

KYOS Webinar
11 February 2021
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The background of the slide is a photograph of a renewable energy farm. In the foreground, there are rows of solar panels tilted towards the right. In the background, several wind turbines are visible against a dramatic sunset sky with orange and yellow hues. The ground is covered in snow.

Webinar: Risk management in renewable PPA's

Cyriel de Jong & Ewout Eijkelenboom
KYOS Energy Analytics

11 February 2021

Risk management of renewable PPAs



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Agenda

15:00 Overview PPAs – Ewout Eijkelenboom

- Rise of PPAs
- Financial exposures of renewable energy projects
- What will be the power price in 2030?

15:15 PPA risk management – Cyriel de Jong

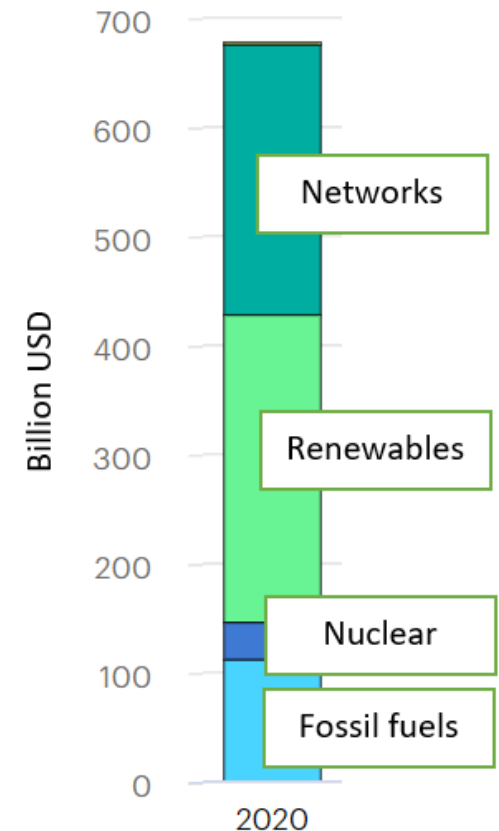
- Role of fundamental model
- Capture rate
- Calculate PPA risk profile

15:35 – Q&A and discussion

15:45 – End of the webinar

Why are PPAs such a hot topic?

- Global trend:
 - Expansion of renewable generation to combat global warming
 - End of stable feed-in-tariffs (FiT)
- Financing and risks:
 - Outright exposure to power price
 - Also to volume and other risks
- Financial reality:
 - Lenders require cash-flow predictability
 - PPA's with utilities and corporates are crucial to provide some predictability



Global investments in power sector, IEA 2020

Corporates get involved with PPAs

PPA will provide offshore electricity for Deutsche Bahn trains

Deutsche Bahn is to increase the amount of electricity it acquires from renewable energy sources under a new power purchase agreement to buy green power

Philips, HEINEKEN, Nouryon and Signify sign virtual PPA contract for Finnish wind farm

11 December 2020

Ineos to get offshore wind power from Norther under PPA with Engie

September 23 (Renewables Now) - Chemicals maker Ineos announced on Tuesday a deal with France's Engie (EPA:ENGI) to buy green power from the 370-MW Norther offshore wind farm in Belgium.



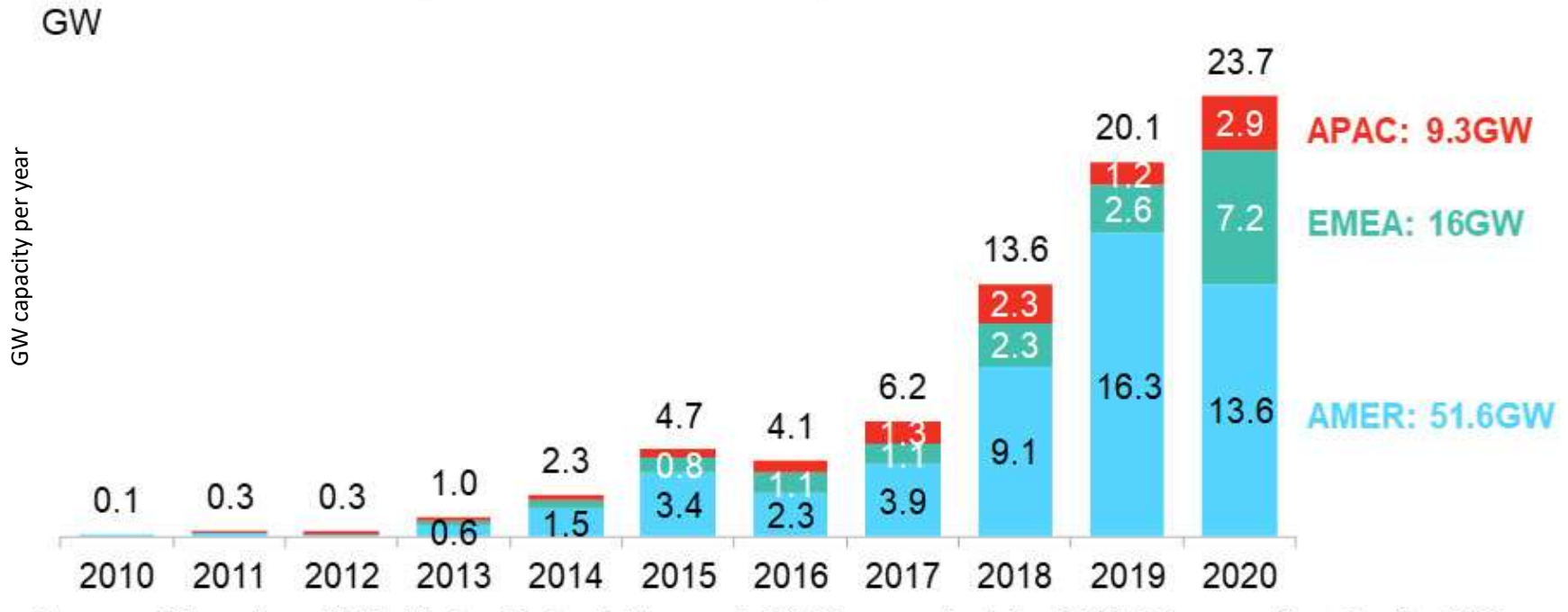
Amazon gets into offshore wind via 380-MW PPA with Shell and Eneco

Renewable Energy World - 2.9.2021



Corporate PPAs

Global corporate PPA volumes, 2010-2020



Source: BloombergNEF

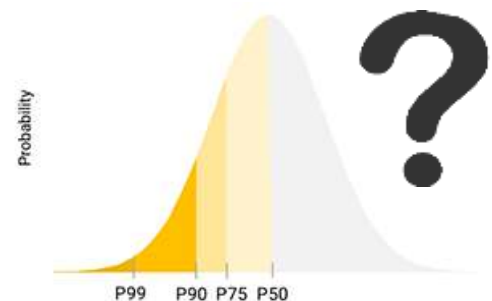
Corporate PPAs have a small share,
but it is growing.
Other PPAs are with utilities.

Requires new knowledge

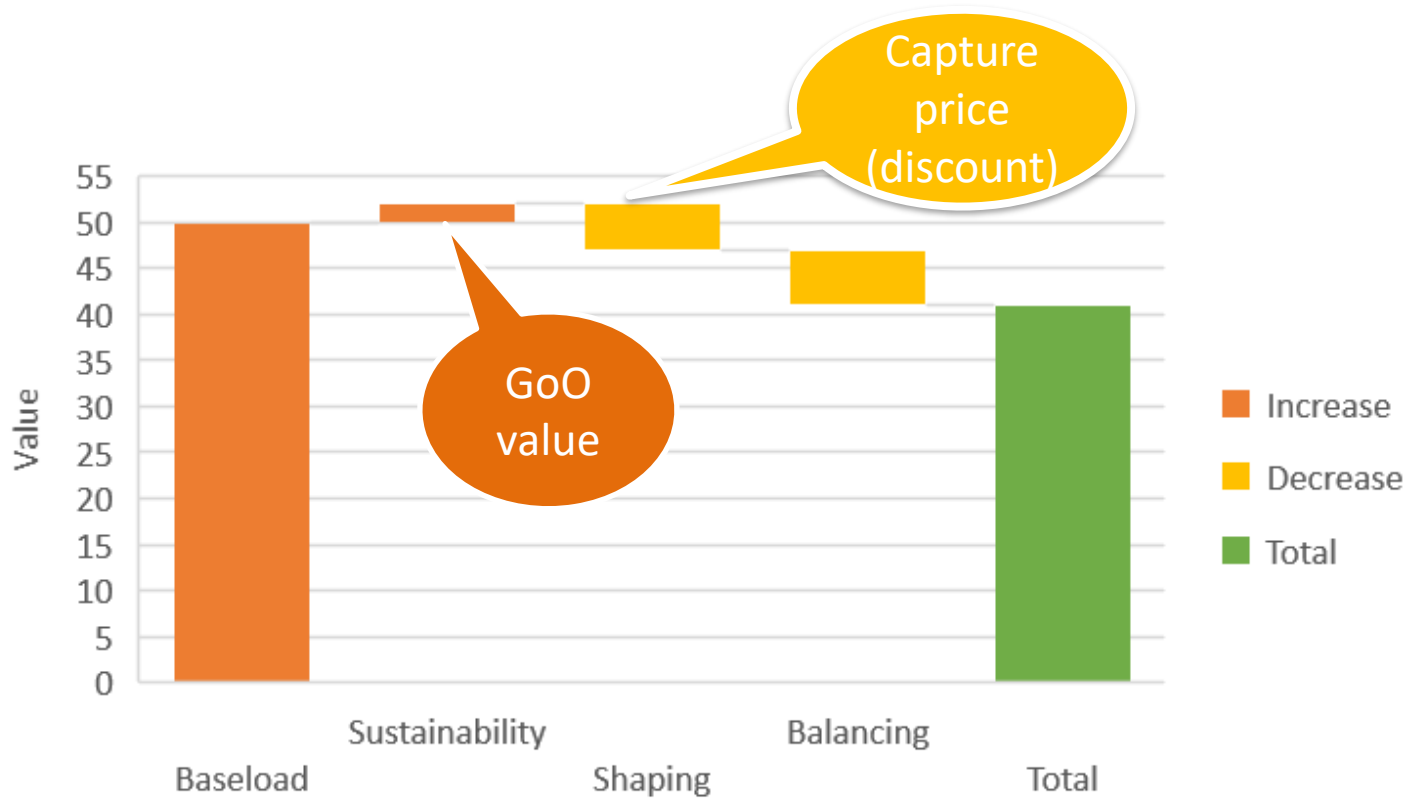
- More and more companies require PPA knowledge, but:
 - Negotiating PPAs is complex
 - Many topics not familiar to PPA buyer/seller
 - Balancing risk
 - Shaping risk
 - Volume risk
 - Long-term power price
 - Fixed price/indexed price
 - Caps/floors

Overall:

- What is the value of each of these elements?
- How does it affect my risk profile?



Value components of renewable power



Each PPA may distribute the value components differently, but ultimately they have to land in someone's pocket.

What will be the power price in 2030?

Why worry about power price in 2030? Or 2035?

- Liquid power trading just 3 years ahead (hopefully increasing)
- Projects will not earn back investment in 3 years, nor in 5 years
- In the next 10-20 years, market will undergo transformation



Future power and capture prices

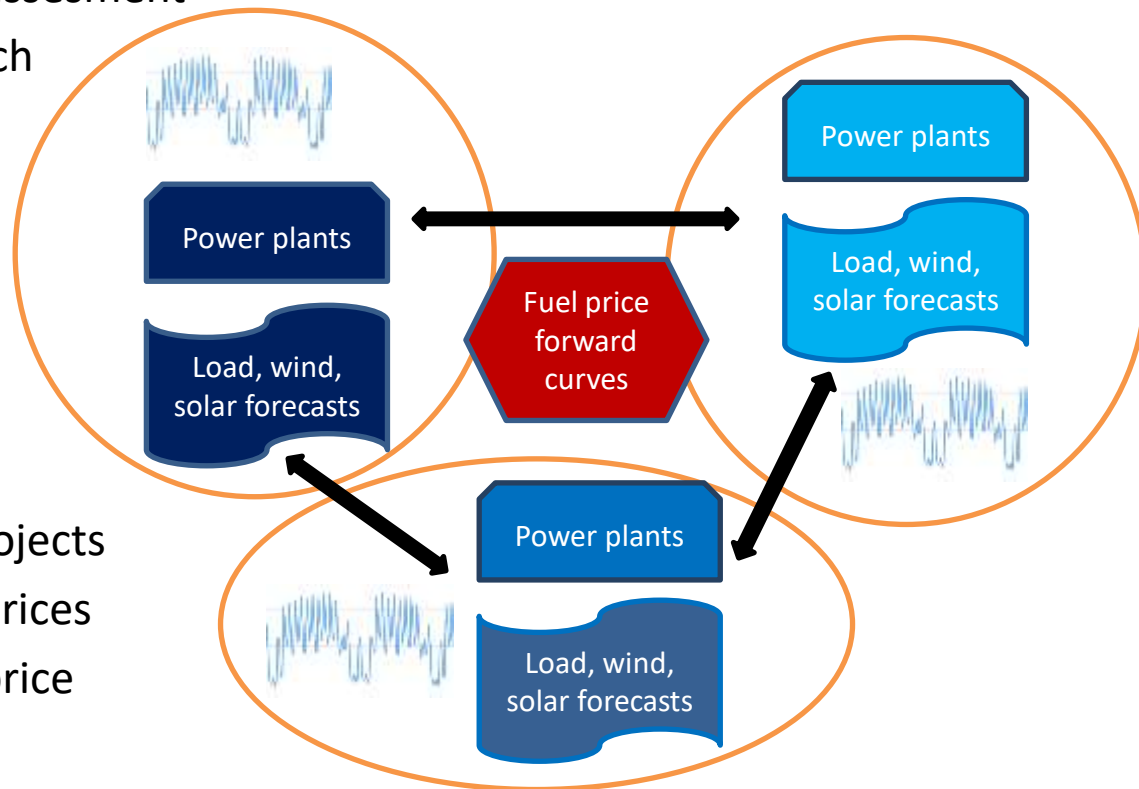


Long-term power price forecast

- **Fundamental power market model**
 - Medium- to long-term price assesment
 - Power plants optimise dispatch
 - And energy storage too



- **Main applications**
 - For investors: value deals, projects
 - For power traders: forecast prices
 - For consumers: buy at good price
- **KYOS base case:**
 - 20 countries
 - Using historical scenarios to forecast load and renewable production



KYOS Base Case – Europe

KYOS Base Case to 2030 : 2021-02-10

Export to Excel

Download plant statistics

Back to results

KyPF ID: 432	KyPF Name: KYOS Base Case to 2030	Iterations: 15
Job ID: 11108	Created: 2021-02-11 02:15:00	

Price summary Capacities Production Fuel consumption Emissions Hourly prices Carbon prices Fuel prices Hourly imbalance Interconnections

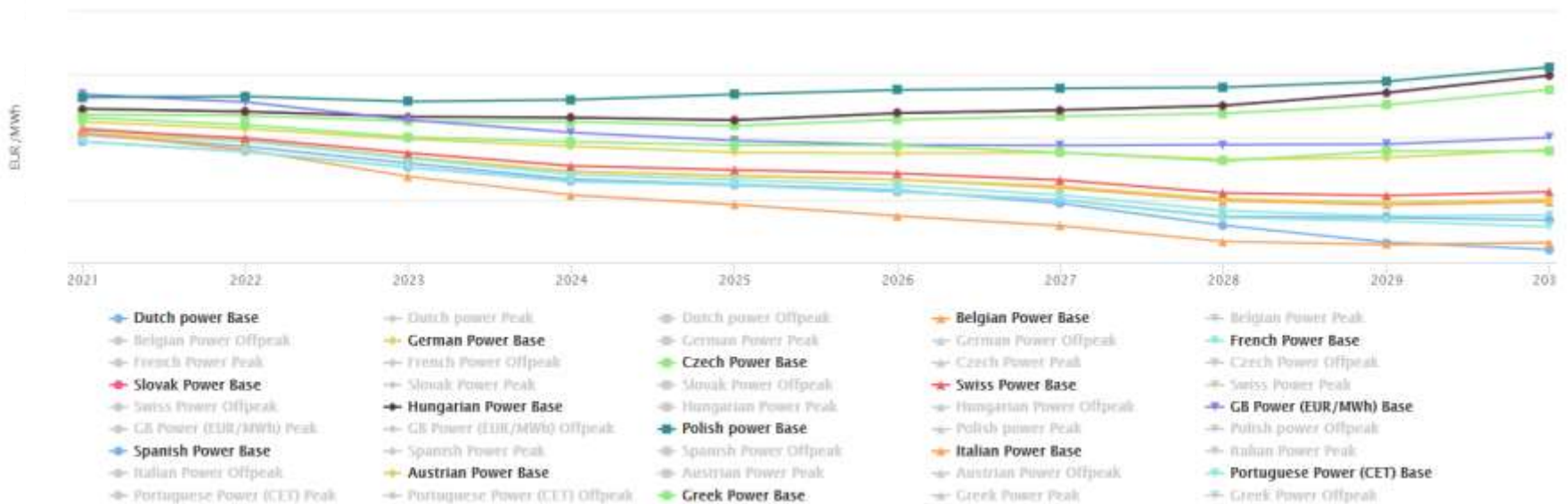
Period

- Year
- Month

Delivery type(s):

Base

Prices yearly



KYOS Energy Consulting

Actual forecasts are per hour

Cannibalisation effect

- More renewable capacities:
 - Produce a lot when prices are low
 - Produce very little when prices are high
- Capture rate will go down if more renewables enter the market
- However, do not underestimate the market:
 - Improved control over renewables → few negative prices
 - Energy storage, demand response → dampen fluctuations

Some capture prices in 2020

- Bad year for German solar and wind
- Good year for Spanish solar and wind (in comparison)

Germany 2020		
	Capture price	Capture rate
Baseload	30.47	100.0%
Solar	24.60	80.7%
Wind on-shore	24.64	80.9%
Wind off-shore	27.84	91.4%

Spain 2020		
	Capture price	Capture rate
Baseload	33.96	100.0%
Solar	32.89	96.9%
Wind on-shore	32.38	95.4%
Wind off-shore		

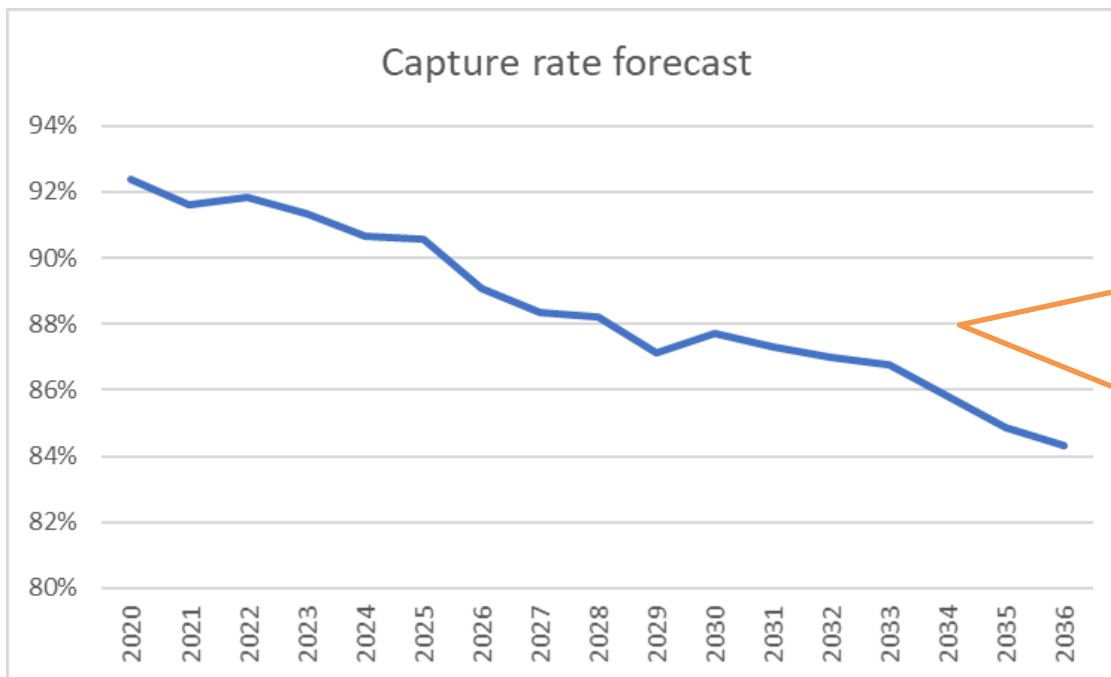
Closer look at German capture prices 2020

- A lot of solar and wind in March, at low prices
- Little solar in December, at high prices
- In individual months: renewable capture price above baseload
- However, monthly price shape also plays a role (corona, gas price, etc)

	Production			Price			
	Solar	Wind-off	Wind on	Baseload	Solar	Wind-off	Wind on
Jan	28%	144%	145%	35.03	38.30	33.80	31.16
Feb	46%	141%	211%	21.92	23.22	20.27	17.60
Mar	106%	115%	132%	22.49	16.22	19.42	18.44
Apr	168%	83%	81%	17.09	8.97	13.25	11.40
May	160%	69%	69%	17.60	14.14	14.18	13.15
Jun	152%	65%	58%	26.18	24.73	22.29	22.28
Jul	162%	69%	62%	30.06	26.25	24.09	21.92
Aug	140%	69%	59%	34.86	33.21	32.00	30.15
Sep	123%	77%	55%	43.69	39.80	38.45	38.09
Oct	56%	136%	123%	33.97	32.67	31.74	30.08
Nov	40%	117%	102%	38.79	39.98	35.22	32.19
Dec	18%	115%	103%	43.52	48.02	39.88	33.81

Forecast future capture price

- Use fundamental model: hourly prices
- Use actual weather data from a particular year to simulate:
 - Renewable production in the market → market price
 - Renewable production of the asset → capture price

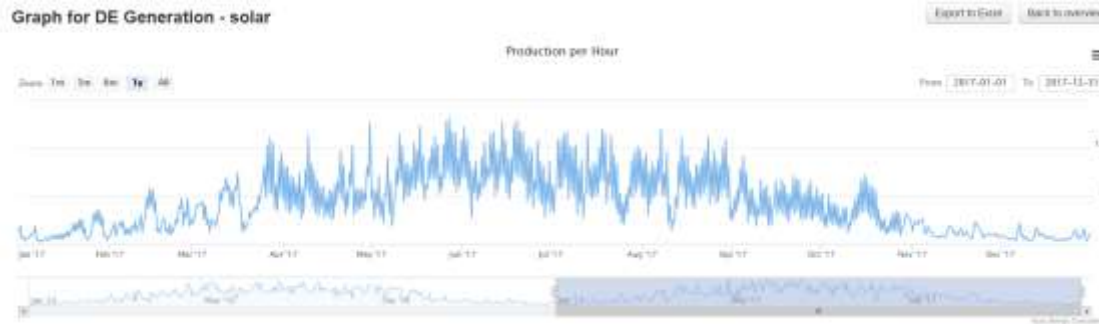


This is an example
(German solar).

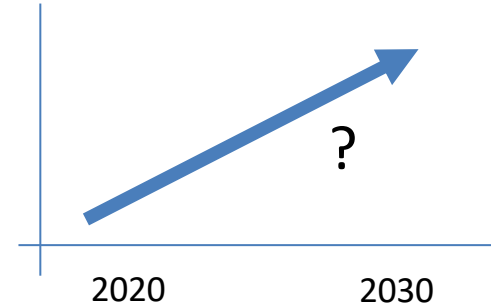
KYOS can generate
capture rate forecast
for any asset.

How do we generate the forecast (1)?

1

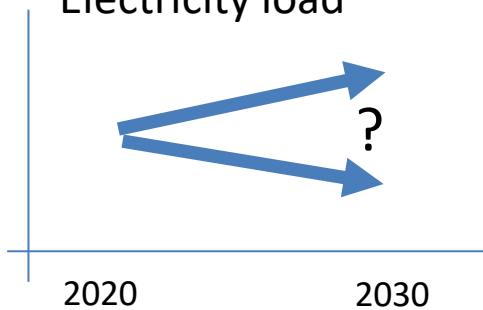


Solar/wind capacity



2

Electricity load



+ electrification
- efficiency

3



550 German assets, 150 French assets, 200 British assets, etc.

Capacities, efficiencies, start costs, variable costs, etc.

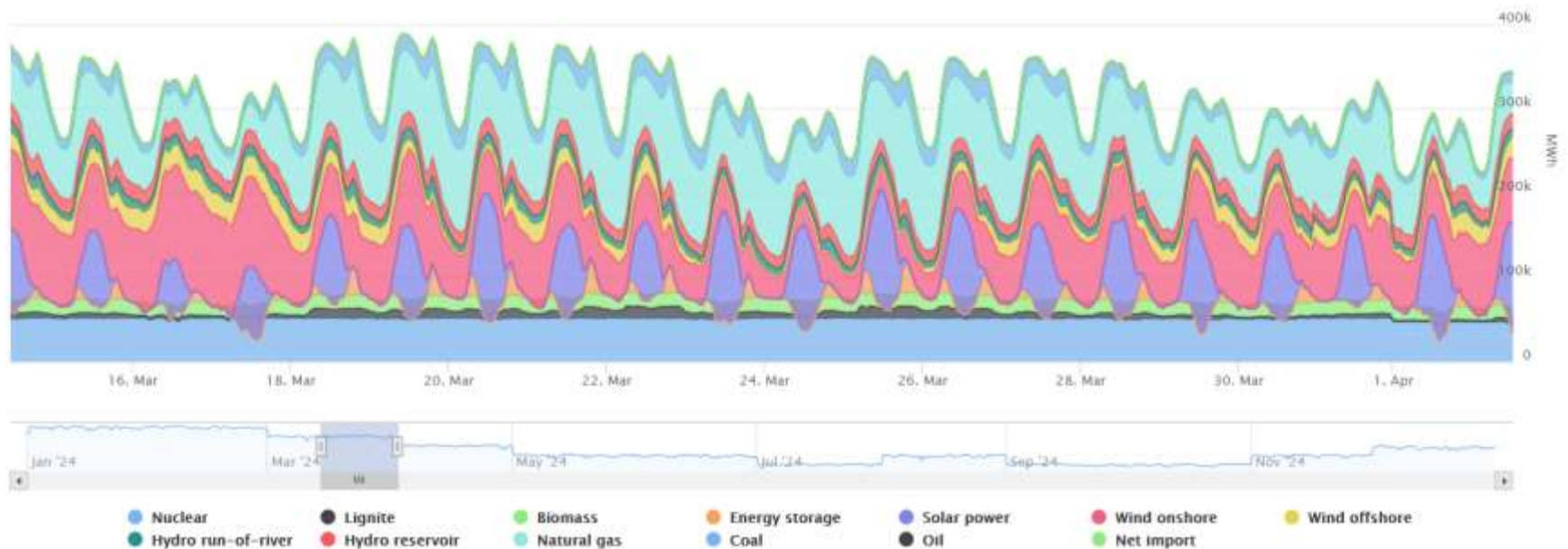
How do we generate the forecast (2)?

- With the fundamental power market model KyPF all assets are bidding into the spot market
- This results in an hourly price per market, in which e.g.:
 - High renewables power output -> low price
 - Low renewables power output -> high price



Understanding the future supply stack

- Fundamental model provides a wealth of information
- Run with multiple 'base years' = historical wind/solar patterns
- Or many other scenarios (fuel prices, capacities,)
 - Provides insight in the variations in capture prices



Power analytics: sharing our insights

power.kyos.com

KYOS European Power Analytics

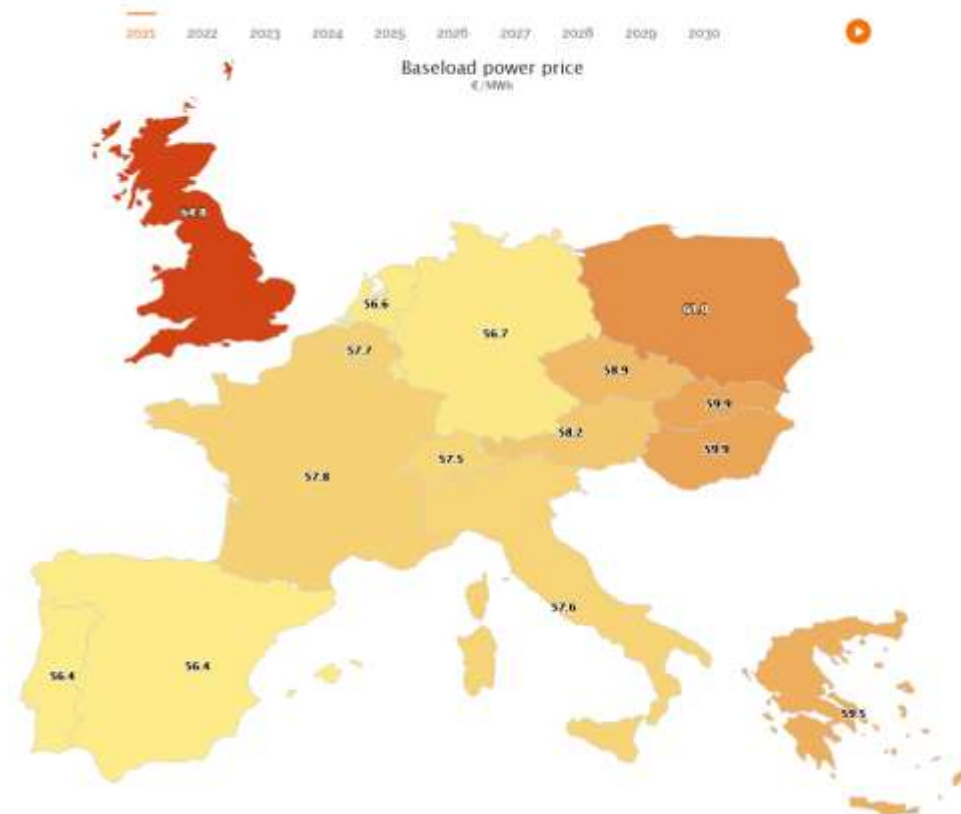
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Welcome to
KYOS power

Benefit from our sophisticated market modeling software, careful data collection and the expertise from our analysts. Explore and learn!

Gain a unique insight in Europe's future power market with KYOS Energy Analytics! We present an assessment of power prices in the next 10 years, together with detailed statistics of the underlying price drivers. The prices are from the KYOS base case scenario, which largely follows national policy plans.

[Find out more](#)



KYOS approach to valuation & risk assessment of PPAs and renewable projects



KYOS approach

- Each project and PPA is unique:
 - Location and technology
 - Market and regulation
 - Contractual parameters
- But all project and PPA assessments require insight in:
 - Expected volumes, prices and cash-flows
 - Distribution of volumes, prices and cash-flows
 - Possibilities to reduce risk with the right structures and hedging strategy

PPA Assessment

The screenshot displays the KYOS KyPPA web interface. At the top, the KYOS logo is on the left, and the user name 'Ewout Eijkelenboom' is on the right. A navigation menu includes 'Settings', 'Price data', 'Time series', 'Curves', 'Assets & Contracts', 'Analytics', 'Custom analytics' (highlighted), 'Reports', and 'Logs'. Below the navigation, there are buttons for 'KyPPA', 'Prototype', and 'Templates'. The main heading is 'KyPPA', with a 'Create profile' button on the right. A filter bar contains 'Show all filters', 'Load filter', 'Save filter', 'Reset selection', and a 'Filter' button. Below the filter bar is an 'IDs' input field with an 'x' icon. A green bar indicates '5 results found'. A dropdown menu shows '20 per page'. The main content is a table with the following columns: ID, Name, Simulation profile, Scheduled, Automated, Jobs, Reporting, and a 'Last result' dropdown.

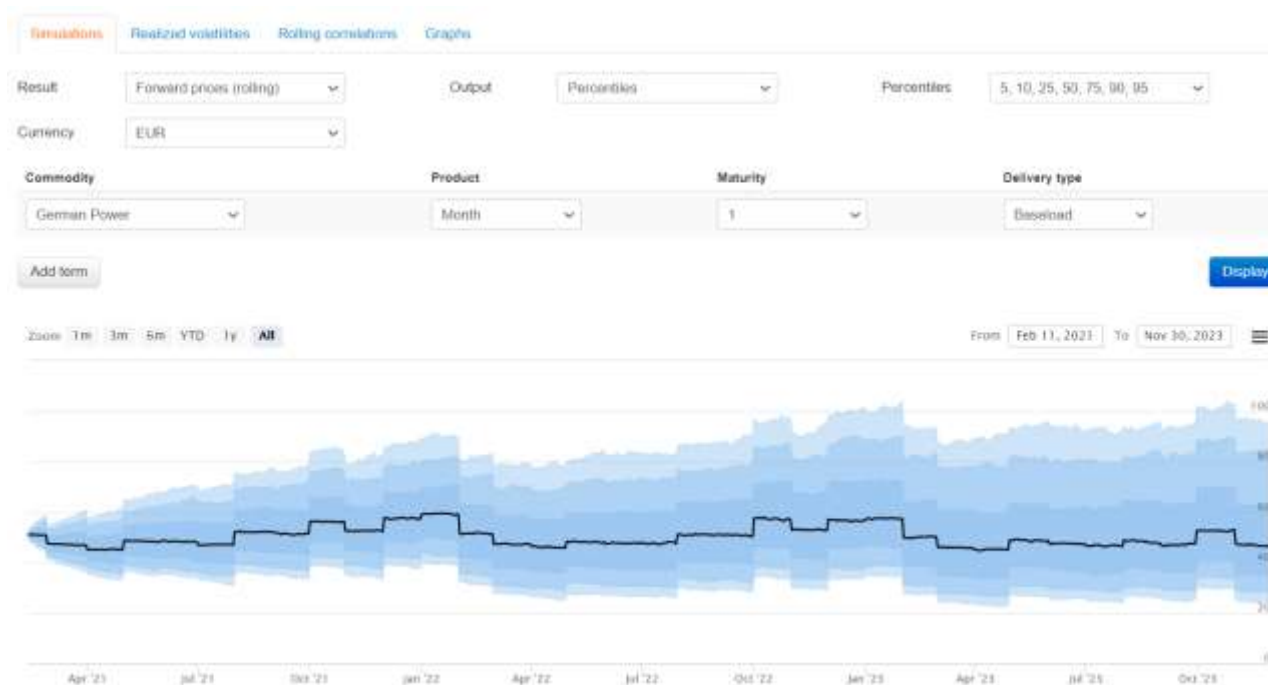
ID	Name	Simulation profile	Scheduled	Automated	Jobs	Reporting	Last result
5	Example DE Wind Fixed Price	DE power for Halle	No	Yes	6	Yes	Last result
6	Example DE Wind Indexed Price Cap/Floor	DE power for Halle	No	Yes	3	Yes	Last result
7	Example DE Solar Fixed Price	DE power for Parchim	No	Yes	3	Yes	Last result
9	Demo RO Solar Fixed Price	RO power with solar demo	No	No	1	No	Last result
10	Demo RO Solar Spot Index	RO power with solar demo	No	No	1	No	Last result

KyPPA module:

- Out of the box standard PPA pricing structures
- Possibility to define user-defined pricing structures

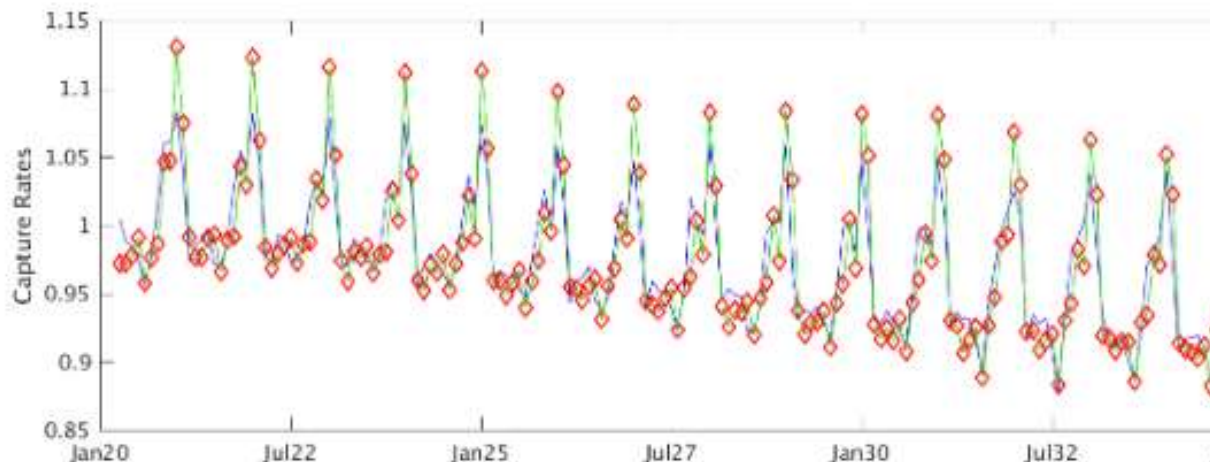
Simulations of prices and volumes

- A single forecast of power prices is not enough
- Monte Carlo simulations of power prices:
 - Forward prices and hourly spot prices
 - Arbitrage-free: on average equal to forward curve (from KyPF)

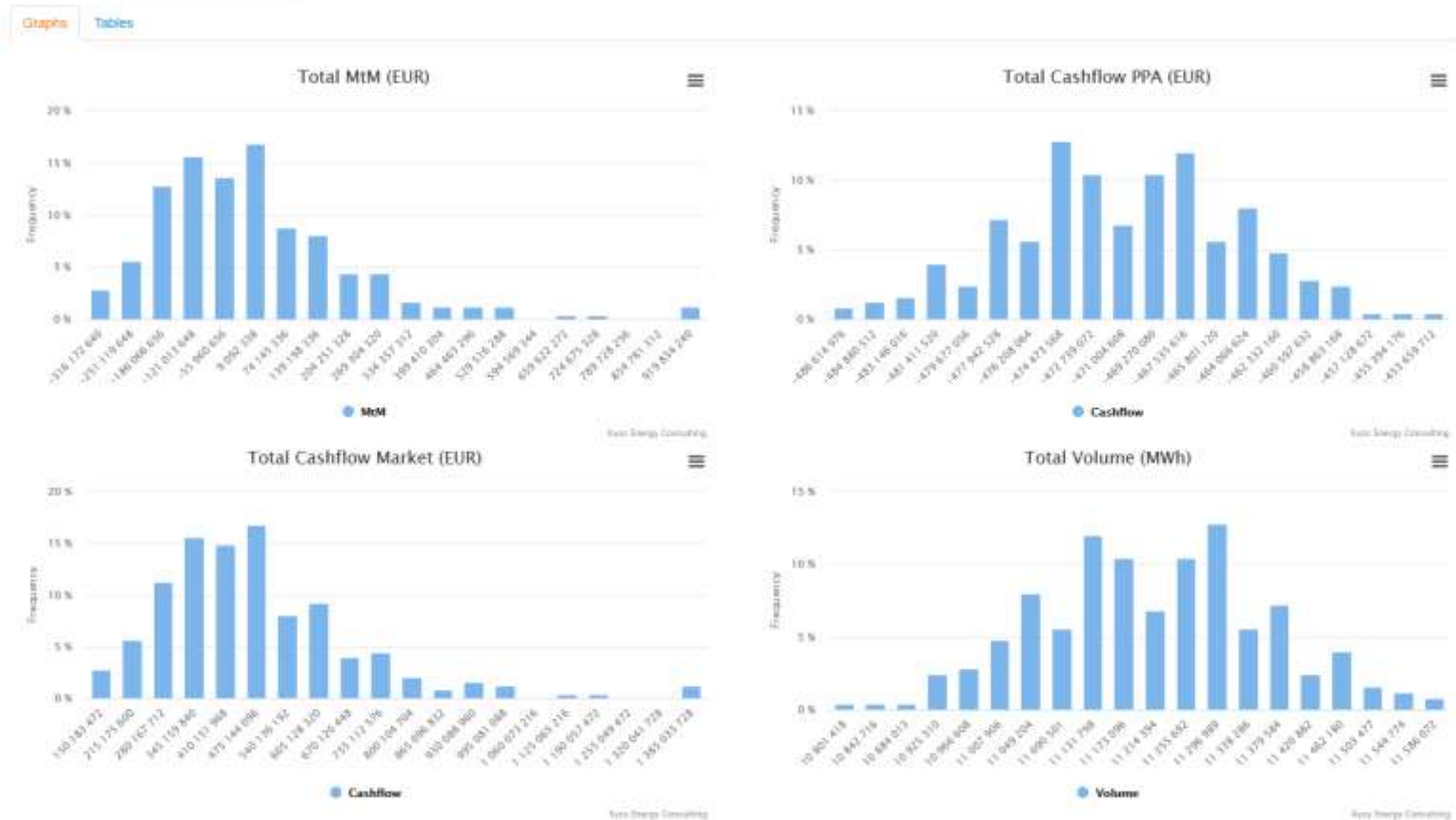


Simulate price and volume

- A single scenario of production forecast is not enough
- Production is negatively correlated to power prices
- Simulate weather and renewable power:
 - Smart historical sampling from period 2005 – 2020
 - Imposing a negative correlation with the power prices to meet the expected capture rates



PPA risk assessment



- Calculate risk profile
- One project or portfolio of projects
- Include effect of hedging strategies

KYOS PPA services

KYOS supports all players in the renewable sector

Project
developer

Bank/investor

Aggregator/
Utility

Corporate

- Valuation support during PPA negotiation/M&A activities
- Regular PPA valuations for accounting and trading purposes
- Support with arbitration cases

- KYOS Analytical Platform - complete tool to capture and manage PPAs
- Python scripts allows user to create own PPA pay-off formulas
- Detailed risk reports for managers and analysts

Thank you

Time for Q&A

We look forward to supporting you in the rapidly changing energy sector!

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