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Investor Confidence in Volatile Markets and Flexible Energy Systems

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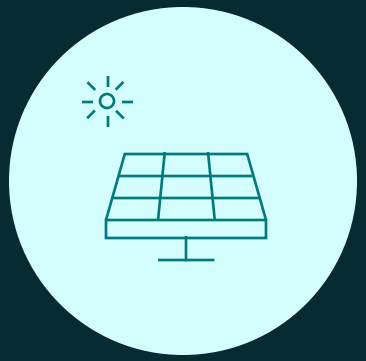
Agenda

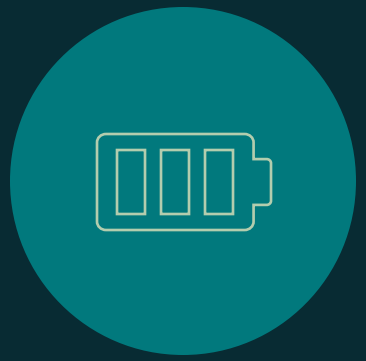
1	Introduction
2	Long-term price forecasting
3	Trend: Change of Power Systems and Price Volatility
4	Trend: Batteries
5	Trend: Hydrogen

Trends in in Electricity Supply until 2050



Expansion of renewable energy

Hydrogen



Batteries

Electric Mobility

Electrification

Demand side management

New nuclear plants

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Long-term price forecasting
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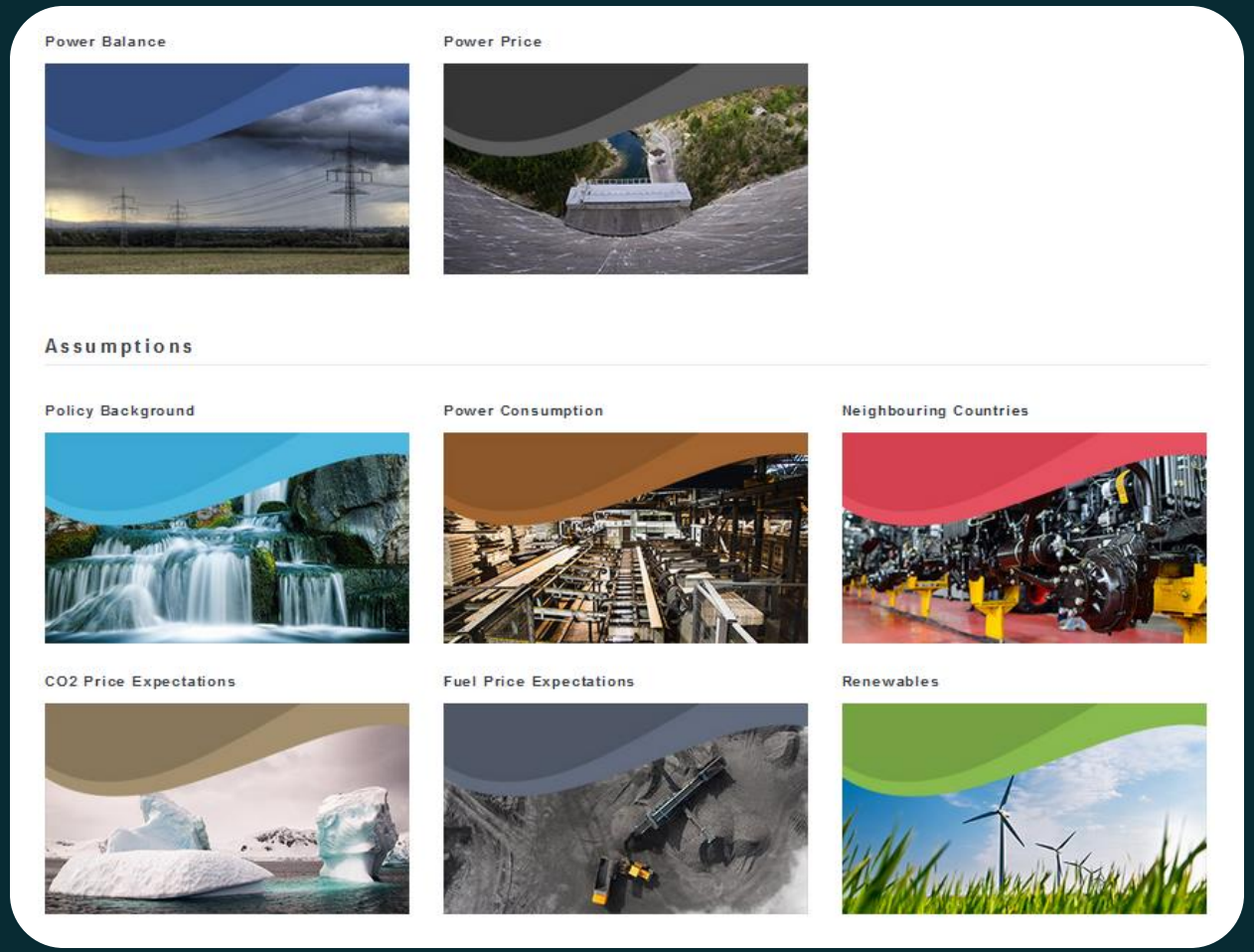
Why Long-term (price) forecasts

Long-term forecasts are intended to cover at least the next 20 years, preferably more. They are primarily used for investment calculations, but also for long-term planning for utilities or industry.



Long-term price forecast products

- Power balance development
- Power price forecast (Normal and 30 weather years)
- Data sets

Including underlying

- fundamental assumptions
- political assumptions
- Fuel price expectations
- CO2 price expectations

- Nordic Countries
- Germany
- France
- Netherlands and Belgium
- Austria and Switzerland
- Iberia
- UK

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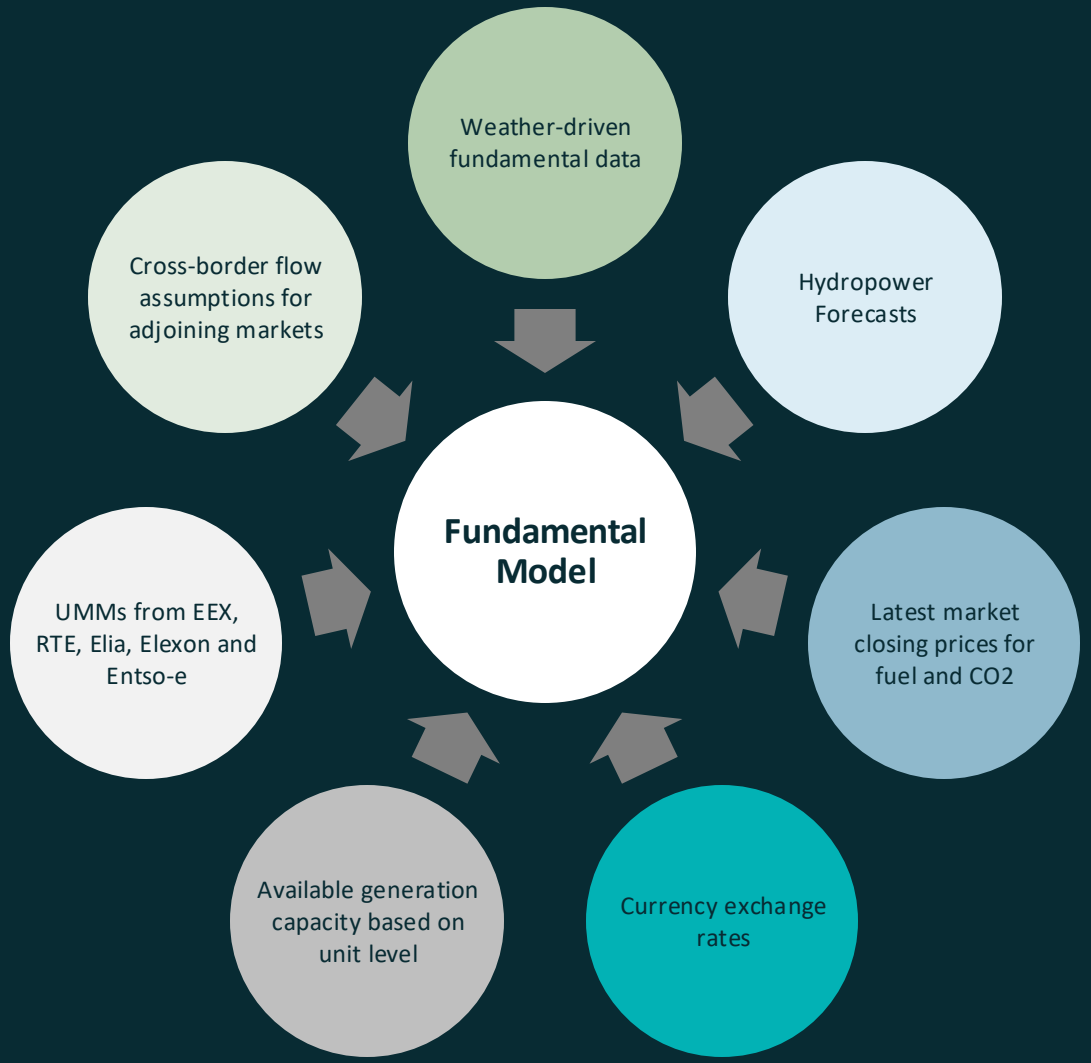
In-house Fundamental Model

- Our in-house fundamental model is a least-cost dispatch and unit commitment model for forecasting power generation, prices, and trade flows for up to 5 years forward and up to 2050 for long-term price forecasts

- It is much more scalable and maintainable than our previous solution and is specifically designed to expand on renewable integration, batteries, and demand-side management.

- We run simulations not only with normal weather but with 30 historic weather scenarios



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Trend: Change of Power Systems and Price Volatility

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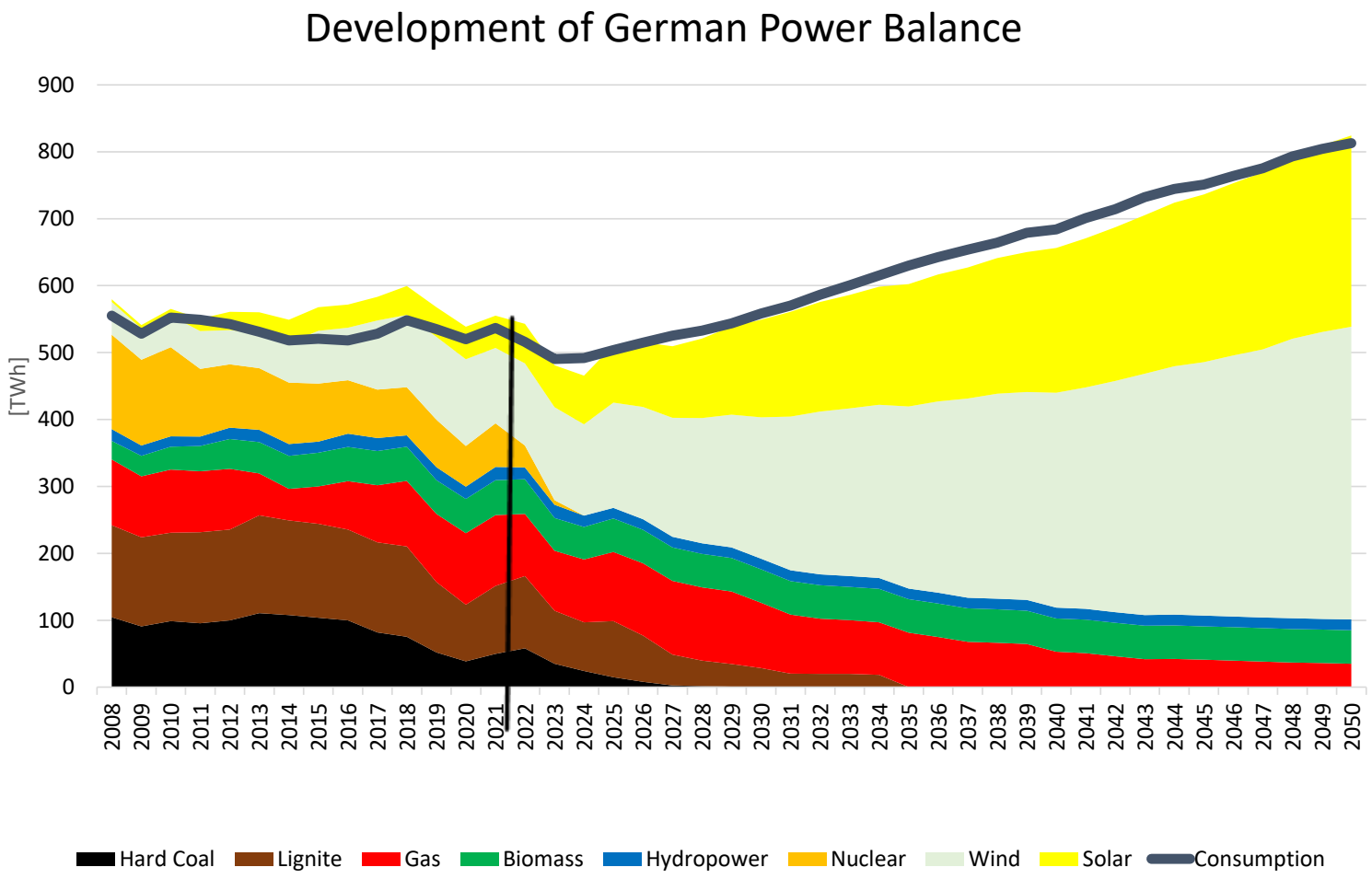
Change to a renewable driven power system



Source: Volue Insight LTP

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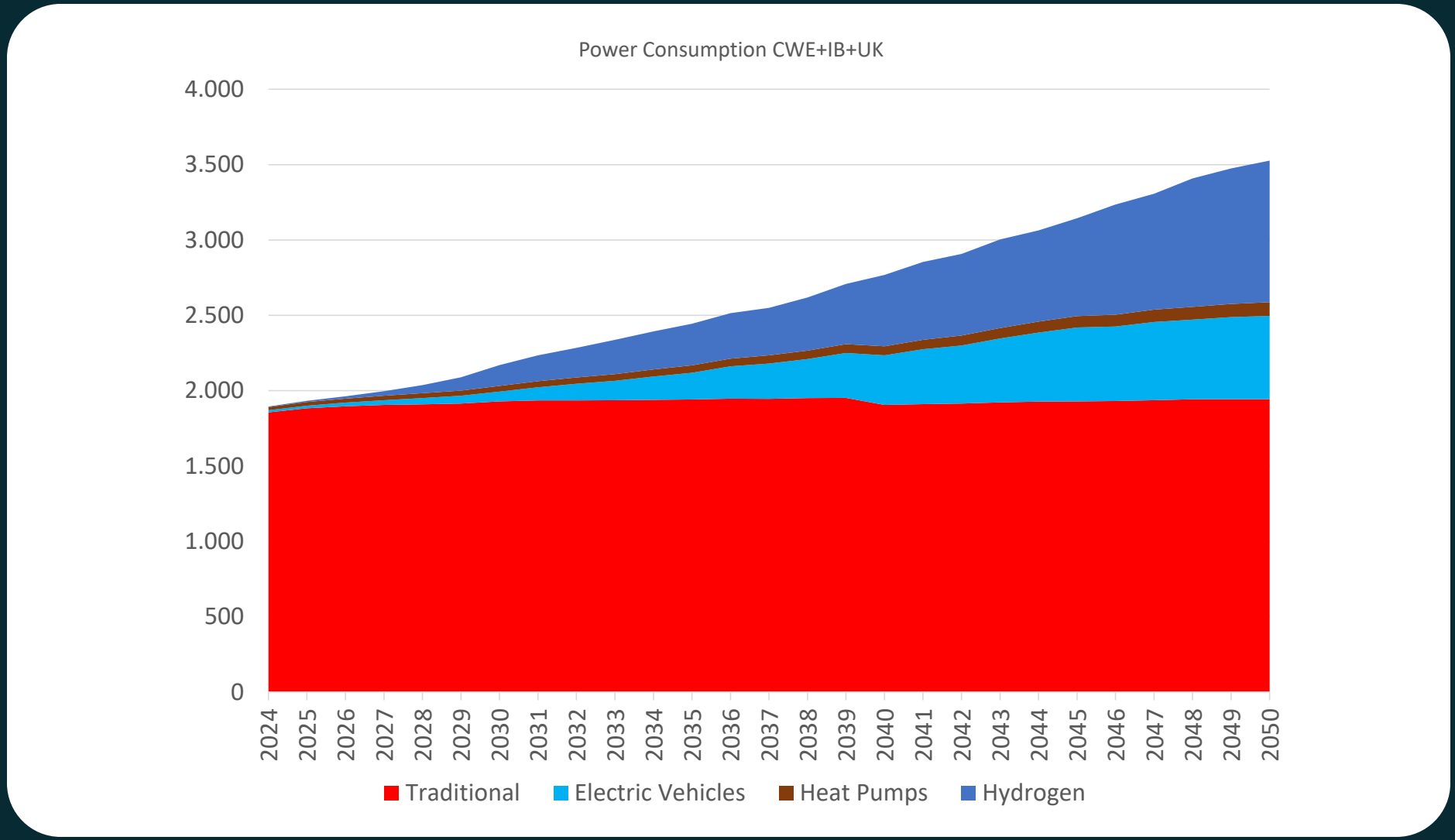
Structure of power consumption



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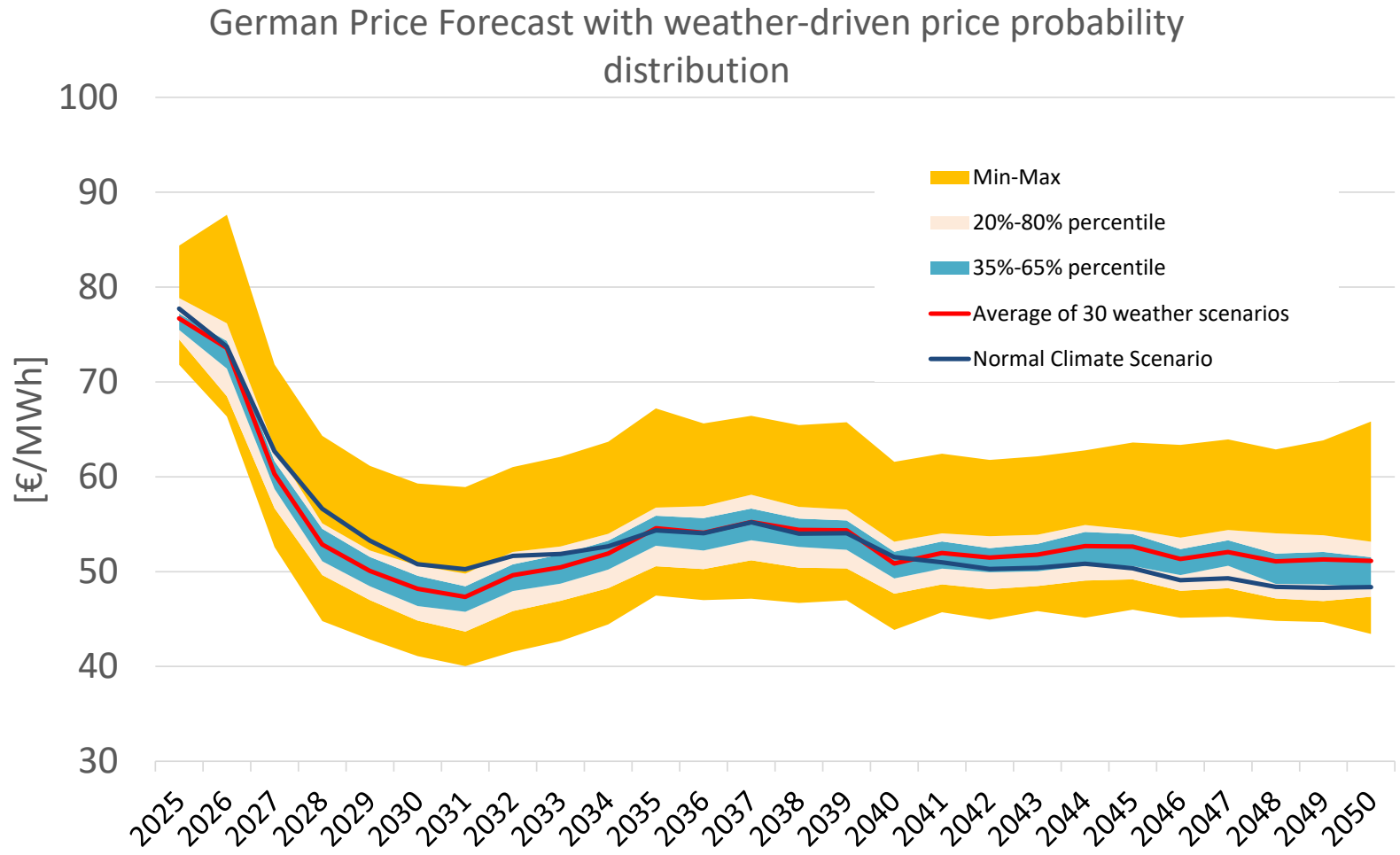
Weather-driven price distribution



Source: Volue Insight LTP

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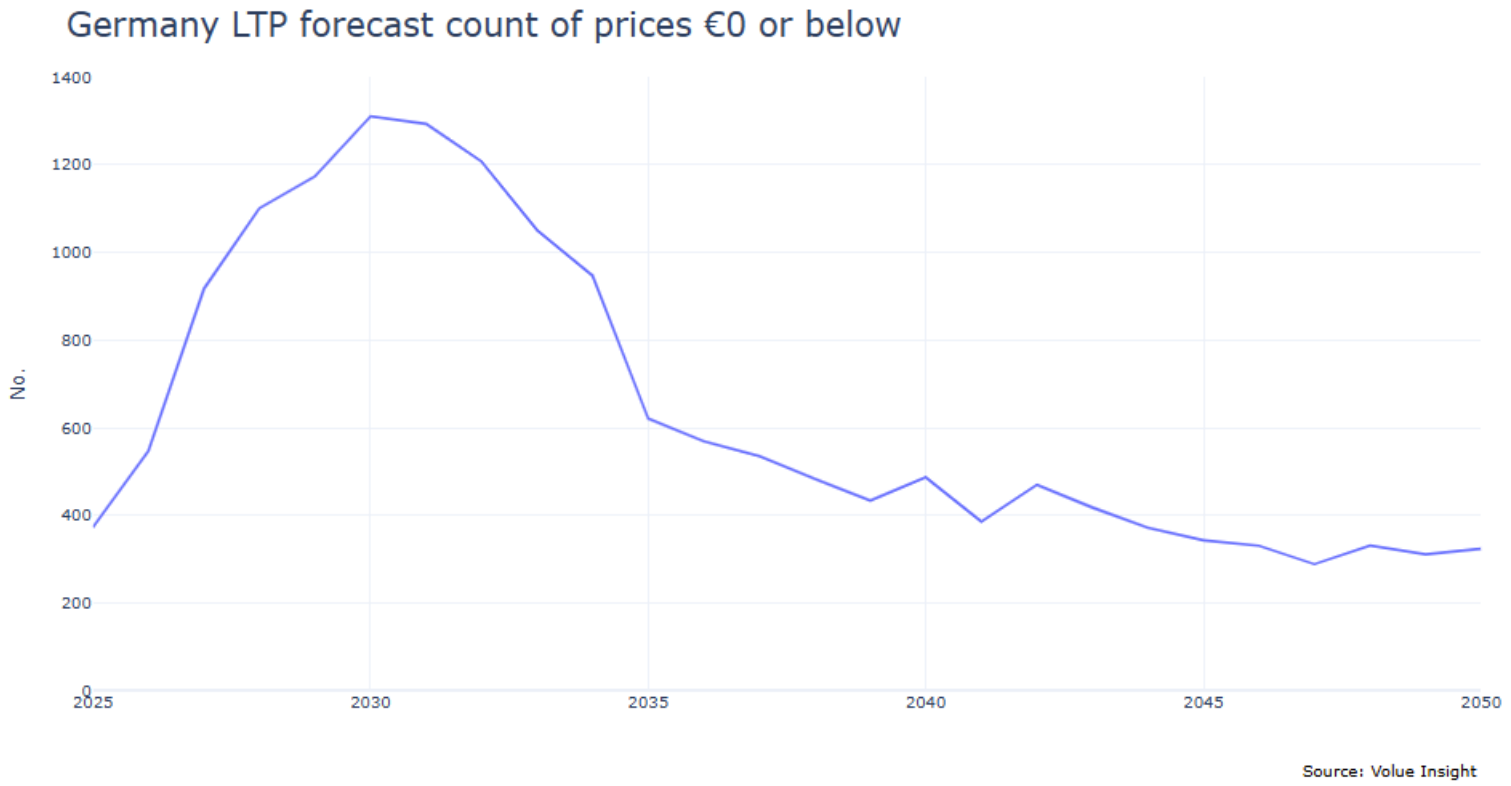
Why Long-term (price) forecasts



- Negative prices on a rising trend in the mid-term as renewable capacity grows faster than demand
- More electrolyser capacity reduces frequency of negative prices post-2030
- Significantly increased battery capacity assumptions decreased number of negative prices

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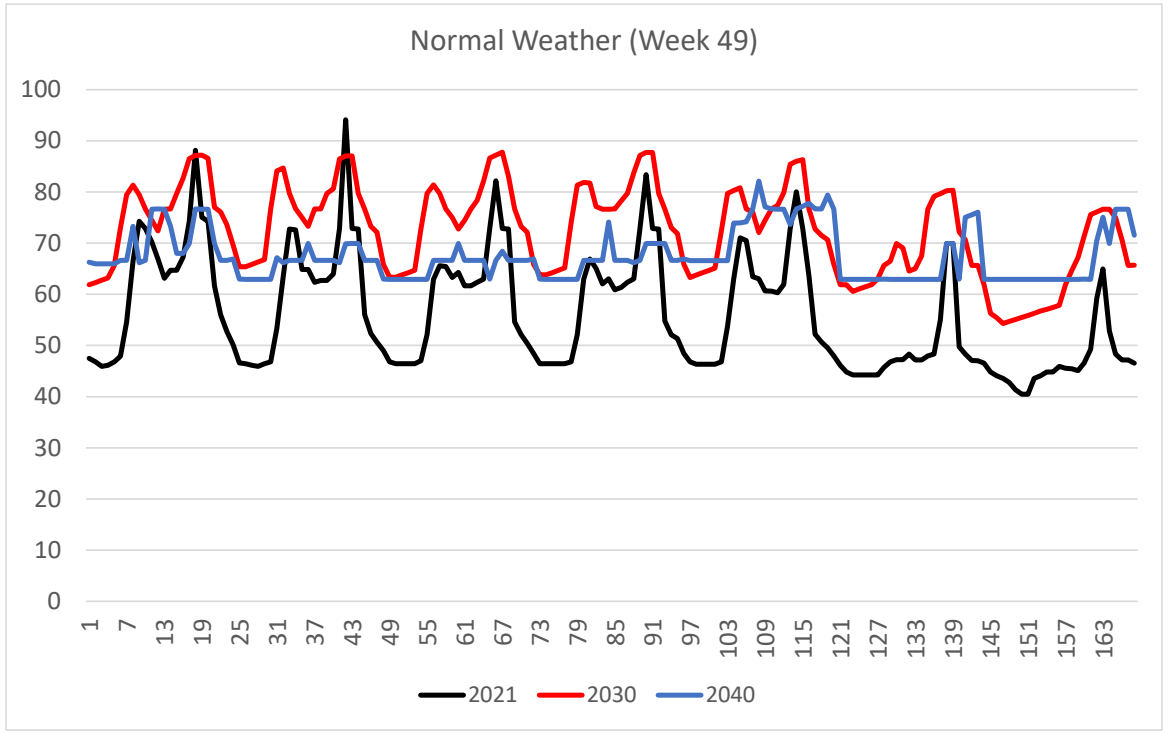
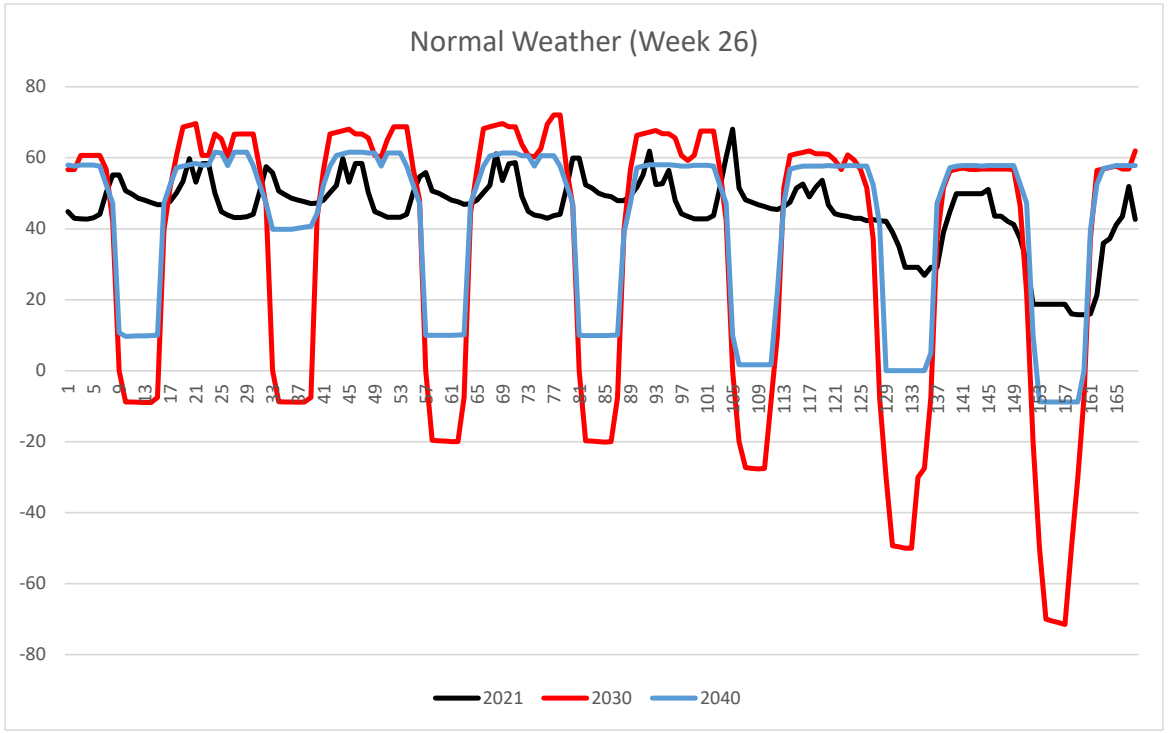
Changes in Price Profiles

Winter Week



Summer Week



Source: Volue Insight LTP

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Product: Capture Price Calculation

Investments need Profitability

- Strong expansion in renewables could lead to cannibalisation effects
- Stronger demand and storages could counteract this cannibalisation

As results of our simulations, we calculate the future capture prices of renewables

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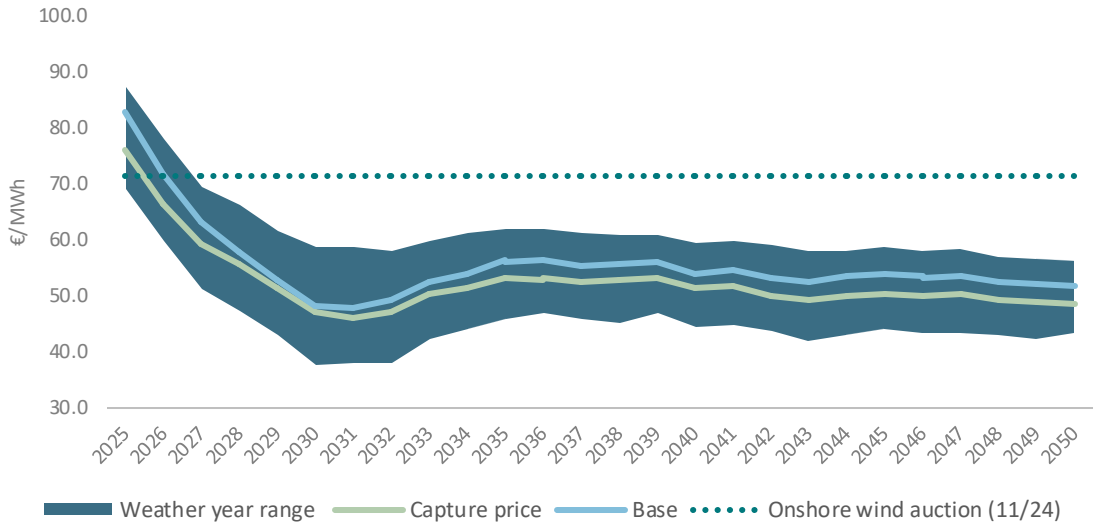
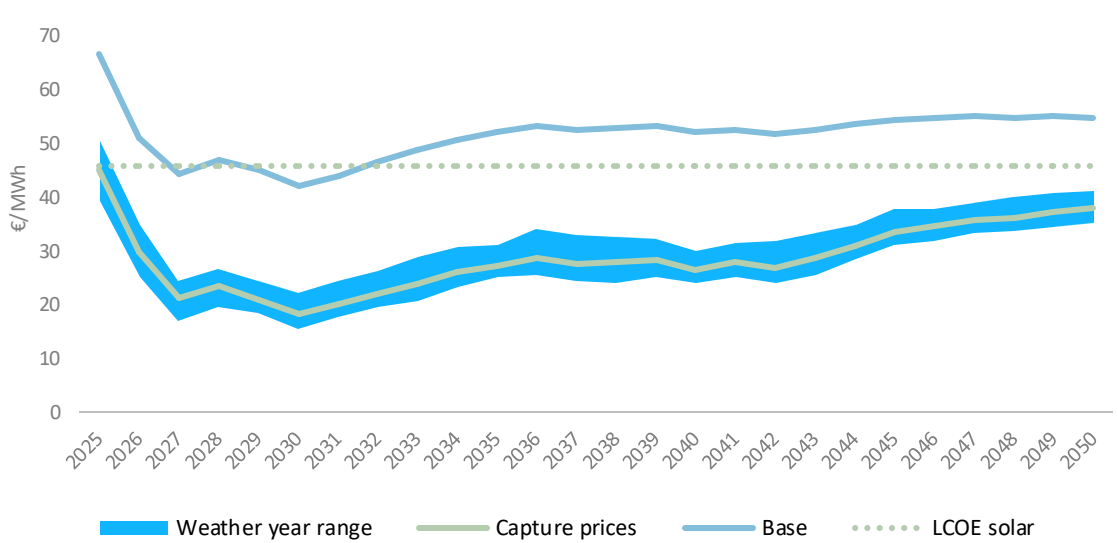
Capture prices in Germany and Spain





- Capture prices falling to their lowest point in the early 2030s
- Discount of capture prices compared to baseload price, also below the latest strike price in renewable auction (November 2024)
- Increasing interest in onshore wind sector, oversubscribed tenders

- Low capture prices highlight difficult investment environment for solar producers in Spain → less attractive
- Need innovative financing solutions such as flexible PPAs to counter price cannibalization effect
- Solar PV accounts for 27% of total generation by 2030 and 42% by 2050

Source: Volue Insight LTP

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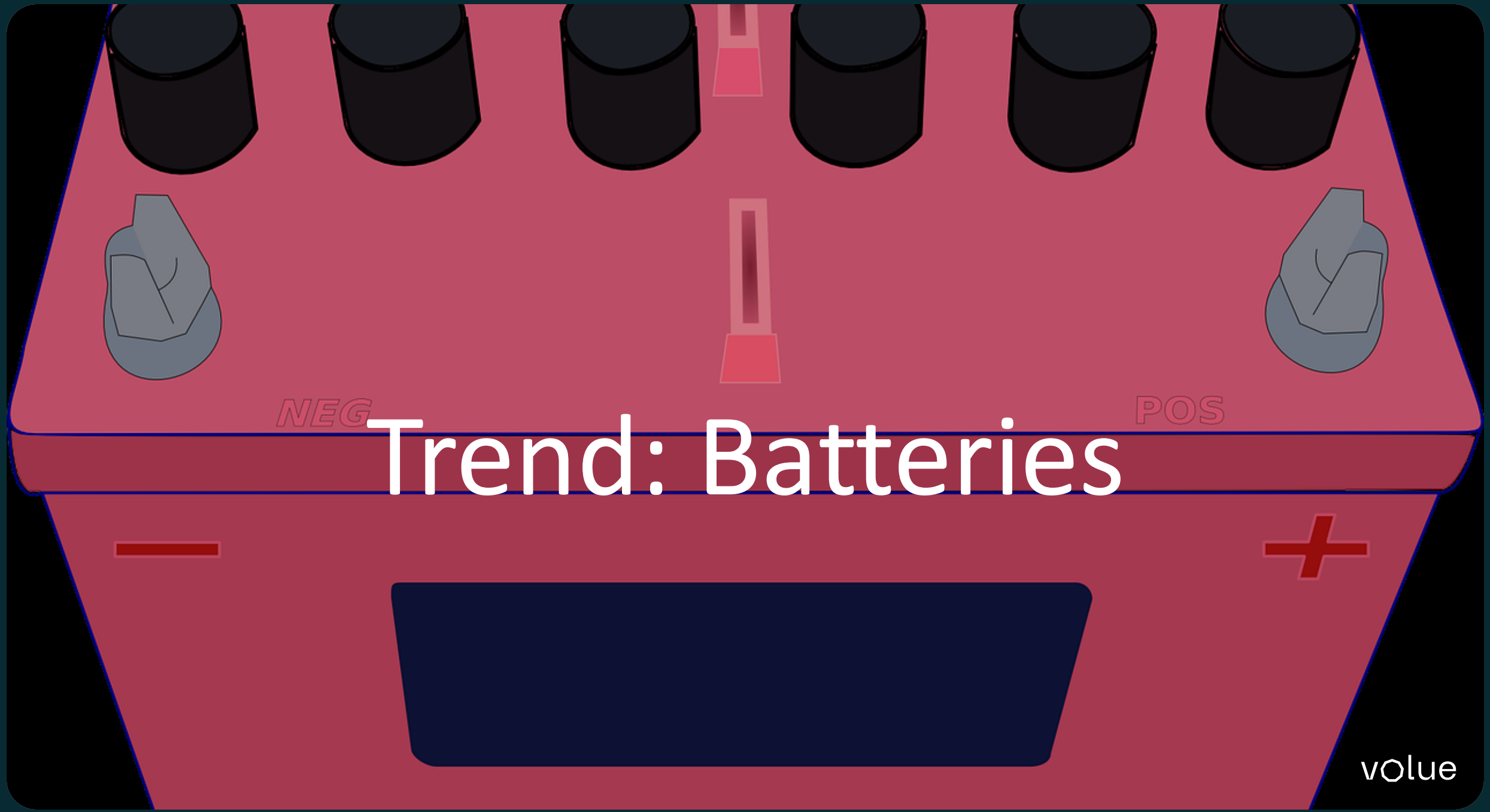

Trend: Batteries

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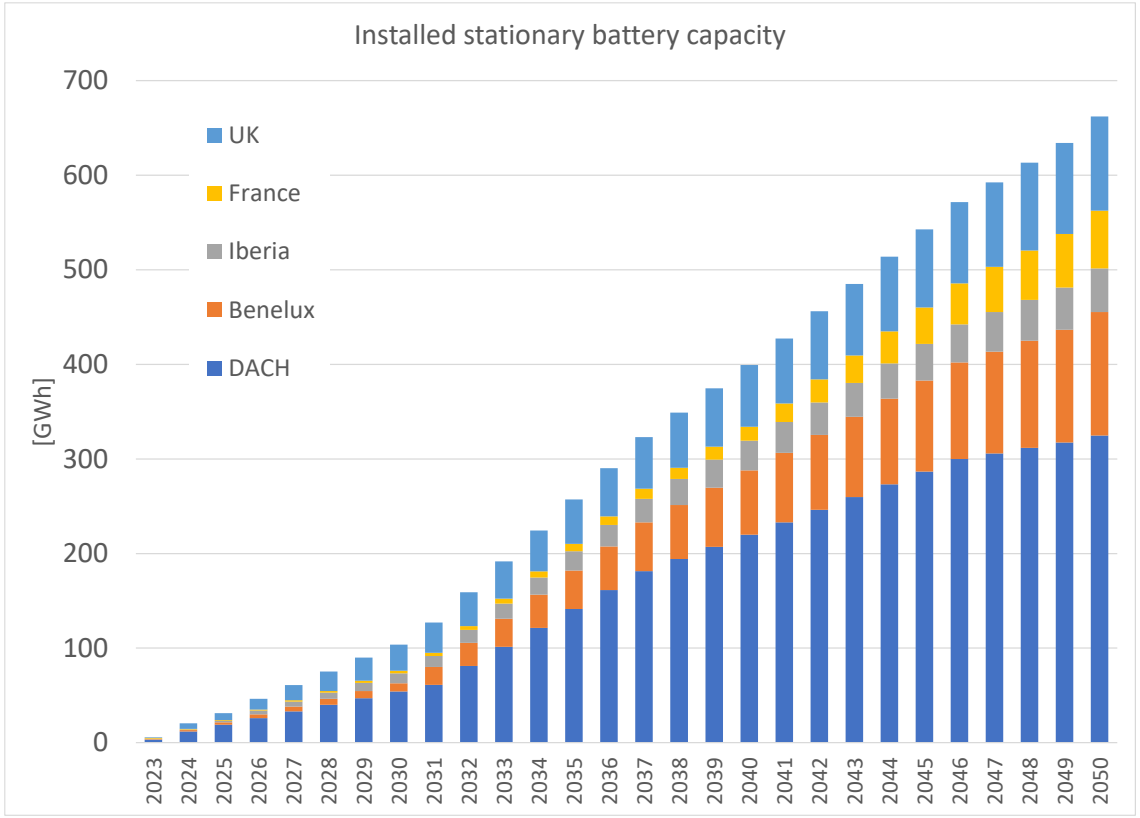
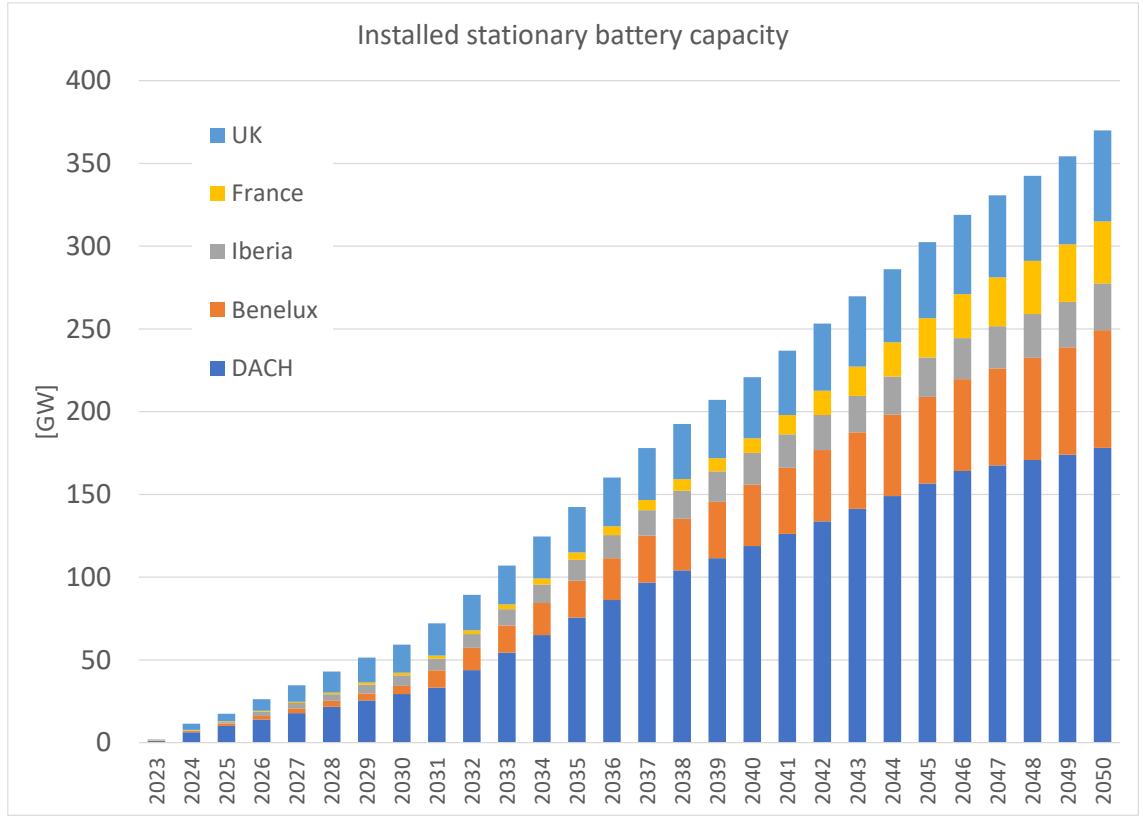
Battery Capacity (Energy+Power)





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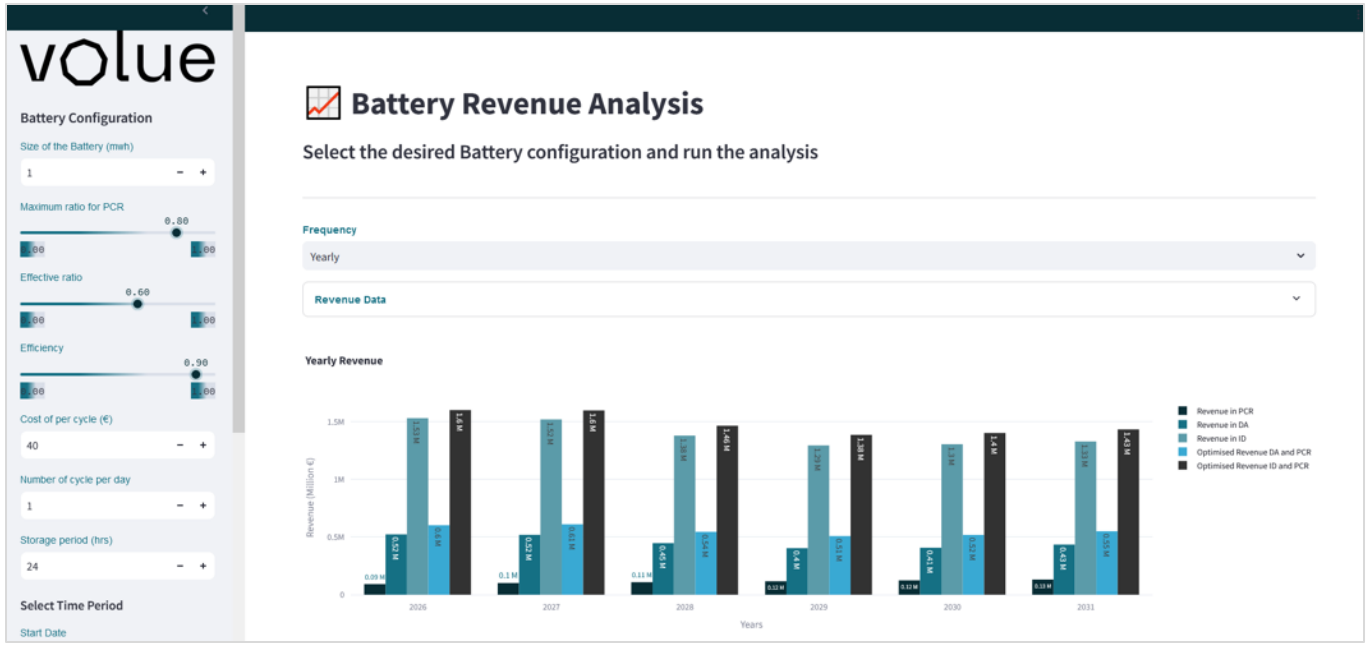
Investment calculation for batteries

Three main income sources for batteries:

1. Optimisation on day-ahead market – more and more batteries lead to cannibalisation effects
2. Offering flexibility as primary control reserve – saturated flexibility demand let prices decrease already
3. Permanent optimisation on intraday markets – this needs for investment calculation a forecast of future price distributions

Product in preparation:



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Trend: Hydrogen

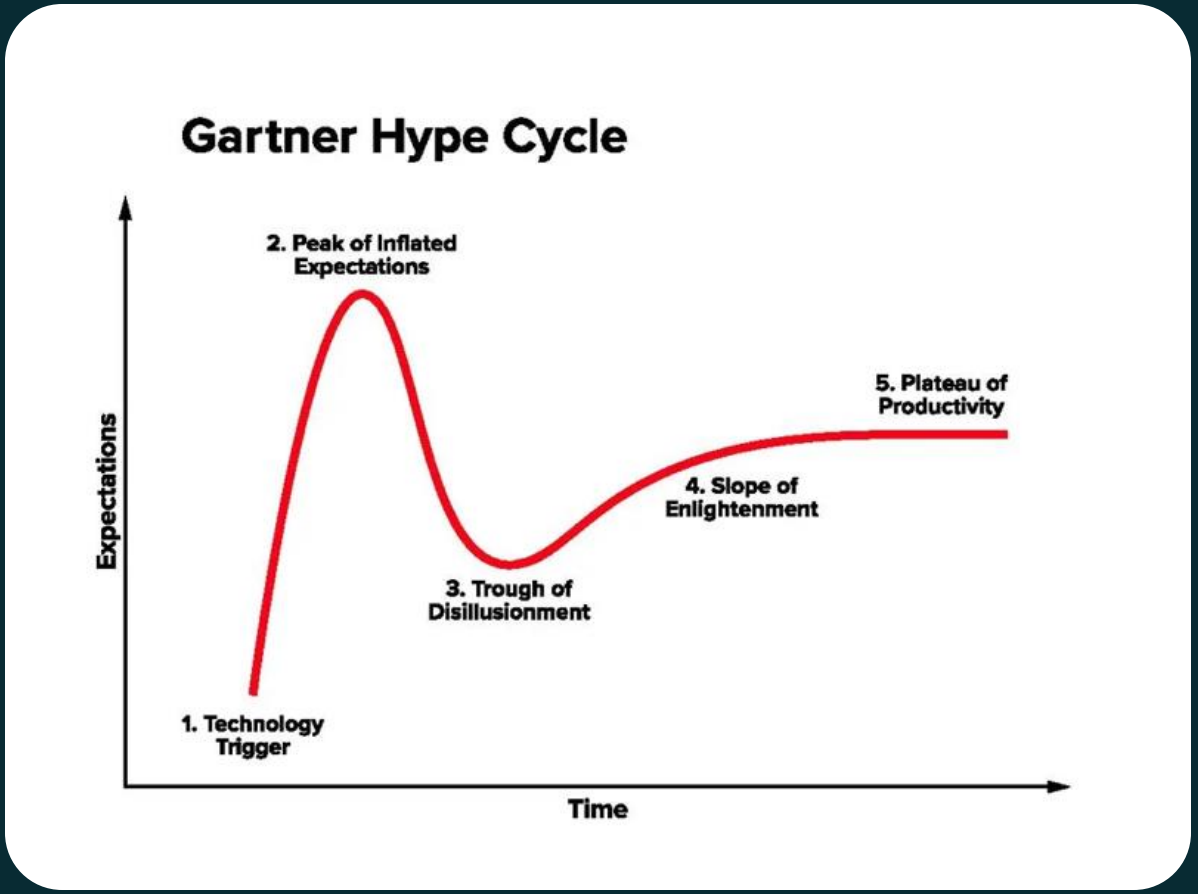
Hydrogen market analysis (under development)

EU Delegated act for hydrogen:

- Which countries could fullfil the 90%-criteria when?
- Which countries fullfil the carbon intensity criteria when?
- In how many hours per year are below 20 €/t or below 0,36 €/MWh (using different weather years) ?

What do we further investigate:

- Future green hydrogen production
- Future green hydrogen demand
- Other hydrogen colors to fill the gap
- Marginal costs and LCOH -Distributed for market prices and from subsidised renewables



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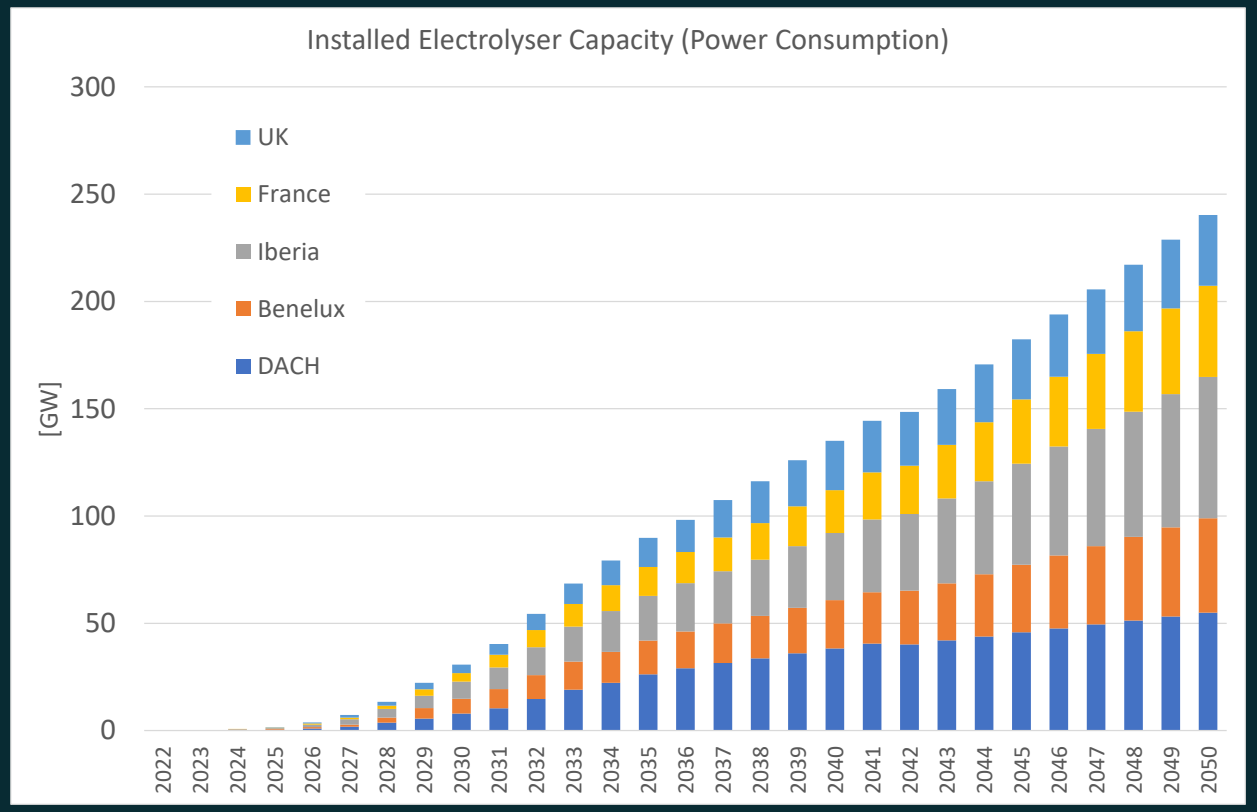
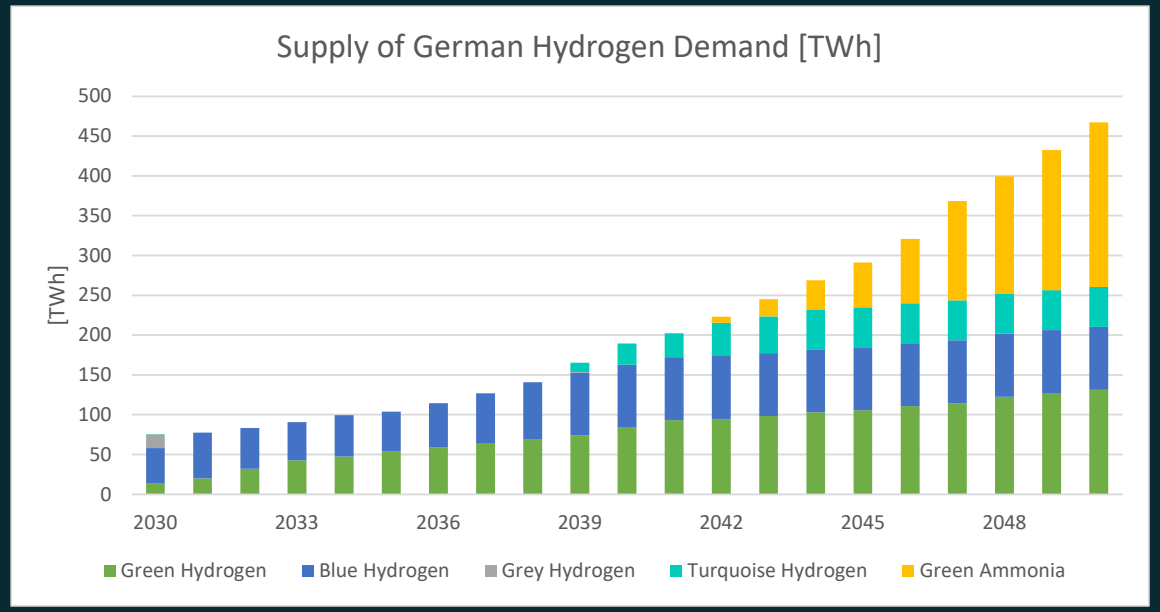
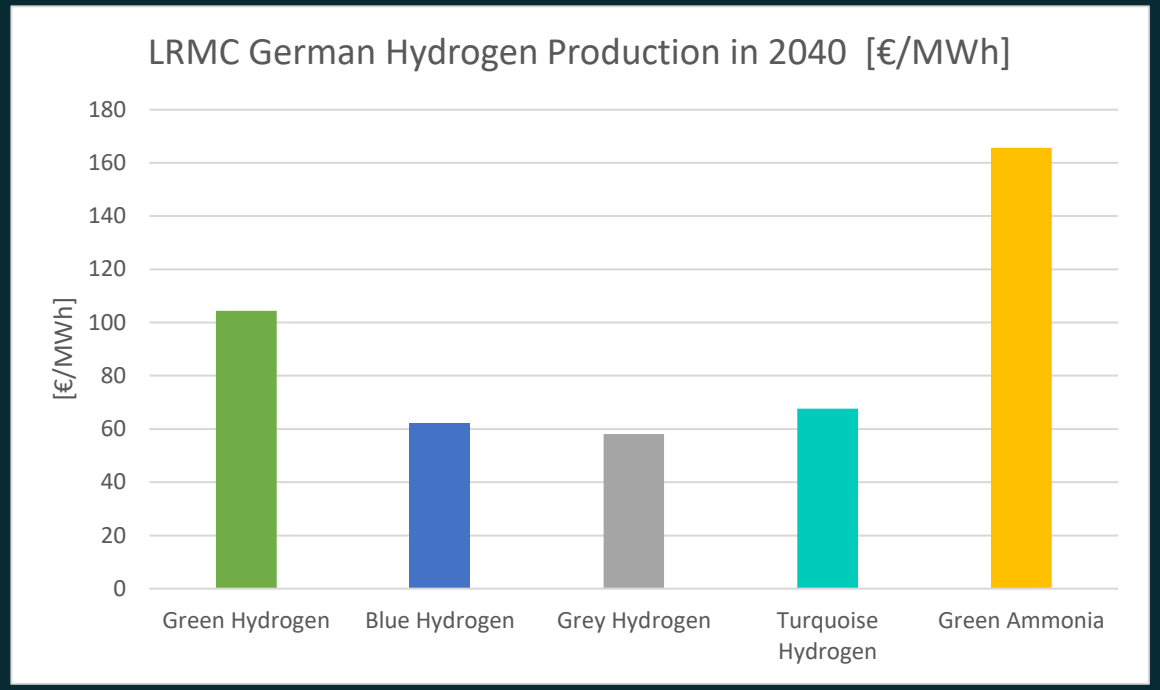
Hydrogen Supply







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Key Takeaways for Investors

- Renewables increase price volatility (now and the next years)
  The variability of wind and solar generation leads to stronger price fluctuations
- Batteries, electrolyzers, and flexible demand act as dampers (after 2030)
  These technologies mitigate volatility by balancing supply and demand, absorbing excess power or shifting consumption.
- Flexibility will become increasingly valuable — but quantifying remains a challenge (needs in-depth analysis)
  Accurate valuation methods are essential.
- Cannibalisation effects raise profitability hurdles (clever makes money)
  As more renewables enter the market, their marginal cost advantages erode price levels — calling for deeper market analysis and trading strategies.
- Complex synergies offer untapped value (clever makes money)
  Integrated systems (e.g., virtual power plants, co-located or PPA-linked assets, consumer coupling) can unlock efficiency and profit potentials.

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Thank you for your attention

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