AURORA ENERGY RESEARCH

Can German renewables become competitive within 5 years?

June 2018

Political ambitions for renewables to become competitive in the near term are high, but significant questions remain

The Minister for the Economy and Energy, Peter Altmaier, expects renewables to become competitive before 2023:

„Ich gehe davon aus, dass die erneuerbaren Energien in absehbarer Zeit, das heißt in den nächsten vier bis fünf Jahren, ihre Wettbewerbsfähigkeit vollständig erreicht haben, und dass wir dann imstande sein werden, erneuerbare Energien ohne zusätzliche Subventionen zu finanzieren“

“I assume that renewables will become fully competitive within the next four to five years, and that will be able to finance renewables without subsidies by then”

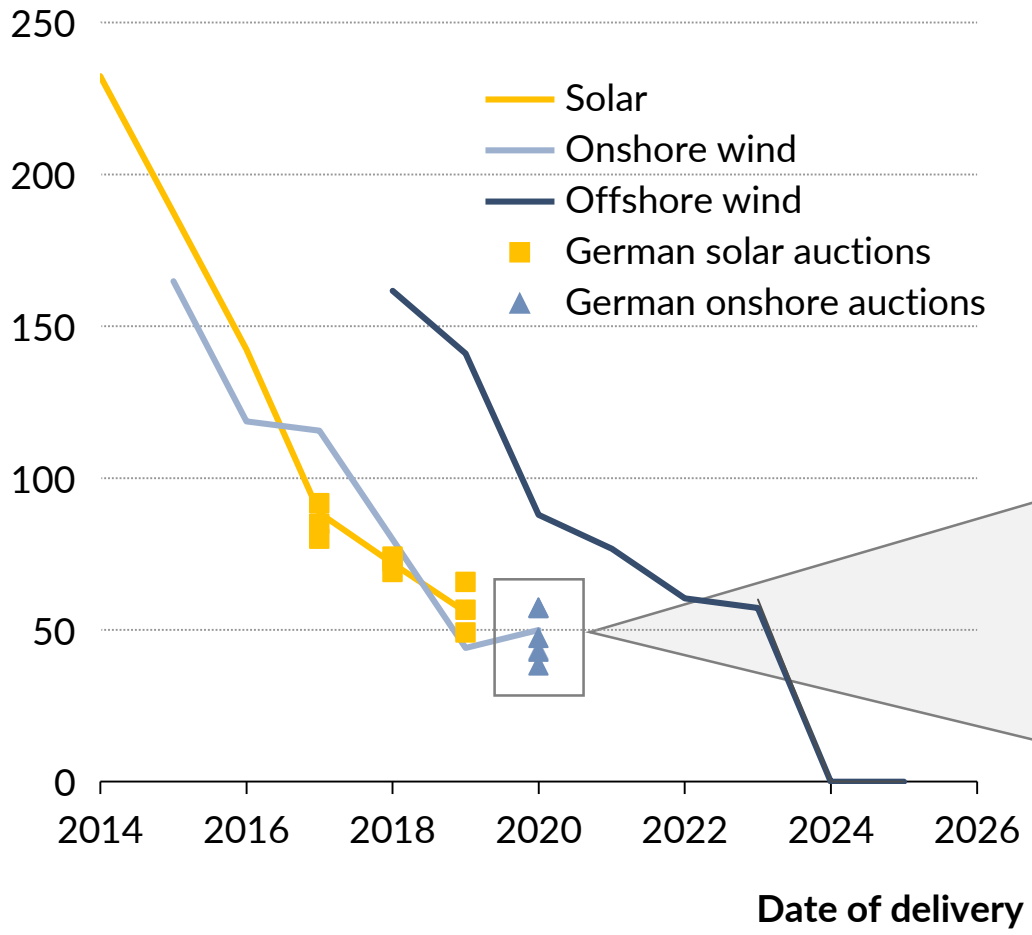
However, it is questionable if RES can become competitive this early in the current market design:

- Will technology costs of renewables continue to decline fast enough?
- How does the 65% coalition target impact revenues of subsidy-free renewables?
- How will financing costs change for higher-risk merchant renewables and how are total project cost affected?
- What role can policy play in facilitating subsidy-free buildout?

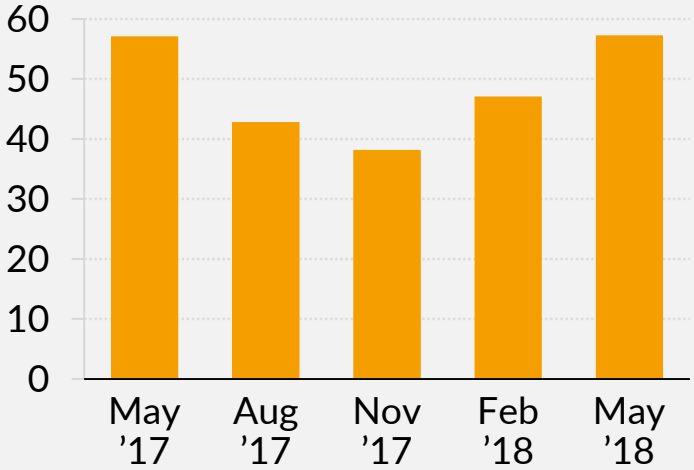
Source: Aurora Energy Research

The EEG 2017 has been a success in reducing costs for renewables…

Subsidy for new builds,
EUR/MWh, nominal



Average of winning onshore wind bids
EUR/MWh, nominal



After initial decline, price resurgence resumed after:

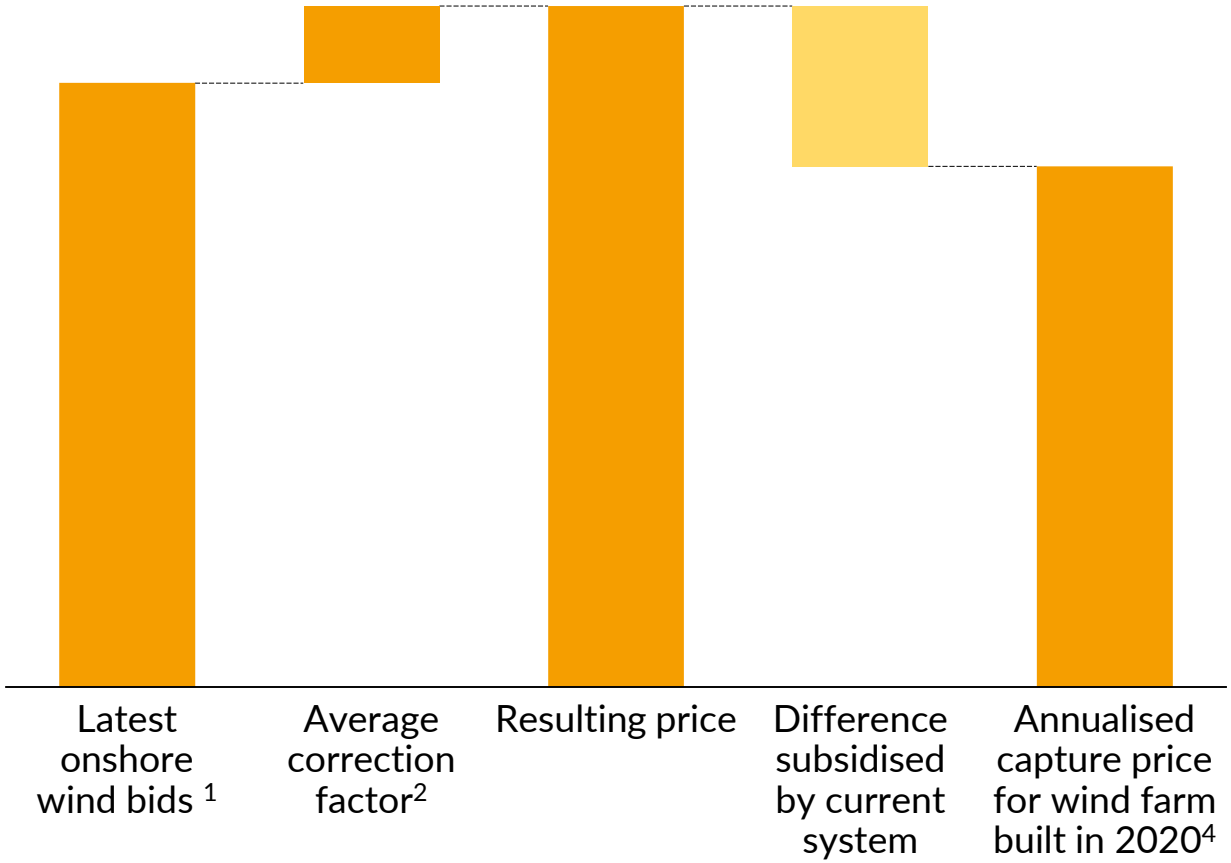
- privileges for "citizens' projects" (longer construction limits and no permit required) were suspended
- 65% RES target was introduced

Source: Aurora Energy Research, BNetzA

However, actual subsidies are higher than published results suggesting current projects are far from being competitive

Power price
Nominal Euro/MWh

ILLUSTRATIVE



Regional location factor

- Auction bids are given for a reference location (standardised windspeed)
- Actual guaranteed prices are corrected by a location-specific factor to incentivise more distributed buildout

Location trend

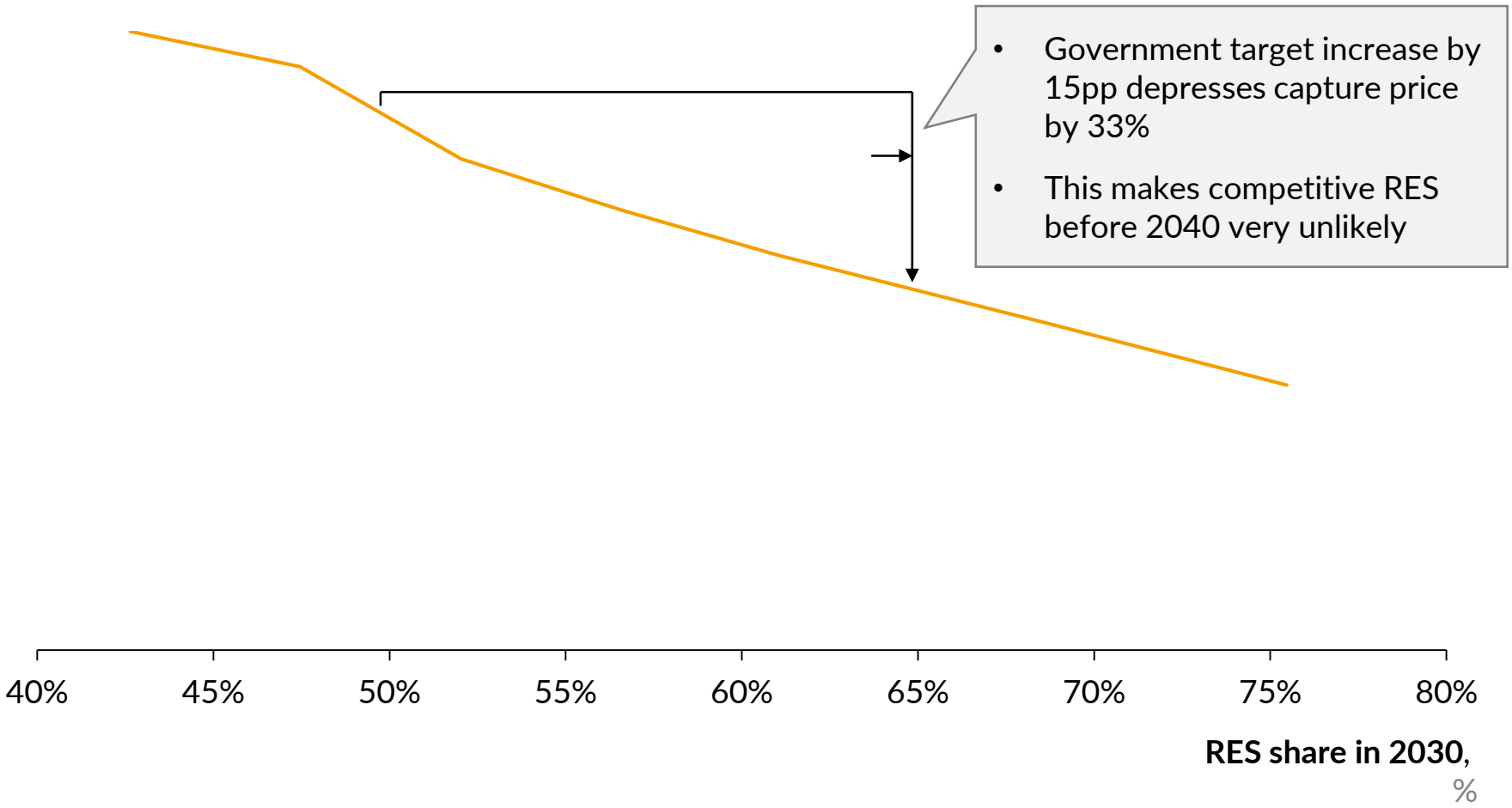
- Average wind farm location at around 75 % of reference yield
- With increasing market saturation, quality of available location is likely to decrease further

1) Average price of successful bids (weighted by capacity) in May 2018 auction 2) Approximated based on locations of wind farm locations in 2012-14
3) 20 year nominal average capture price, (inflation projection 1.5% p.a.) Aurora Central Scenario

Source: Aurora Energy Research, BMWi

The 65% coalition target cannibalises market revenues of renewable plants

Onshore wind capture price[2],
EUR/MWh real 2017, levelised average 2023

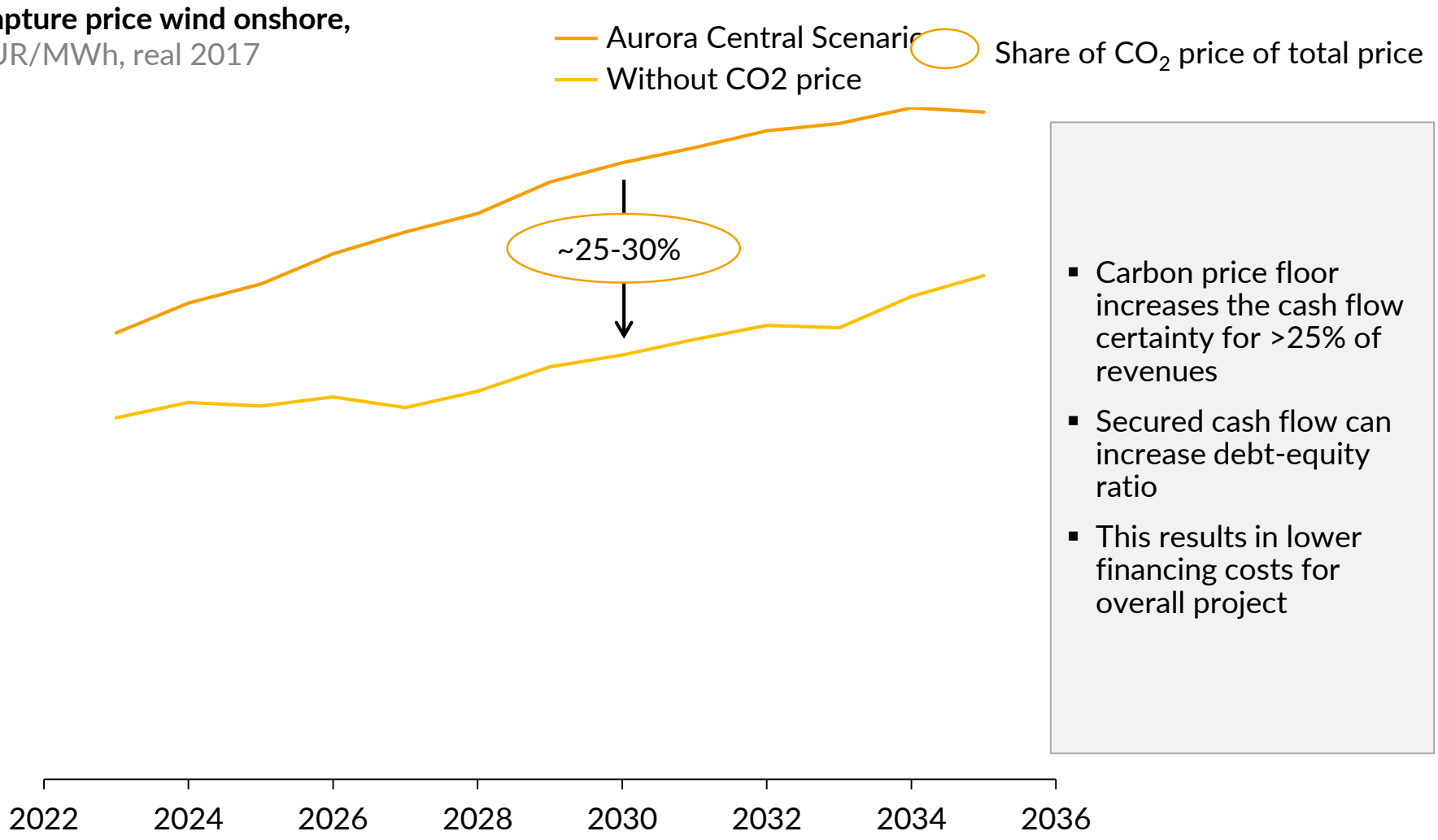


1) Levelized capture price in 2023 2) market price achievable by wind onshore farm

Source: Aurora Energy Research

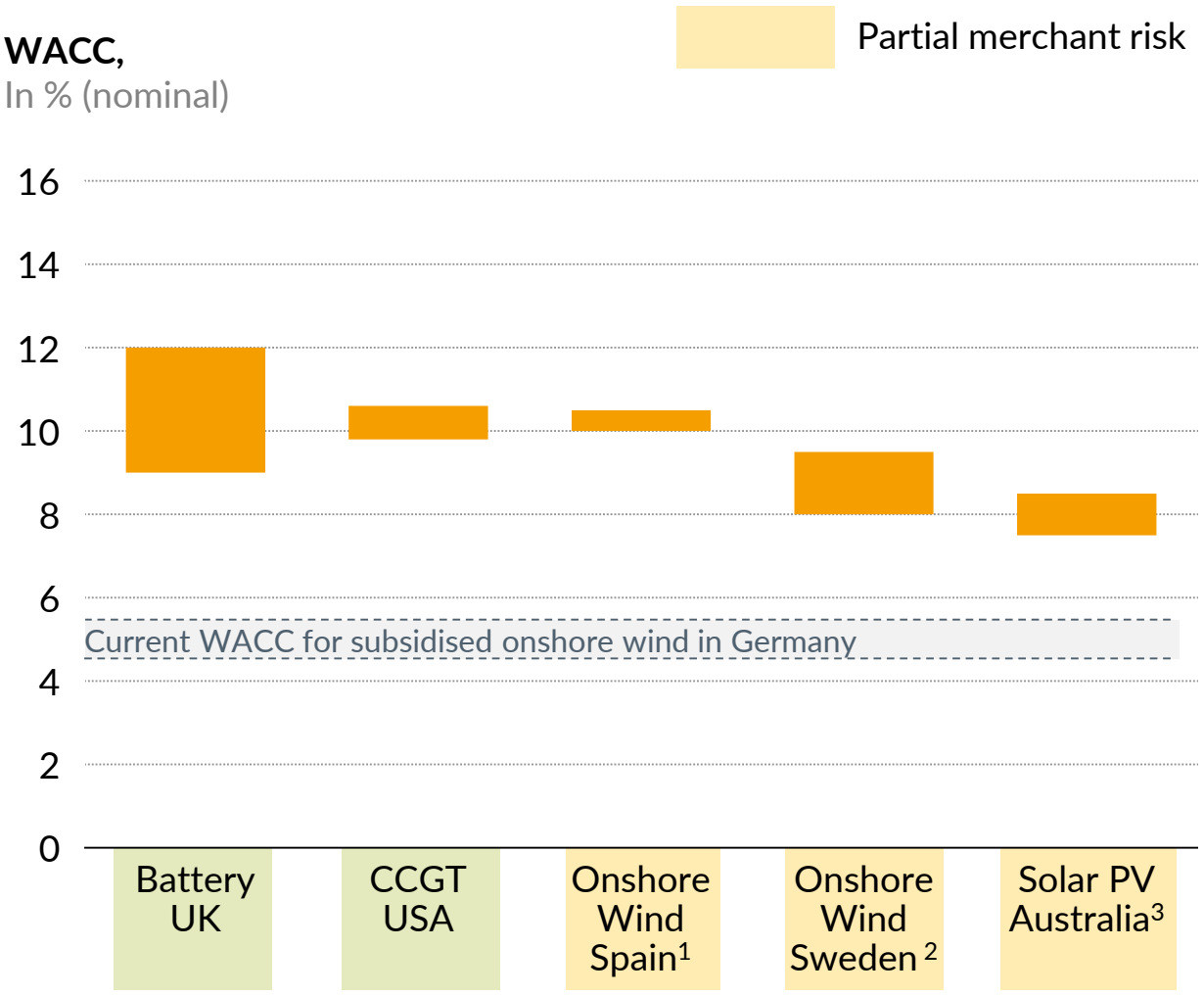
A carbon price floor significantly increases certainty on 25-30% of revenues of a merchant asset and decreases capital costs

Capture price wind onshore,
EUR/MWh, real 2017



- Carbon price floor increases the cash flow certainty for >25% of revenues
- Secured cash flow can increase debt-equity ratio
- This results in lower financing costs for overall project

Subsidy-free renewables face significantly higher cost of capital than current supported investments under EEG



- Exposure to higher levels of market risks raises capital cost…
- …impacting their market competitiveness
- Reducing cost of capital represents a key lever for regulatory efforts

Notes: 1) Supported by low price floor covering some downside risk 2) Benefiting from additional priority via green certificates in the market 3) Benefiting from additional support via mandated renewable shares in generation portfolios

Source: Grant Thornton, Agora Energiewende, Castalia Strategy

PPAs increase revenue certainty and lower cost of capital by up to 4 percentage points

PPA impact on cost of capital

- PPAs increase certainty of project's revenues and assure availability of cash flow for debt service
- Increased availability of cash flow to cover debt services enables higher debt share
- Higher (debt) leverage decreases cost of capital for the sponsor
- Reduced project risk decreases cost of equity and further lowers WACC

- Only with PPAs widely applied can they make a relevant impact on RES WACC and competitiveness
- System with higher liquidity and lower transaction cost (i.e. time and legal resources) for PPAs important for application throughout different sectors and scales

Change in financing cost under PPA contracting

Capital structure
Share (in %)

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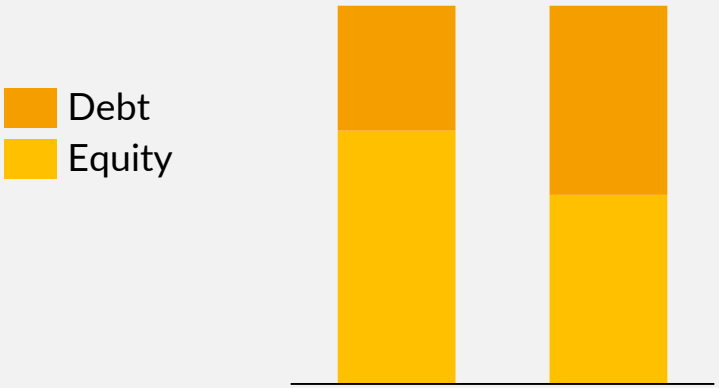


	Merchant conditions	PPA contracted
WACC	**10 - 11%**	**6- 7%**
Debt-equity ratio		
Total	1/2	1

Sources: Aurora Energy Research

We assessed three policy options quantitively: status quo, PPAs and a carbon price floor under three market scenarios

Policy options	Status quo	PPAs	Carbon price floor
	• Continuation of current EEG system • Merchant RES at 10.5 % WACC when exceeding EEG build-out path	• No EEG build-out past 2022 • Policy framework to create favourable conditions for PPA • WACC of 7.5 %	• No EEG build-out past 2022 • Carbon price floor at 45 EUR/t to incentivise RES • 9 % WACC due to lower uncertainty
Market scenarios	**Central**	**High**	**Low**
	As in Aurora Central in particular • Carbon price of 31 EUR/t in 2030 • Gas price of 27 EUR/MWh in 2030	As in Aurora Central except • Carbon price of 52 EUR/t in 2030[1] • Gas price of 46 EUR/MWh in 2030	As in Aurora Central except • Carbon price of 8 EUR/t in 2030[1] • Gas price of 15 EUR/MWh in 2030

1) In carbon price floor scenario, minimum carbon price of 45 EUR/t CO_2

Sources: Aurora Energy Research

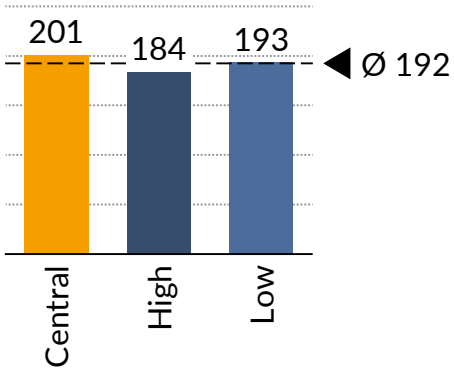
Carbon price floor is most resilient against change in market conditions, other policies are comparably more cost effective

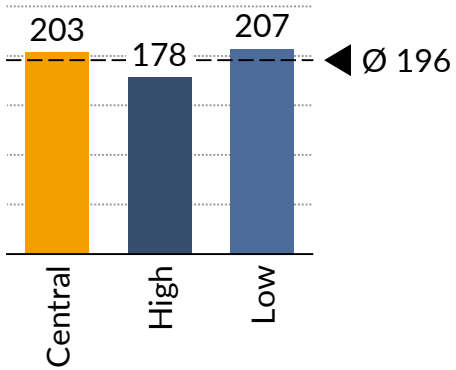
Status Quo

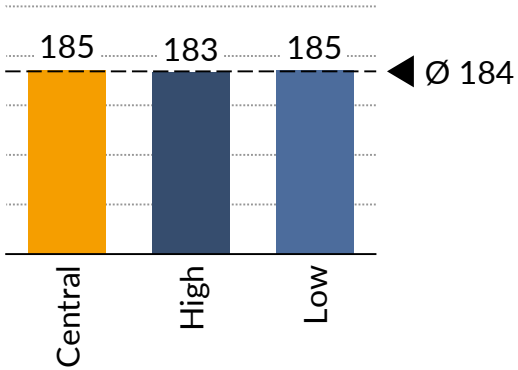
PPA

Carbon Price Floor

Power sector CO2 emissions 2030,
million tCO_2

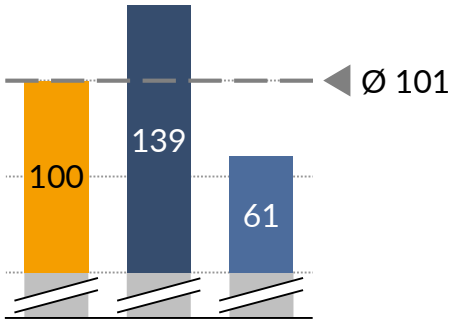


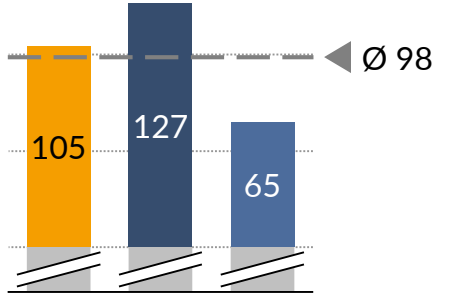


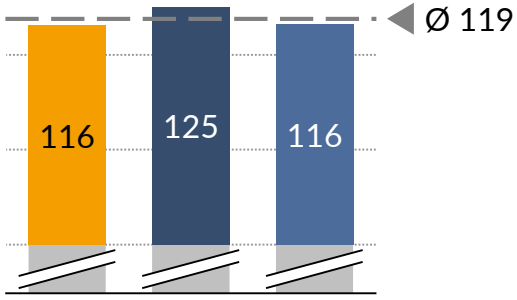


Impact on electricity cost,
% of central price projection

Remaining price components[1] | Central | High commodities | Low commodities



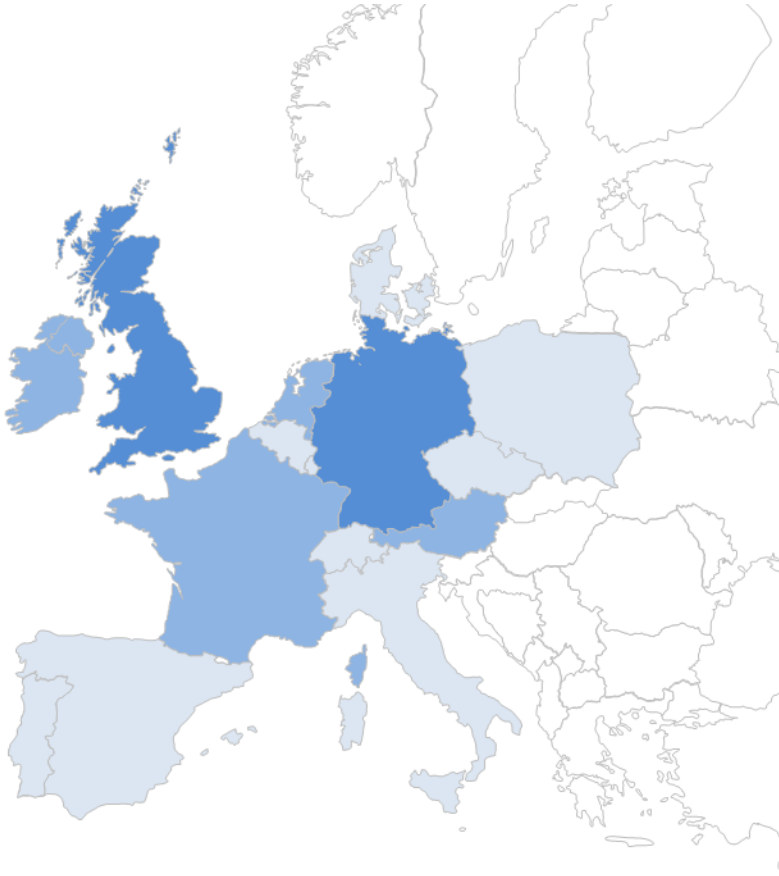




1) Remaining price components – e.g. grid charges & taxes - remain constant over scenarios. Legacy subsidies only change marginally

Source: Aurora Energy Research

Aurora offers power market forecasts and market intelligence spanning Europe's key markets



Comprehensive Power Market Services	Power Market Forecast Reports	Bespoke forecasts
☑ Power market forecast reports	☑ Power market forecast reports	☑ Aurora can provide power market forecasts upon request
☑ Forecast data in Excel	☑ Forecast data in Excel	
☑ Global energy market forecast reports	☑ Global energy market forecast reports	
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☑ Analyst support		

Source: Aurora Energy Research

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