AURORA ENERGY RESEARCH

Recent trends & price benchmarks for Nordic PPAs

Public webinar

15 August 2023

Aurora PPA valuations are currently available for 12 European countries, with more to follow soon

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Overview of evaluation and calibration status across European markets

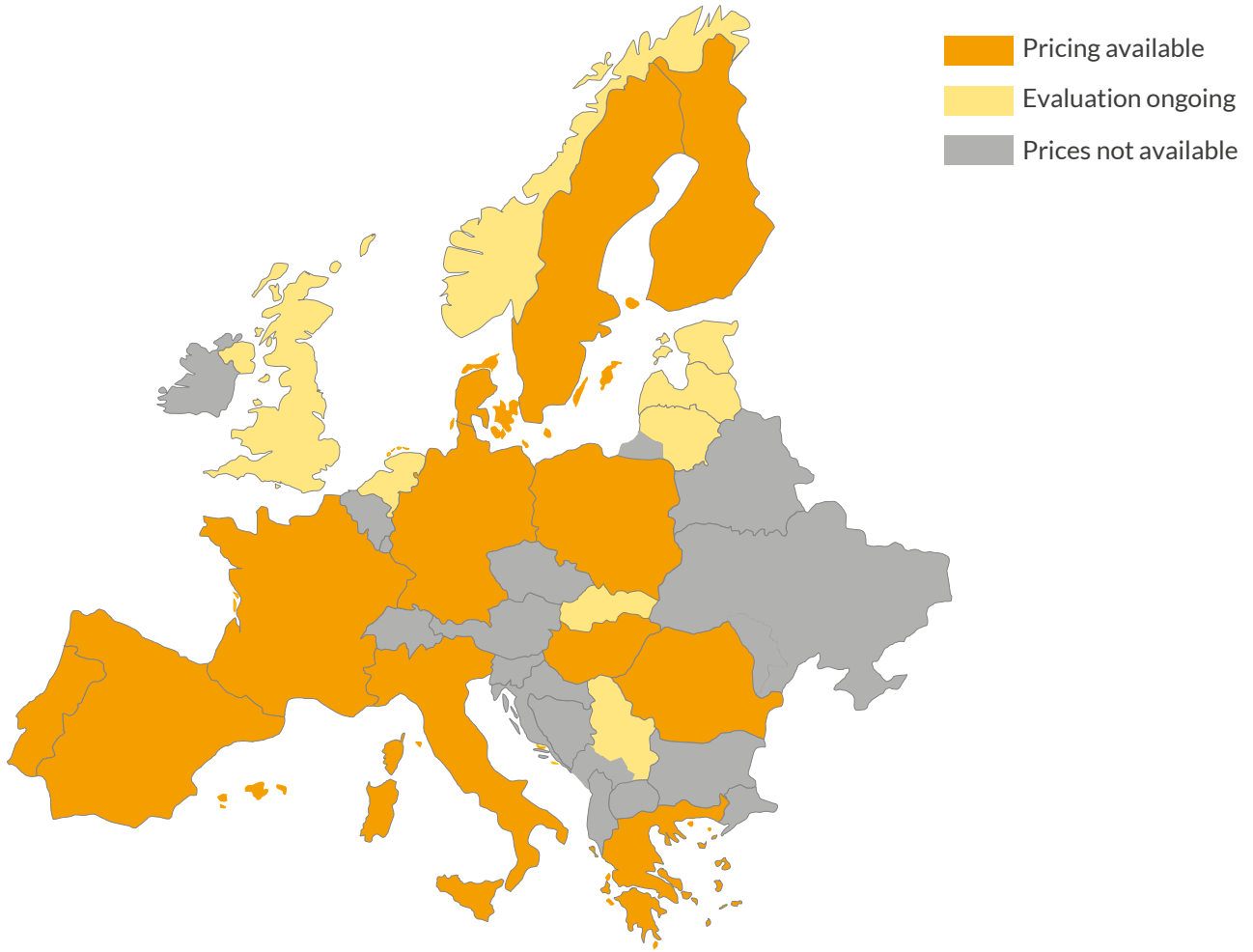
Aurora's PPA quotes database

The tool roll-out across European markets is based on a market and technology specific calibration using our broad database of PPA quotes.

220+
market quotes

40+
participating companies

19
countries



Source: Aurora Energy Research

The Nordics are among the most mature PPA markets in Europe, dominating the onshore wind PPA market

Market Maturity

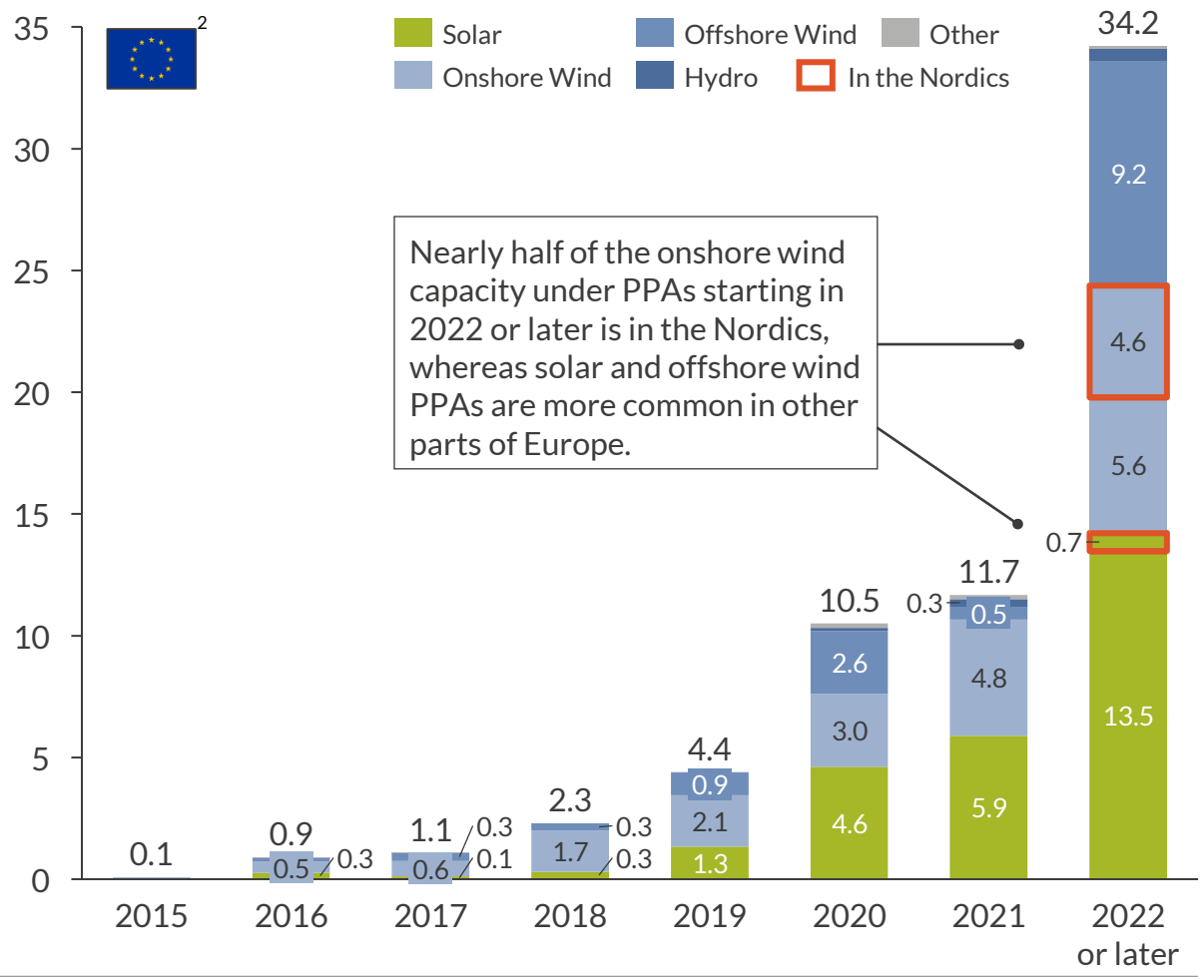
GW

Country	GW under PPA	Market maturity
	22.9	
	15.0	
	13.7	
	4.9	
	3.0	
	1.9	
	1.6	
	1.5	
	1.5	
	1.1	
	1.1	

Less mature — More mature

Announced[1] PPAs by start year and technology in selected EU countries

GW



1) As of April 2023. 2) Countries in scope: Germany, Nordics (Denmark, Finland, Norway, Sweden), Great Britain, Spain, France, Portugal, Netherlands, Italy, Belgium, Poland, Ireland.

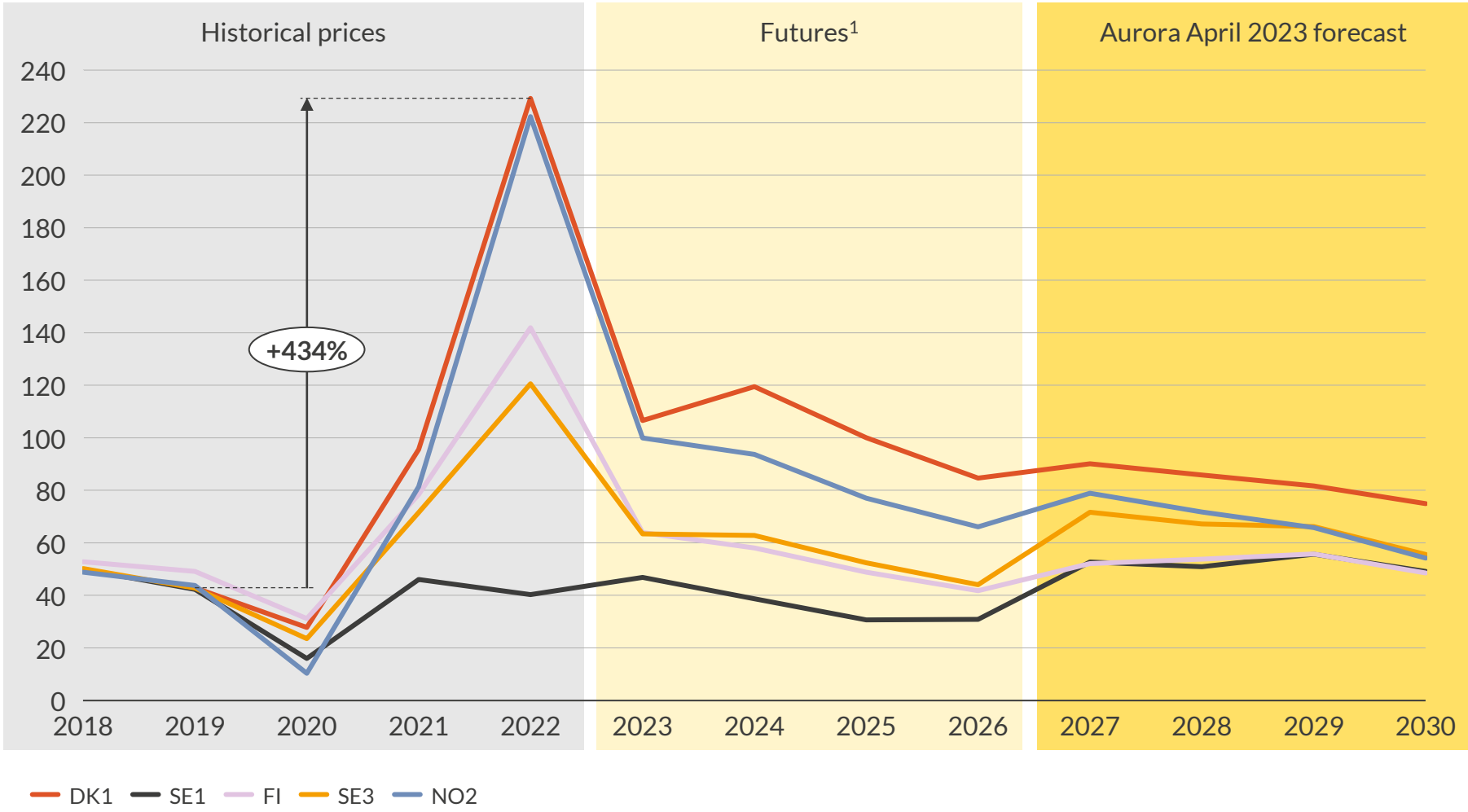
Source: Aurora Energy Research

Comment

- The Nordics are, along with Spain and the UK, one of the most mature PPA markets in Europe.
- The European PPA markets for both wind and solar have grown rapidly in recent years, Nordic onshore wind PPAs being one of the biggest drivers.
- Solar and offshore wind PPAs have so far concentrated in other regions, but there is growth potential for these technologies in the Nordics.

In the Nordics, record high power prices in 2022 and low liquidity of power futures increased hedging needs, hence demand for PPAs

Wholesale power prices
€/MWh (real 2022)



1) As of 10 May 2023. Values for 2023 are a blend of historical and futures prices.

Source: Aurora Energy Research, Nasdaq

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Comments

- In 2022, following the Russian invasion of Ukraine, power prices in most of the Nordics rose to new heights.
- The power prices of the southern price zones peaked in 2022 at prices 3–5 times higher relative to pre-2020 levels.
- High power prices increase the short-term hedging demand of corporates and utilities.
- Interest in PPAs as long-term hedging instruments has therefore been increasing over the past year.
- The futures market liquidity decreased substantially in 2022 with traded volumes declining by half relative to the year before, further contributing to the increased PPA hedging demand.

Aurora's PPA valuations mimic a utility's hedging strategy and key elements are varied stochastically to provide a robust market benchmark

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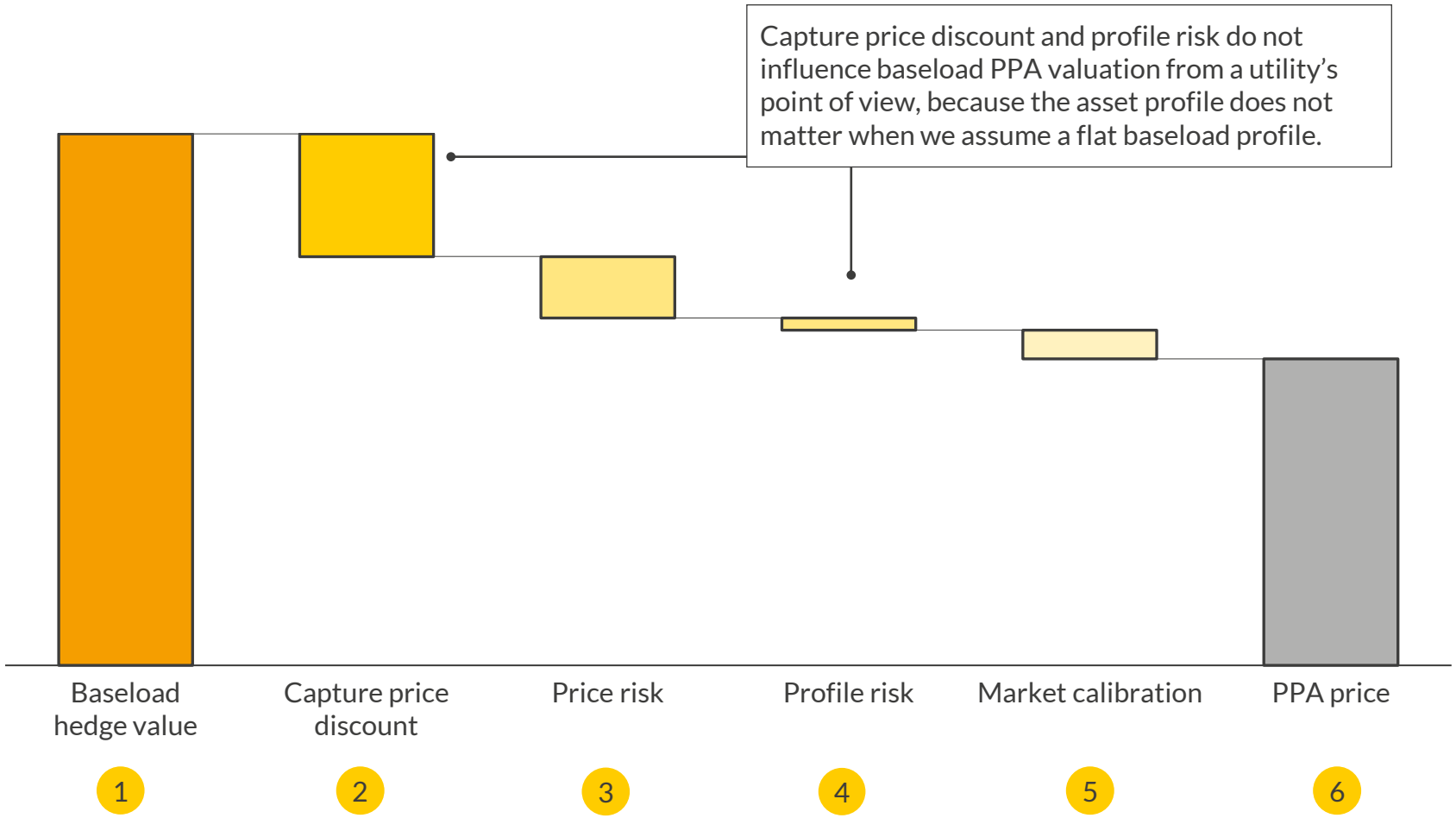
Key elements of Aurora's PPA price methodology

Source: Aurora Energy Research

Starting point of the PPA valuation is the value of the baseload hedge, adjusted by different risk and cost components

PPA price calculation: waterfall components
€/MWh



Source: Aurora Energy Research

Comments

1. Expected revenues from selling/ buying baseload futures following stack and roll strategy, incl. rolling losses
2. Difference in value of asset-specific generation profile vs. baseload profile
3. Risk discount reflecting uncertainty in baseload price realisation. Offtakers choose confidence level P(X) > 50
4. Risk discount reflecting uncertainty in realised production and capture prices
5. Risk discount reflecting other risk factors not explicitly priced into risk factors above, calibrated with market price quotes
6. PPA price result

note: balancing costs and Guarantees of Origin value may be added dependent on contract specifications

Pay-as-produced PPA for onshore wind is valued at 33-39 €/MWh in SE2 and Finland; solar in DK1 at 75 €/MWh

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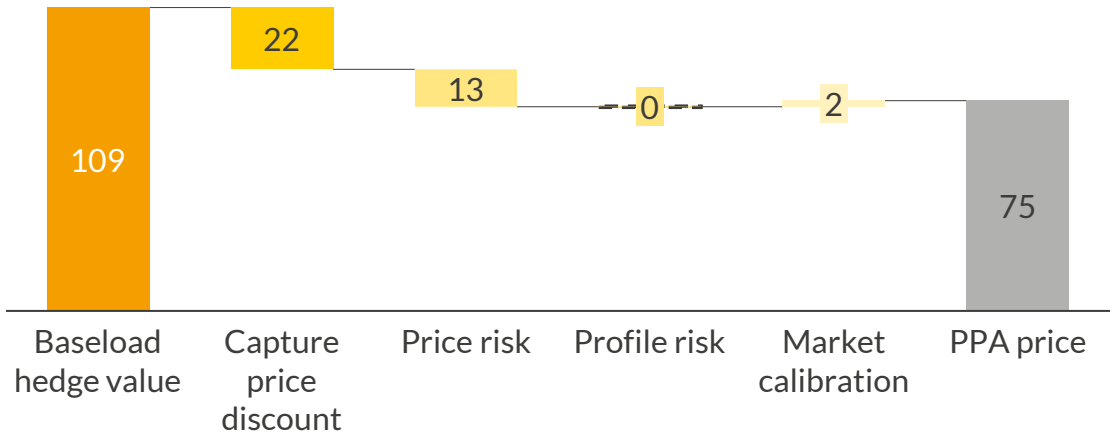
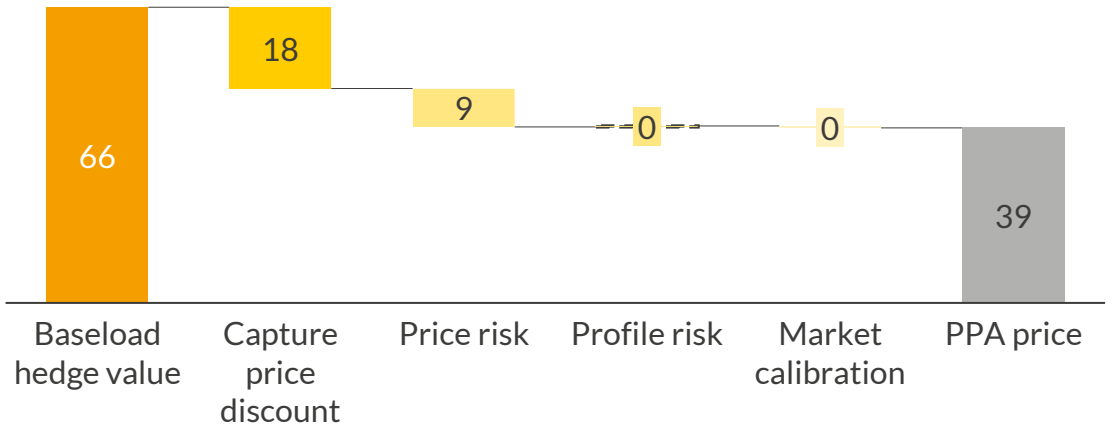
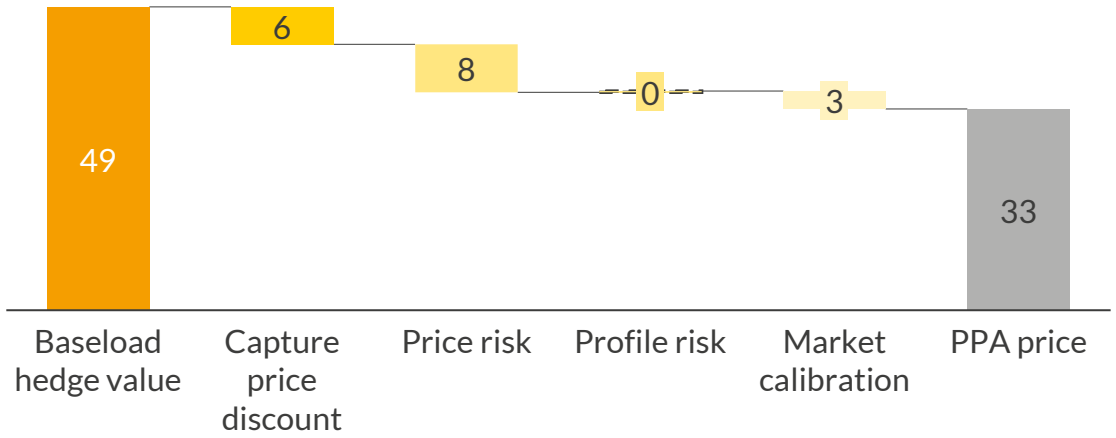
10-year solar pay-as-produced PPA in DK1 starting in 2024
€/MWh, nominal



10-year onshore wind pay-as-produced PPA in Finland starting in 2024
€/MWh, nominal



10-year onshore wind pay-as-produced PPA in SE2 starting in 2024
€/MWh, nominal



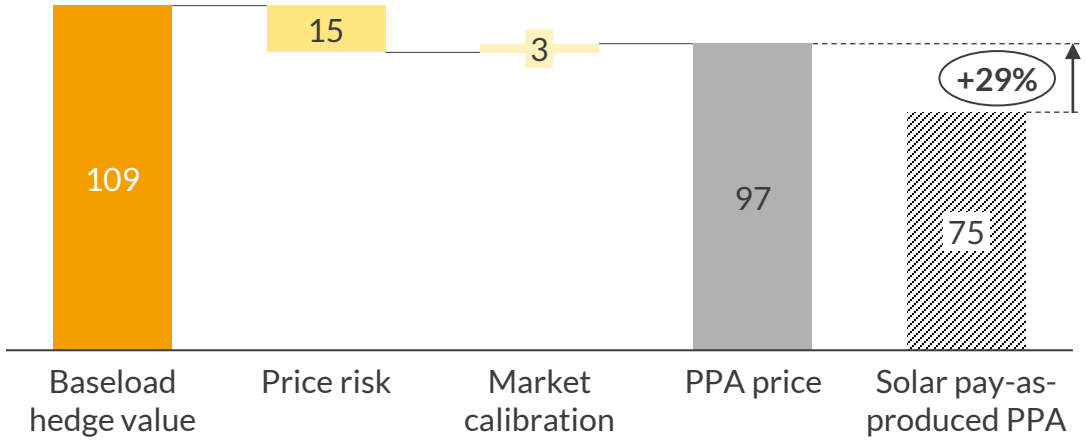
Comments

- The largest factors driving the price of a pay-as-produced PPA are baseload prices and the capture rate of the contracted technology.
- Price risk reduces the value further but is dependent on the baseload hedge value, which is higher in DK1 than in SE2 and Finland, resulting in a higher price risk in DK1.
- Capture price discount is driven by both the price level and the capture rate of the given technology; Danish solar is highly cannibalized in a high-price environment, while wind in SE2 is moderately cannibalized in a low-price environment.
- Profile risk has only a limited impact because of low average deviation in weather years.

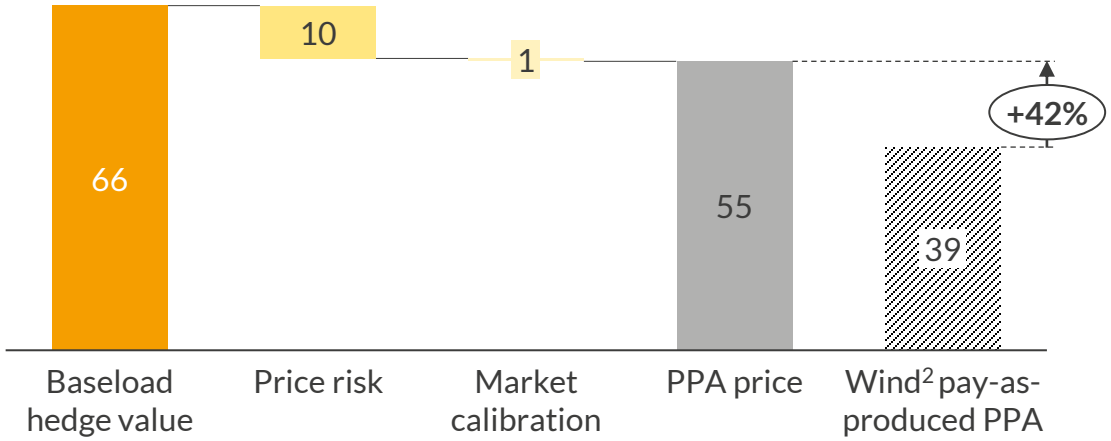
Sources : Aurora Energy Research

Baseload PPAs for are valued at 38-97 €/MWh in the focus regions, with the valuation in DK1 much higher than in the other regions

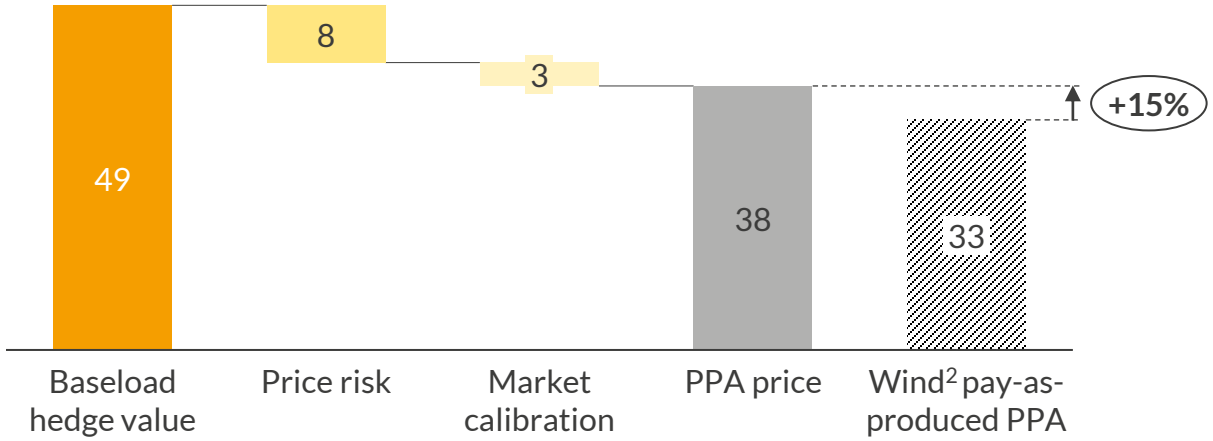
10-year baseload[1] PPA in DK1 starting in 2024
€/MWh, nominal



10-year baseload[1] PPA in PPA in Finland starting in 2024
€/MWh, nominal



10-year baseload[1] PPA in SE2 starting in 2024
€/MWh, nominal



Comments

- In our pricing method, the technology does not impact baseload PPA valuation because regardless of the asset profile, the offtaker gets the same flat baseload profile.
- For a baseload PPA, the value of the baseload hedge and the associated price risk largely determine the value of a PPA from an offtaker's perspective.
- The discount of a pay-as-produced onshore wind PPA to a baseload PPA is larger in Finland than in SE2 because of higher capture price discount in Finland.

1) We assume a flat baseload profile over the year. 2) Onshore wind.

Sources: Aurora Energy Research

We offer tailored PPA advisory support ranging from end-to-end transaction support to strategic advisory

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1 Decarbonisation, power procurement and PPA strategy	▪ Strategic assessment of options on corporate decarbonisation and scope 2 emissions reduction pathways, including PPAs, direct renewable investments ▪ Supporting utilities and corporates defining European PPA strategy and implementation plan
2 PPA tendering and market outreach support	▪ End-to-end PPA advisory, including preparation of tender documents and teasers ▪ Organisation of tenders or participation in tenders or direct market approach ▪ Assessment of offers and short listing
3 Commercial negotiation support and risk assessment	▪ Advisory support in the context of PPA negotiation, including Fair Value PPA pricing, and additional cost components (balancing costs, Guarantees of Origin) ▪ Assessment and mitigation of commercial PPA risks
4 PPA Valuation	▪ PPA transactions: Evaluation of offers and pricing proposals ▪ Portfolio strategies: Assessment of combination of different renewable production profiles, combined pricing and risk assessment ▪ Re-evaluation of PPA contract values (e.g. for accounting purposed)

We are supporting different client groups:

Utilities

- Strategic support for utilities on their European PPA, portfolio and hedging strategies
- Main contact points: Strategy, Analytics, Trading and Origination

Renewable Developers

- PPA pricing and commercial risk assessments
- Portfolio strategies
- PPA tendering and negotiation support

Corporates / Industrial offtakers

- Strategic advice on decarbonisation pathways (early-stage support)
- End-to-end PPA transaction advisory
- Re-evaluation and negotiation of PPAs

Banks / Lenders

- PPA pricing and commercial risk assessments (debt financing)

Nordics Power and Renewables Markets Service:

Dive into key market analysis and forecasts for the Nordics power and renewables markets

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Full Power and Renewables
Subscription Analytics Service

Forecast Reports & Data

Bi-annual forecast reports with quarterly data updates

- **Forecast data of** wholesale and capture prices to **2060** with annual, monthly and quarterly granularity
- Data under **Central Low** and **High scenarios** for all **12 price areas** in Denmark, Finland, Norway and Sweden
- **Quarterly updates** to reflect near term commodity price changes
- **Capacity development**, generation mix, interconnector capacity, capacity buildout, exports
- Capture prices by price area for **onshore wind & offshore wind & solar PV –** also for **floating offshore**
- **Policy & technology outlook**
- **Projection of imbalance costs and price for Guarantees of Origin**
- **EU-ETS carbon price forecasts**
- All forecast data easily downloadable in Excel format and available as interactive dashboards on our EOS platform

Strategic Insights

3 Strategic Insight Reports

Three in-depth thematic reports on topical issues

Policy Updates

Timely research notes on recent changes to policy and regulation, demonstrating the impacts and opportunities for market participants

3 Group Meetings

Three Group Meeting roundtable events with key market participants such as developers, investors, financiers, utilities, grid operators, government

Analyst Support

Bi-annual workshops and support from our bank of analysts, including native speakers and on-the-ground experts


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