EEX Group Workshop

Subsidy-free Renewables in Europe: Hedging of PPA Price Risks

27 June 2019

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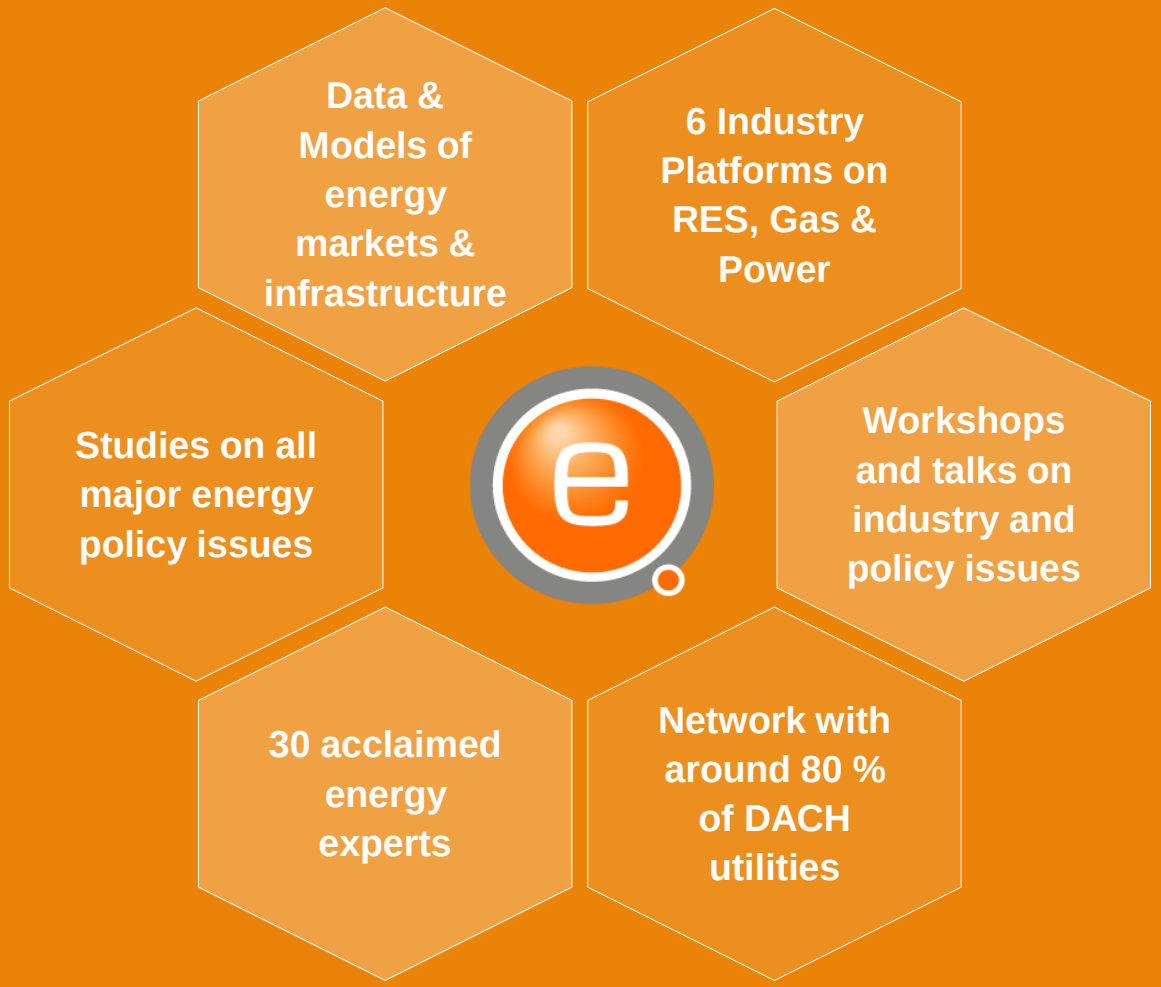
enervis – our services and products



enervis – power market services

enervis applies models, data and market experience to evaluate energy assets.

Long-term power price forecasts for:

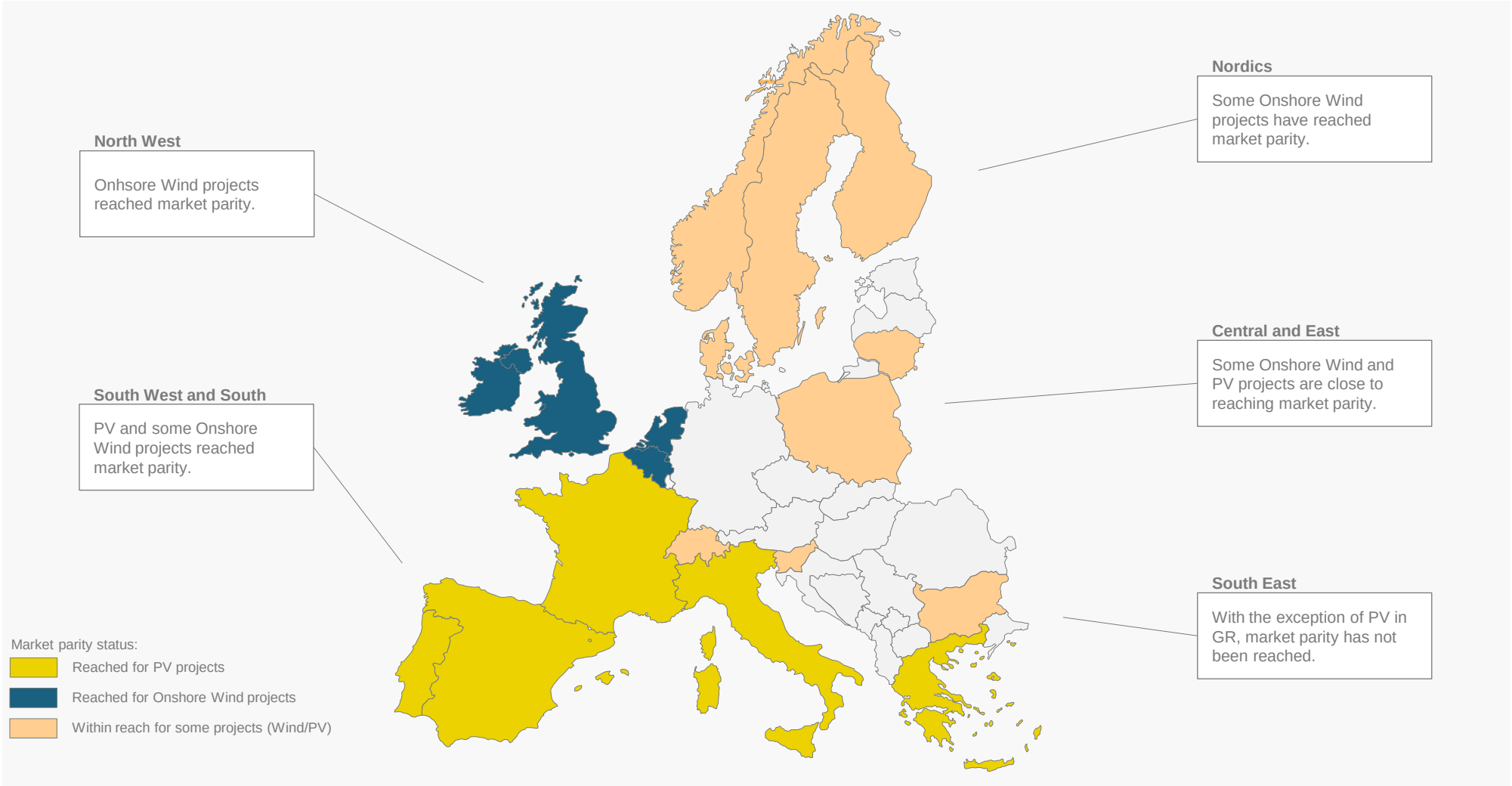
- PV and Wind
- Conventional Power Plants
- Combined Heat and Power
- Storage
- P2x Power-to-X

enervis products:

- European Power Market Outlook
- Market Value Atlas and Revenue Report
- PPA evaluation tool

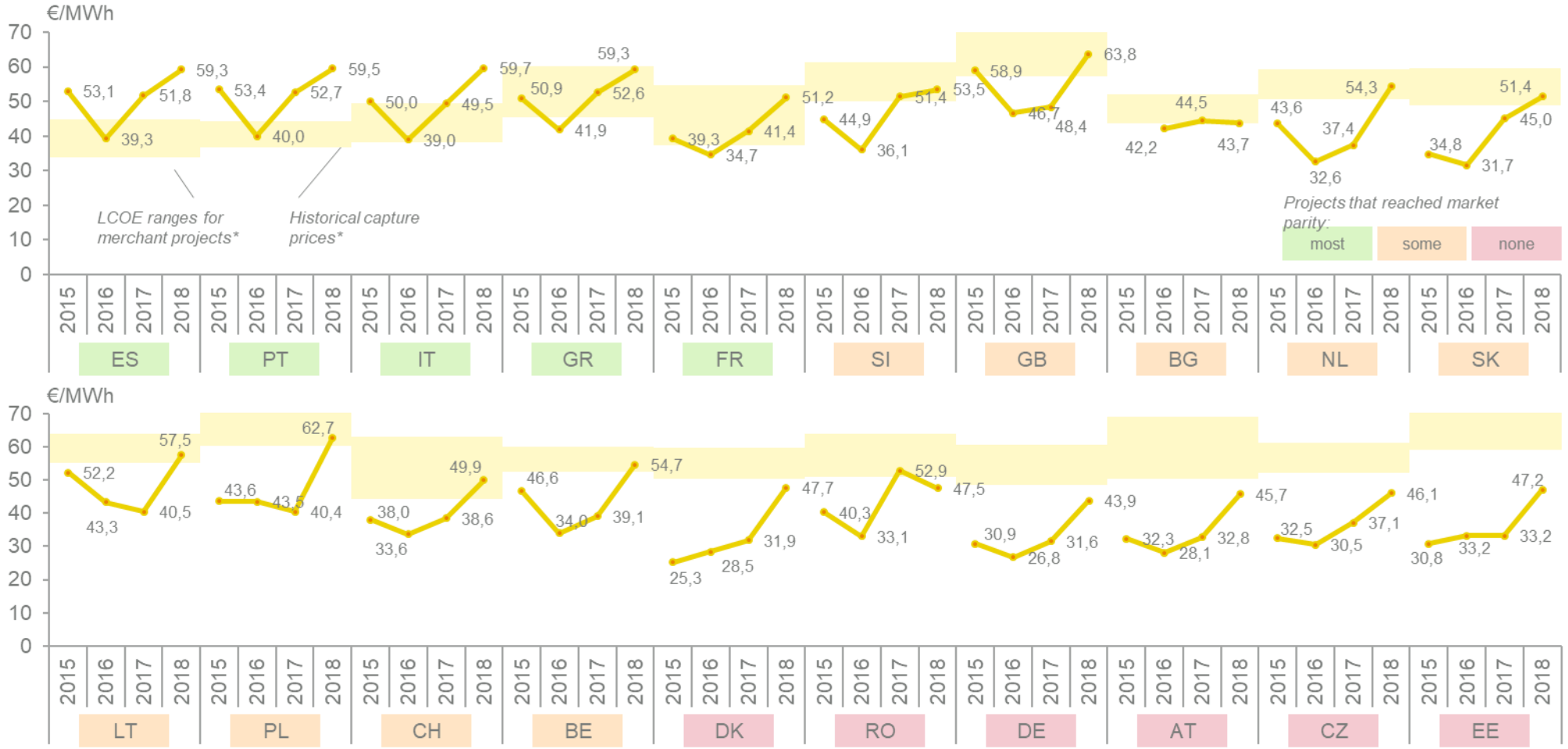
Status Quo: Market Parity of Renewables in 2018

PV reached market parity in Southern Europe and is close to in some more Central and Eastern countries.
Onshore Wind reached market parity in the North West and is close to in the Nordics and North Eastern countries.



Capture prices and LCOE of PV in Europe 2015 – 2018

Analysis of historical data and indicative LCOE ranges / Assumption of identical underlying technology for comparability of LCOE values

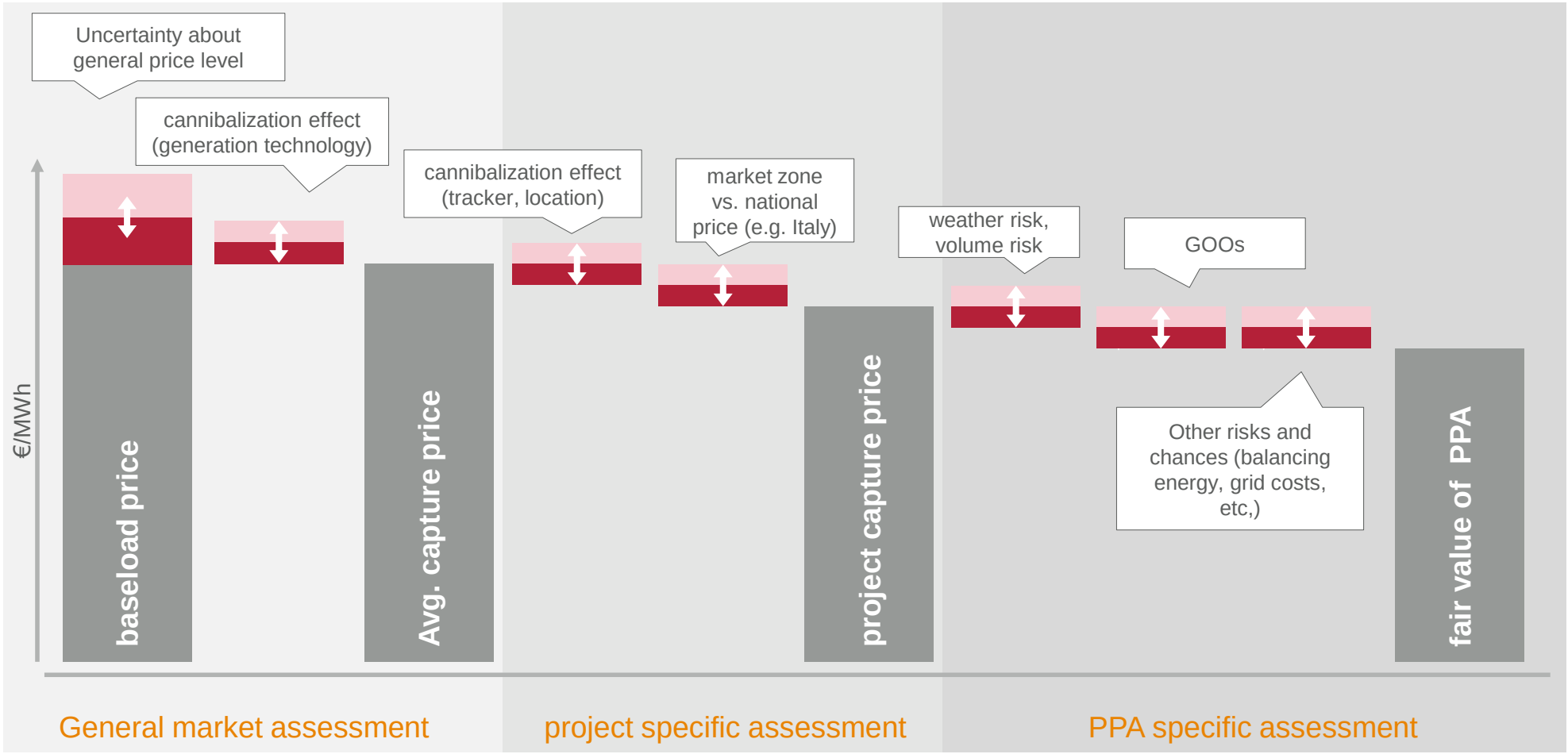


In a majority of European countries, historical capture prices of PV lie within reach of project LCOE, thus having reached market parity in some, notable southern, countries in 2018.

* Capture price values for countries split into price zones: weighted averages (zonal). LCOE ranges obtained based on examplary technology, country specific financing assumptions for merchant projects and high-resolution weather data.

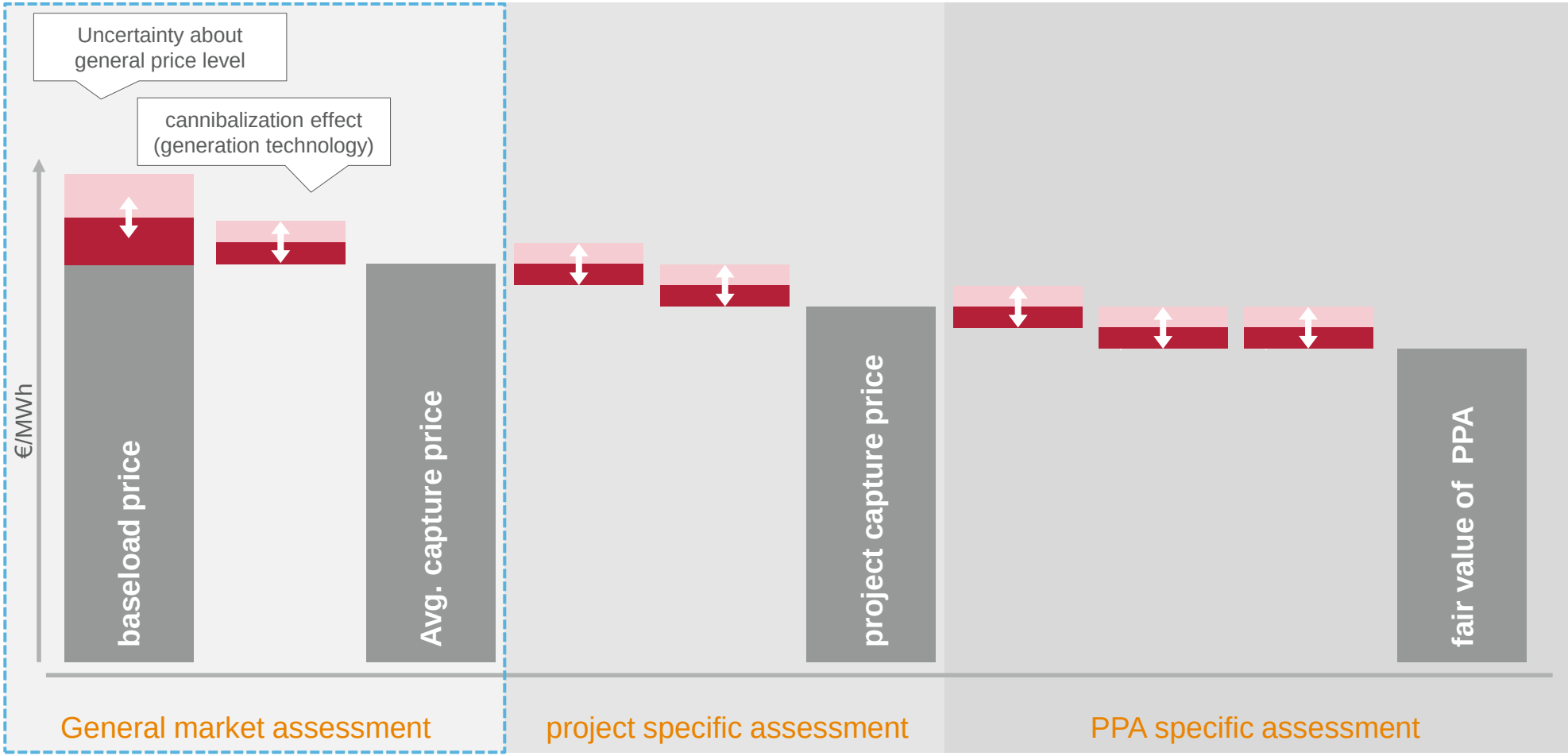
Revenue risks

Merchant chances and risks associated with the investment in a renewable energy project



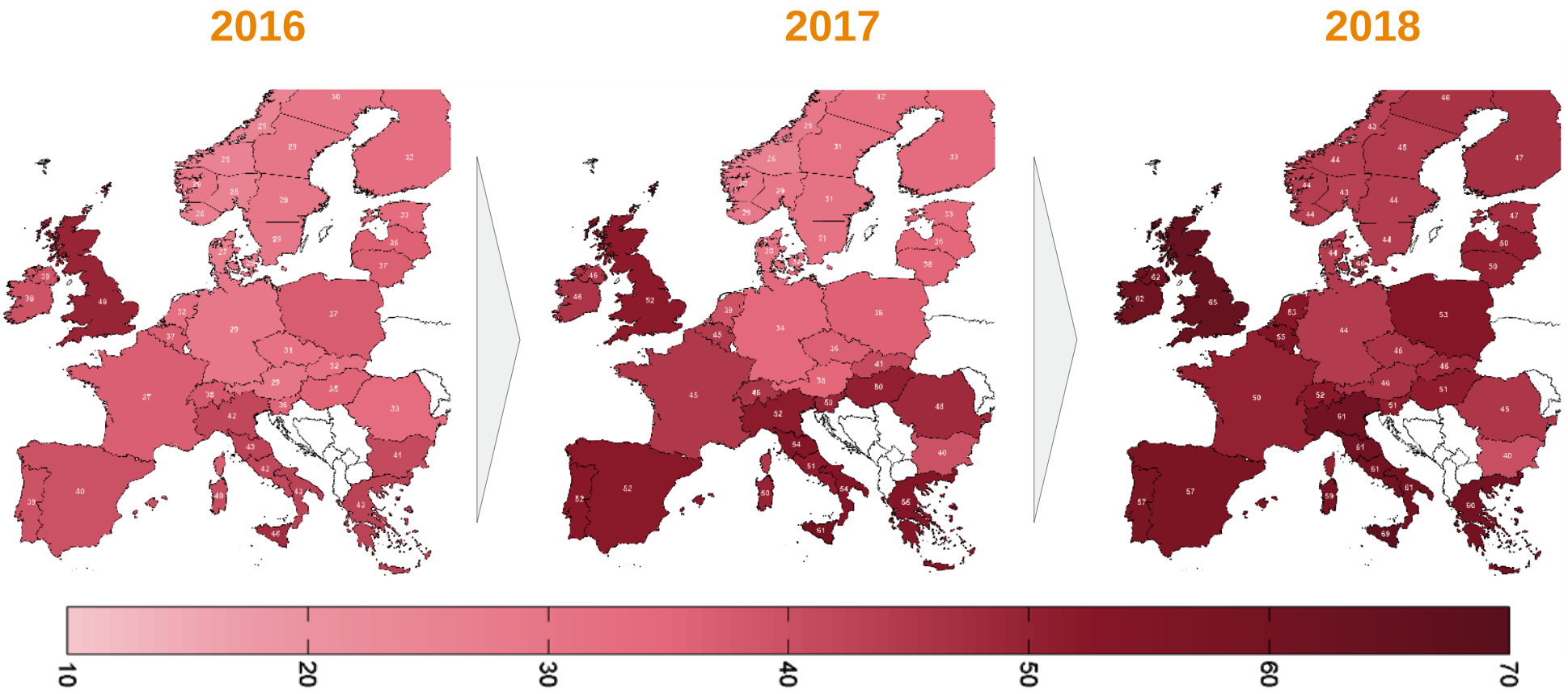
Revenue risks

Merchant chances and risks associated with the investment in a renewable energy project



Development of European Wholesale Power Prices

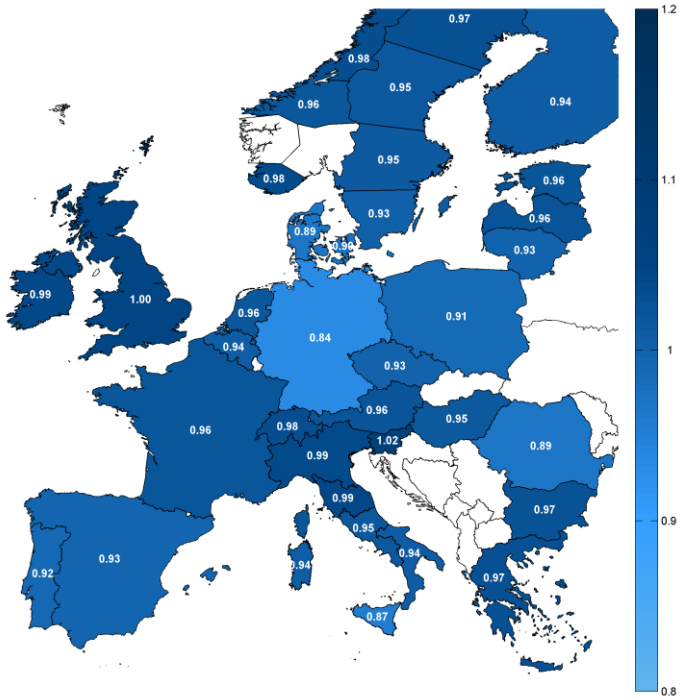
Almost every European power market saw a steady increase in base prices from 2016 – 2018 due to rising coal, gas and CO_2 prices (introduction of market stability reserve)

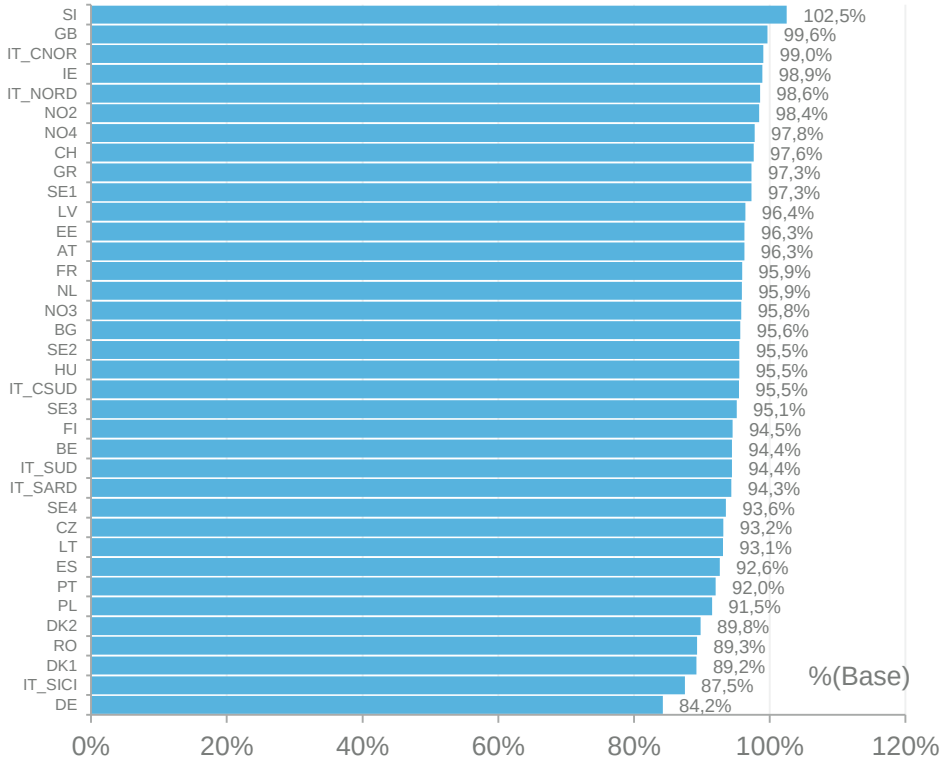


Cannibalization of Onshore Wind capture prices 2018

Analysis of technology specific average wholesale capture prices based on historical hourly wholesale prices per bidding zone and historical hourly production data / Graphs show average capture prices relative to base

2018



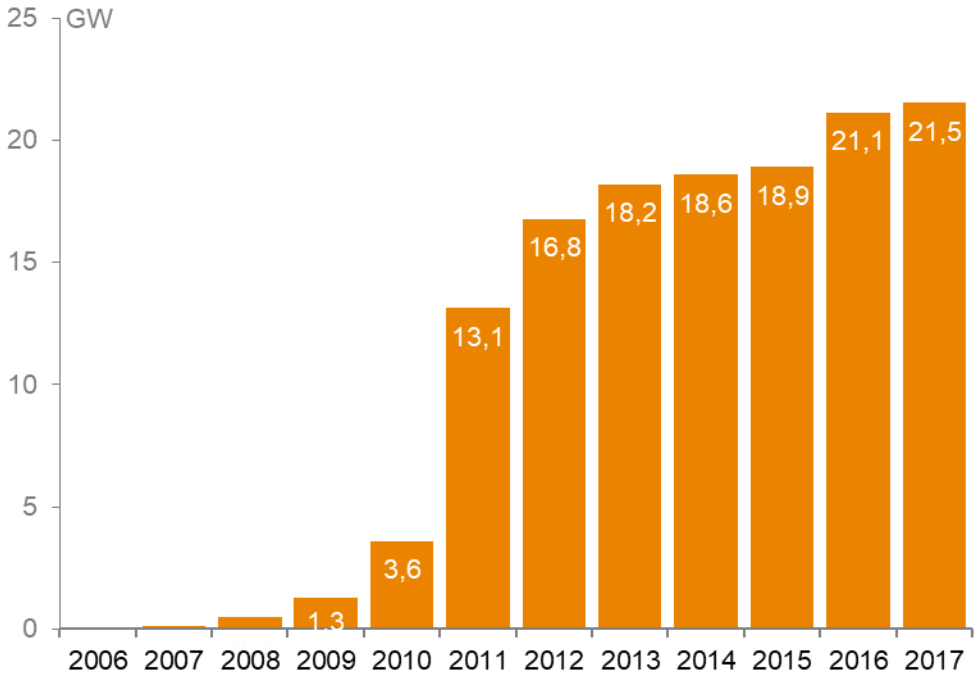


Revenues of Onshore Wind are under pressure with higher penetration rates, resulting in specific average market revenues slightly - and up to two-digits - below base.

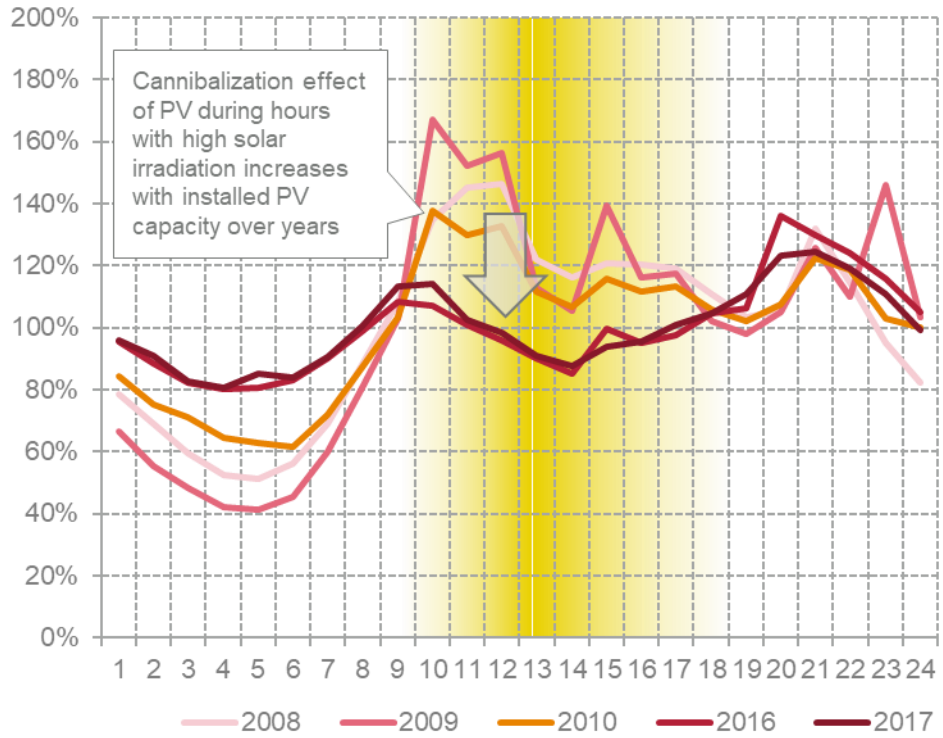
Historical cannibalization effect of PV - Italy

Due to an increase of photovoltaic installations in the last 10 years of about 21 GW, the percentage value of the Spot price in Spain during the noon hours has dropped sustainably

Historical growth in PV capacity



Average power price profile



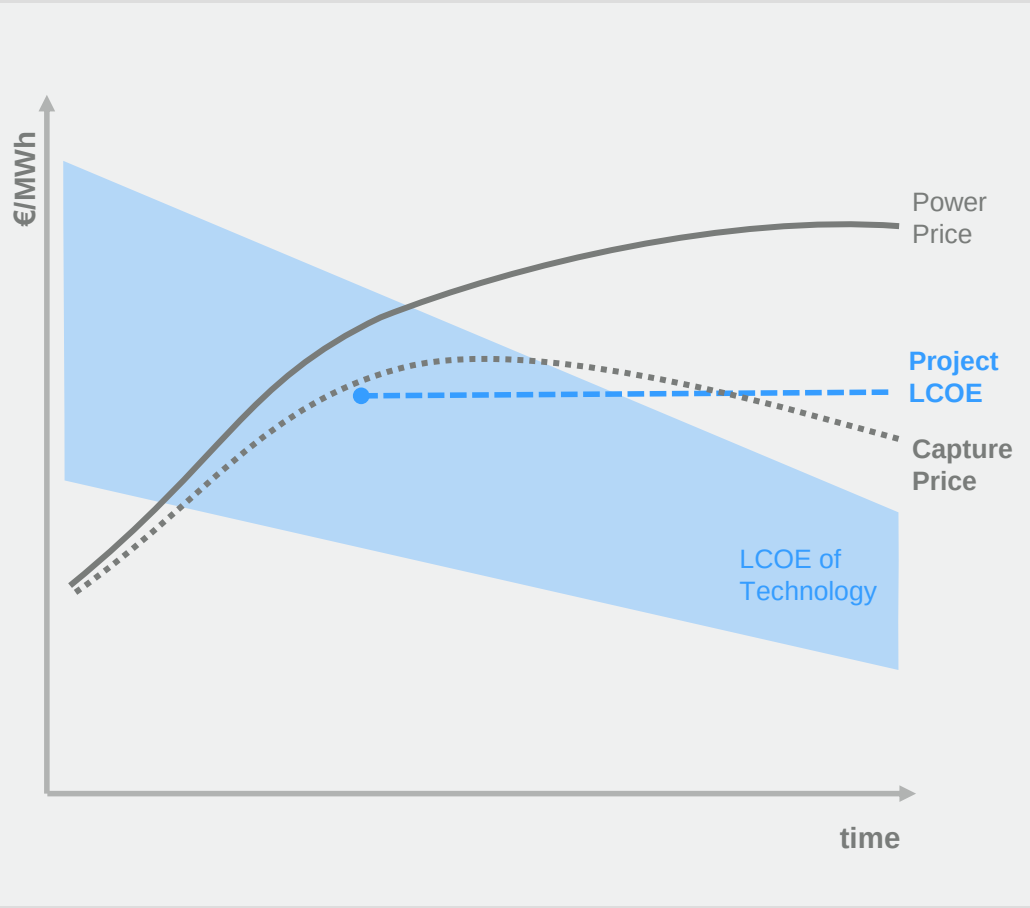
Source: Gestore Mercati Energetici (GME) Italia

Drivers of future Power and Capture Prices

The future development of capture prices is mostly determined by commodity prices (gas, coal, CO_2), conventional power plant capacities (coal, nuclear phase-out plans) and future deployment of RES from tenders and merchant projects

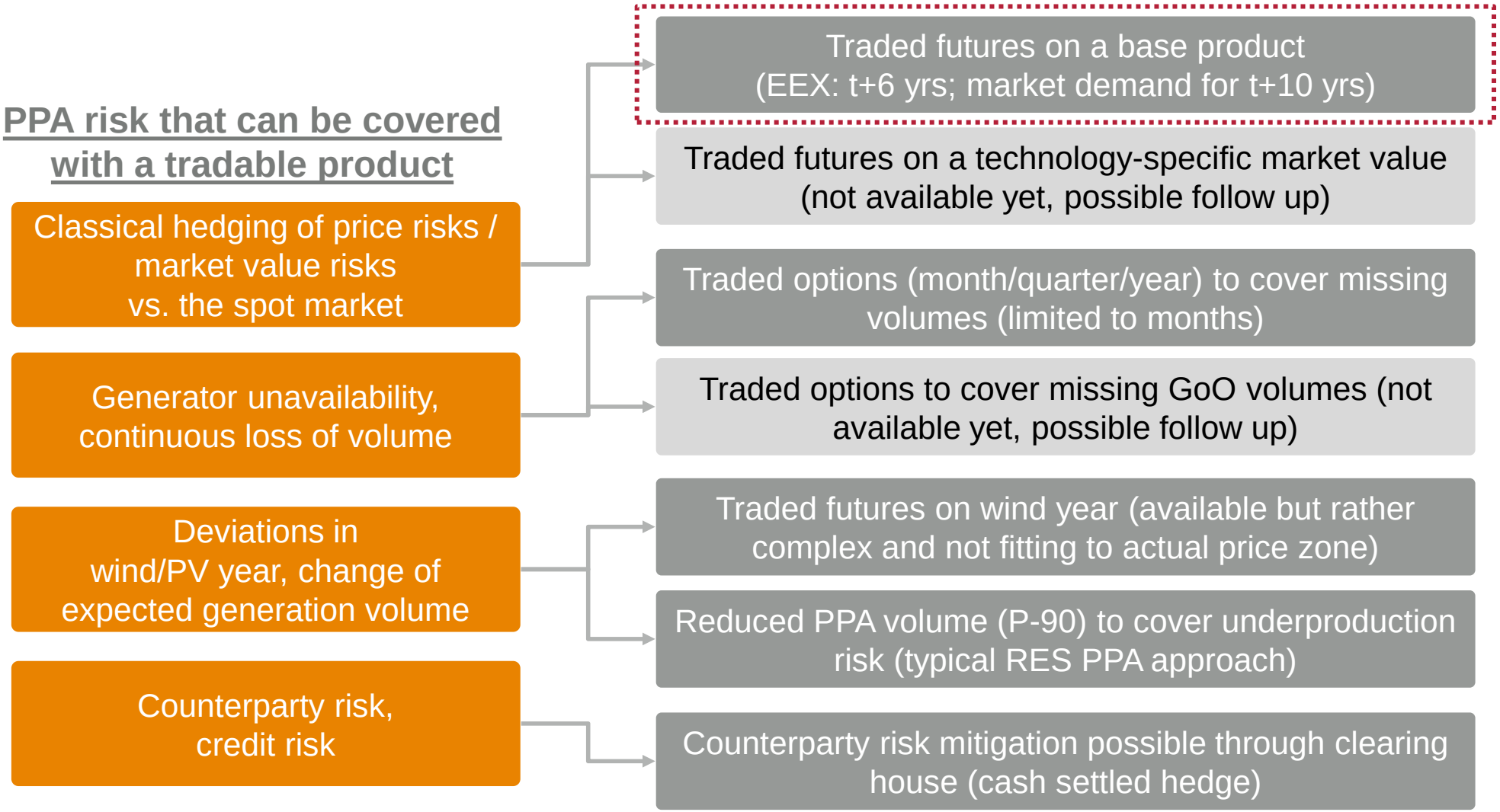
Drivers	Capture Price Impact
Fuel / CO_2-price development	
Development of LCOE RES tender volumes	
Conventional power plant capacities	
Net transfer capacities (NTC)	
Storage and flexibility	
Development of electricity demand	

Project-level Impact



Options for PPA risk management

Hedging options and risk management products for renewable PPAs



How to hedge RES Wholesale Revenues?

Value-neutral hedge for a PPA

Hedging of PV and Wind generation in the futures market: „value-neutral hedge“

40 €/MWh x 14,000 MWh — Producer

Annual value = base price x market value factor (…%) x annual production volume

560,000 € = 50 €/MWh x 80% x 14,000 MWh

50 €/MWh x 11,200 MWh — Trader

eex

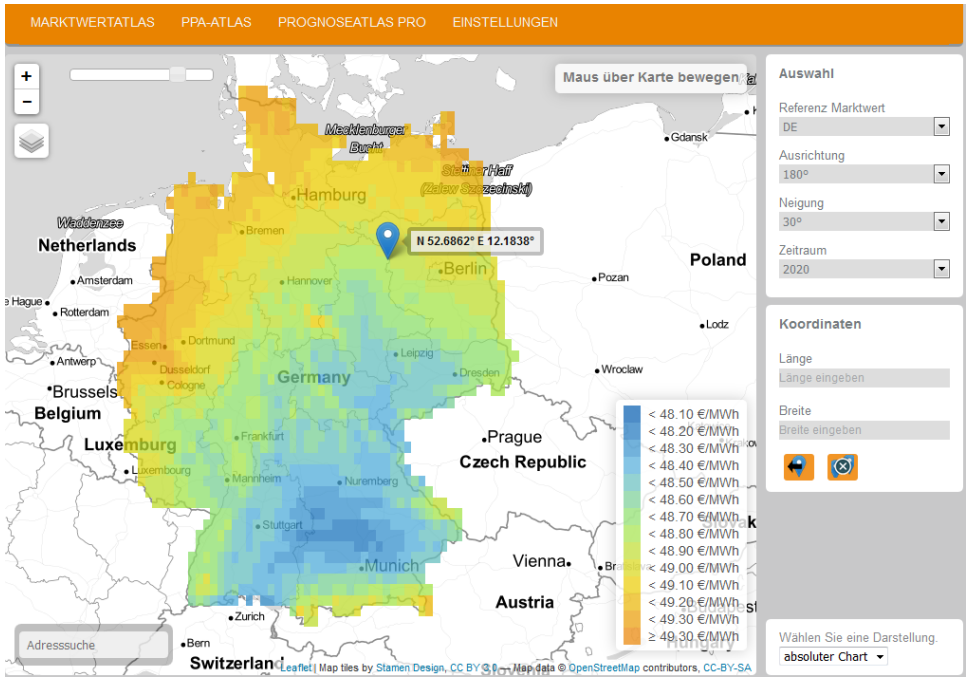
Futures product

Sales volume (base load of ~ 1.3 MW)

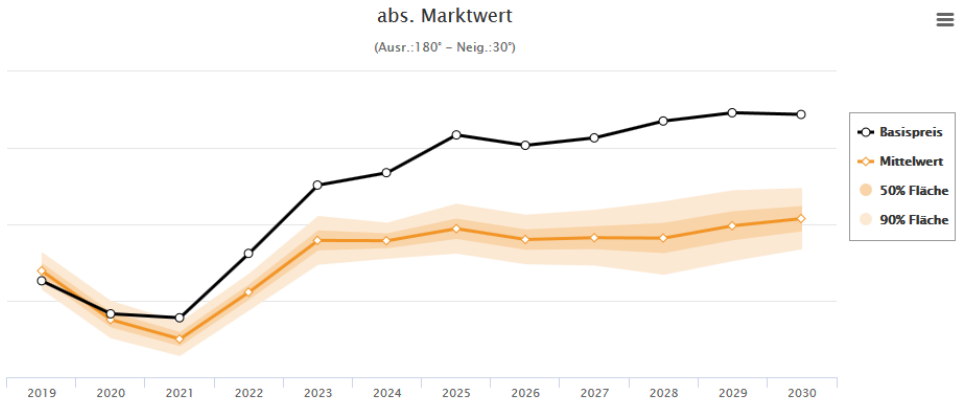
- **The expected value of the production is sold (risk of market value development)**
- **Additional risks must be valuated and priced in and reduce PPA price**

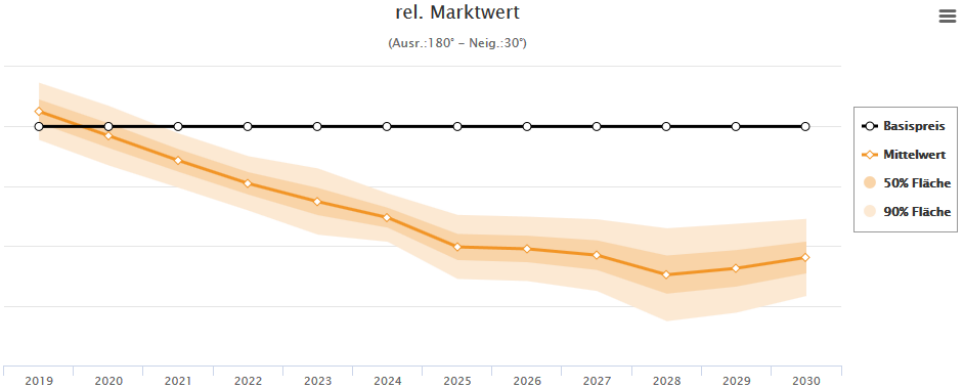
PPA valuation: Profile, Location, Volume Risk

enervis PPA-Atlas (PV)



Project specific valuation





enervis long-term market study

European Power Market Outlook 2019 - 2050

Available countries	DE, AT, CH, FR, BE, NL, PL, CZ, SK, HU, GB, ES, PT, IT, DK, NO, SE, FI, BG, MK, AL
Scenarios	Best guess scenario or three consistent scenarios (high, medium, low)
Spot prices	Base, Peak, Off-Peak and Spreads
Merchant renewables	Modeling of additional merchant renewables, if economically feasible
Capture prices	PV, onshore and offshore wind
Capacity and generation mix	By fuel and technology
Export-balance	Net-exports by border
Summary	Management summary of major drivers and scenario results by country.
Detailed set of assumptions	Fuel and CO2 prices, cost of generation technologies, NTCs, renewable trajectories, number of EVs, electricity demand etc.

renewable energy valuation tool

European Market Value Atlas

Online tool for valuation of site specific Wind Onshore and PV market values

Regions Germany and France

Technologies Wind energy and photovoltaic

Time Frames Real data based on the past few years in power markets

Scenario based long term forecasts up to 2050

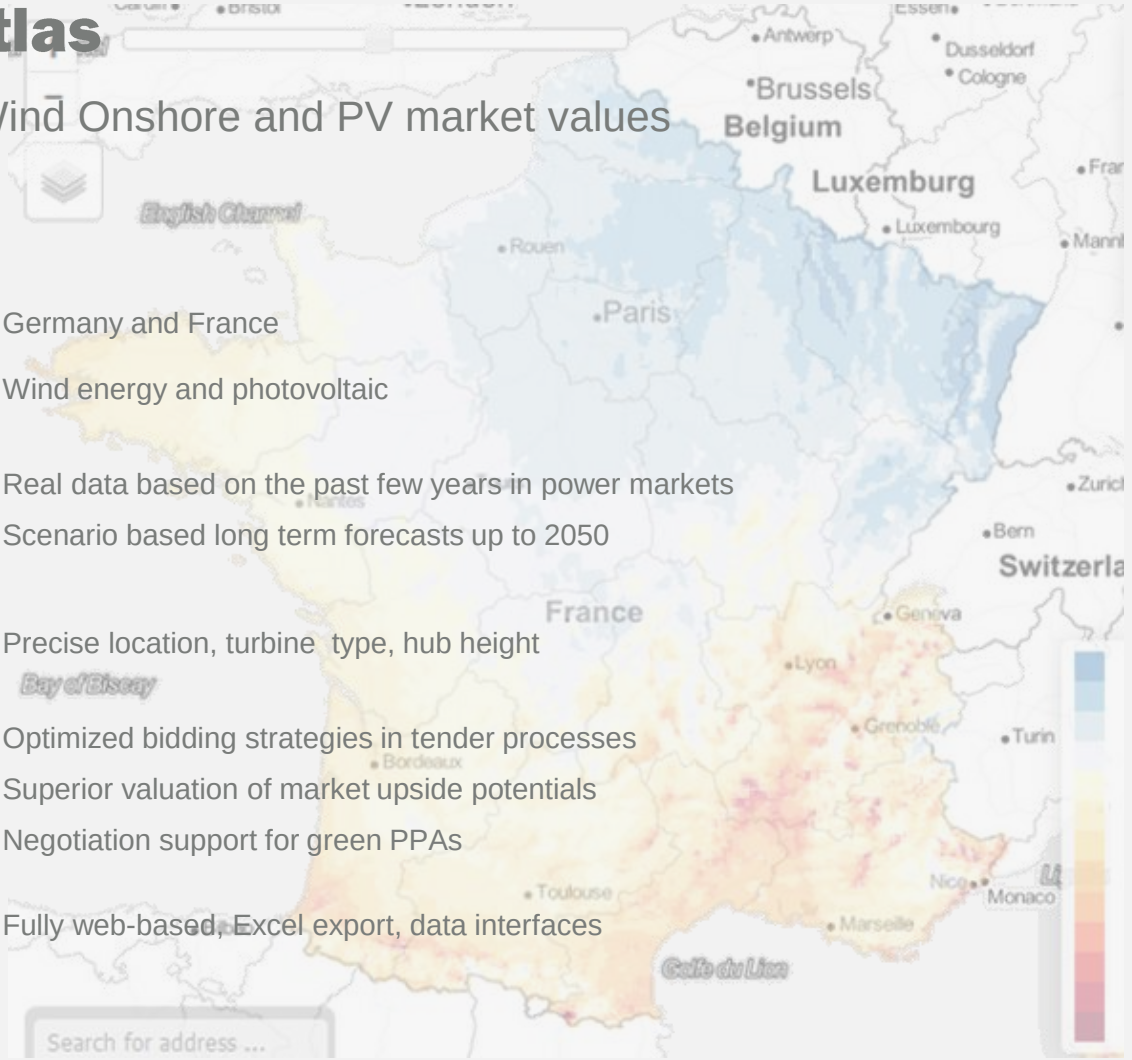
Customization Precise location, turbine type, hub height

Applications Optimized bidding strategies in tender processes

Superior valuation of market upside potentials

Negotiation support for green PPAs

Handling Fully web-based, Excel export, data interfaces



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