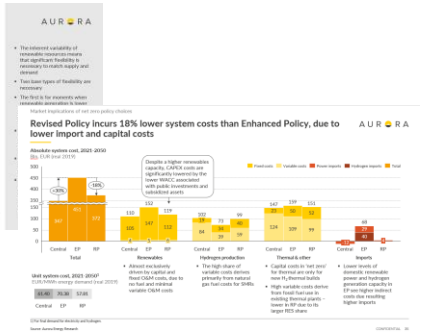
Quarterly data and market reports to assess RES projects

- All forecasts across **4 scenarios** (Central, High, Low, Net Zero) until 2050
- **Regional capture prices**
  - 5 wind & 2 solar PV regions in Germany
- Capacity additions under EEG and subsidy-free per region
- Negative prices and impact of 6-hour/ 4-hour-rule periods, technology costs, and imbalance costs
- **Guarantees of Origin (GOO)** market statistics and price forecast
- Detailed reports focusing on the **economics of renewables**, including both **subsidised and subsidy free** business models
- Structuring and pricing of **PPAs,** as well as price benchmarks and off-taker analysis

Group Meetings and Strategic Insight Reports

- **In-depth thematic report on topical issues** for the renewables industry
- **Two multi-client roundtable discussions** per year in Berlin to discuss reports
- Past and future topics include
  - *Outlook on markets for Guarantees of Origin*
  - *Merchant renewables and PPAs in Germany*
  - *Cost-potential curves: renewables build-out potential*





Interaction through workshops and ongoing support

- **Bilateral workshops** in your offices to discuss specific issues on the German renewables market
- **Ongoing availability** (calls, access to market experts, modellers) to address any questions across European renewables markets
- Invitation to all Aurora events and discounted invitations to Aurora's annual **Spring Forum**

All intelligence for a successful business, based on bankable price forecasts

For more information, please contact
Antonia Kilavuz, Commercial Associate

✉ **antonia.kilavuz@auroraer.com**
☎ **+49 (0) 30 120 84969**

Details and disclaimer

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Prepared by
Linus Beer
(linus.beer@auroraer.com)
Julia Breuing
(julia.breuing@auroraer.com)
Claudia Günther
(claudia.guenther@auroraer.com)

Approved by
Casimir Lorenz
(casimir.lorenz@auroraer.com)
Hanns Koenig
(hanns.koenig@ auroraer.com)


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