



# Risk Management of renewable assets

4 October 2022

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# Agenda

- Introduction
- A simulation approach to assess risks and hedge effectiveness
- Hedging price risks of renewable assets
- Case study – optimal PPA sizing
- Q&A and discussion

# Intro KYOS Energy Analytics



# KYOS renewable energy services



KYOS supports all players in the renewable energy sector

	Project developer	Bank or investor	Utility or Aggregator	Corporate off-taker
Software	<ul style="list-style-type: none"><li>• KYOS Analytical Platform - complete software system to price and manage renewable assets and PPAs</li><li>• Make long-term power price projections and perform what-if analysis</li><li>• Monitor and manage a complete portfolio of assets, PPAs and hedges</li><li>• Analyse different hedging strategies before entering in new deals</li><li>• Obtain detailed risk reports for managers, investors and analysts</li></ul>			
Advisory	<ul style="list-style-type: none"><li>• Get valuation support during PPA negotiation and M&amp;A activities</li><li>• Get regular PPA valuations for accounting and trading purposes</li><li>• Get support with arbitration cases, re-financing and re-powering</li></ul>			

# KYOS Energy Analytics

- International client base across Europe, plus Americas and Japan
- 30+ people, of which 20+ in Haarlem
- More than 100 corporate clients for its software services

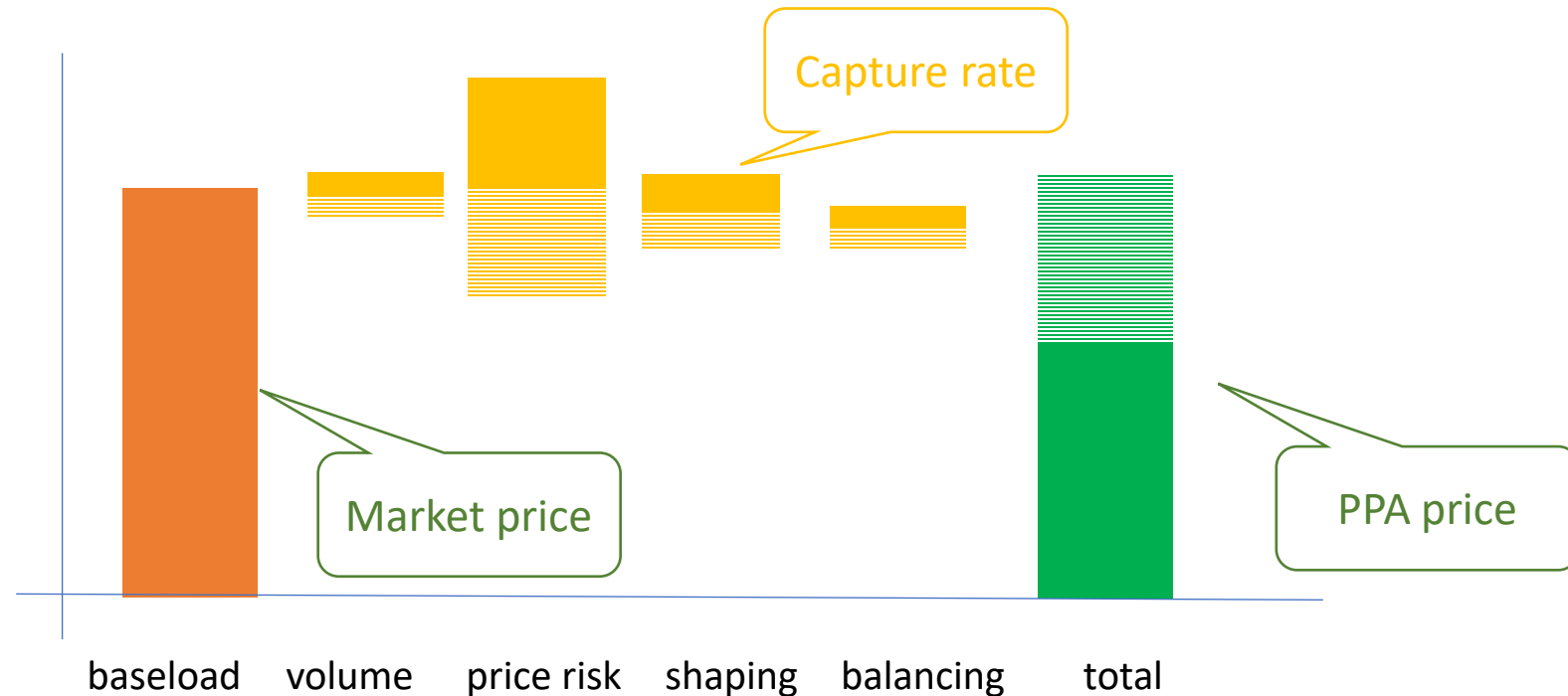


# A simulation approach to assess risks and hedge effectiveness



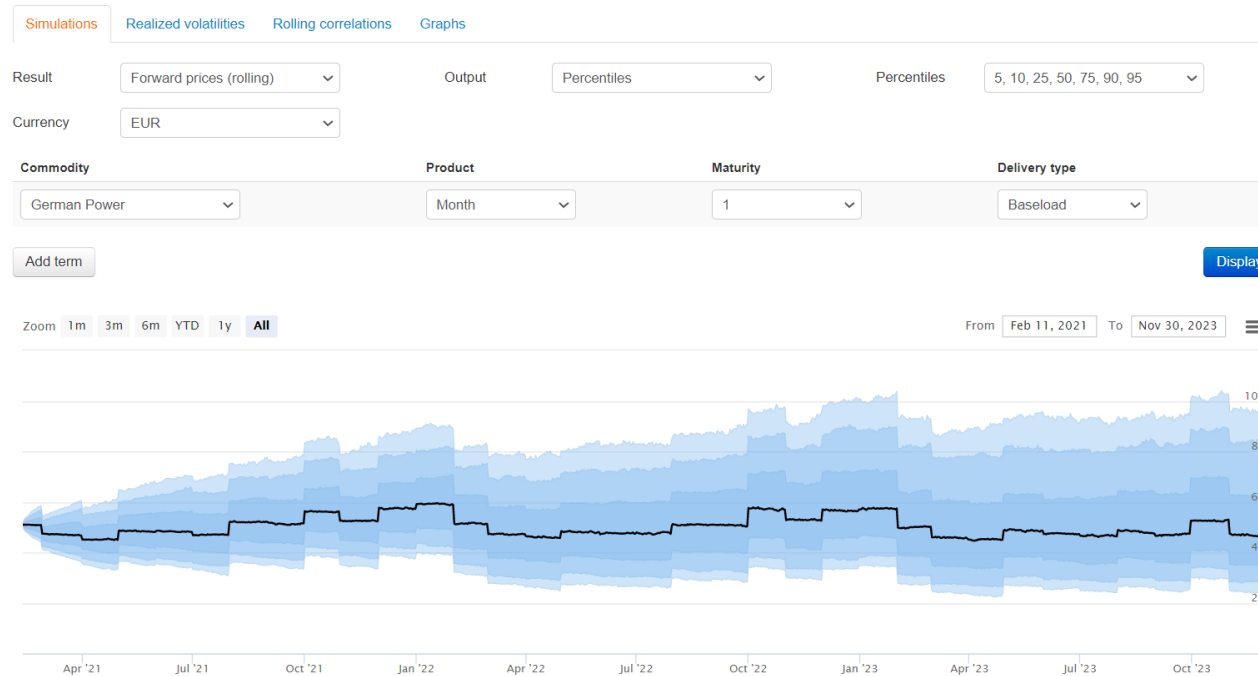
# PPA value components and risk

- Some risk components are easier to hedge.
- Power price risk is typically largest risk component



# Why simulate prices?

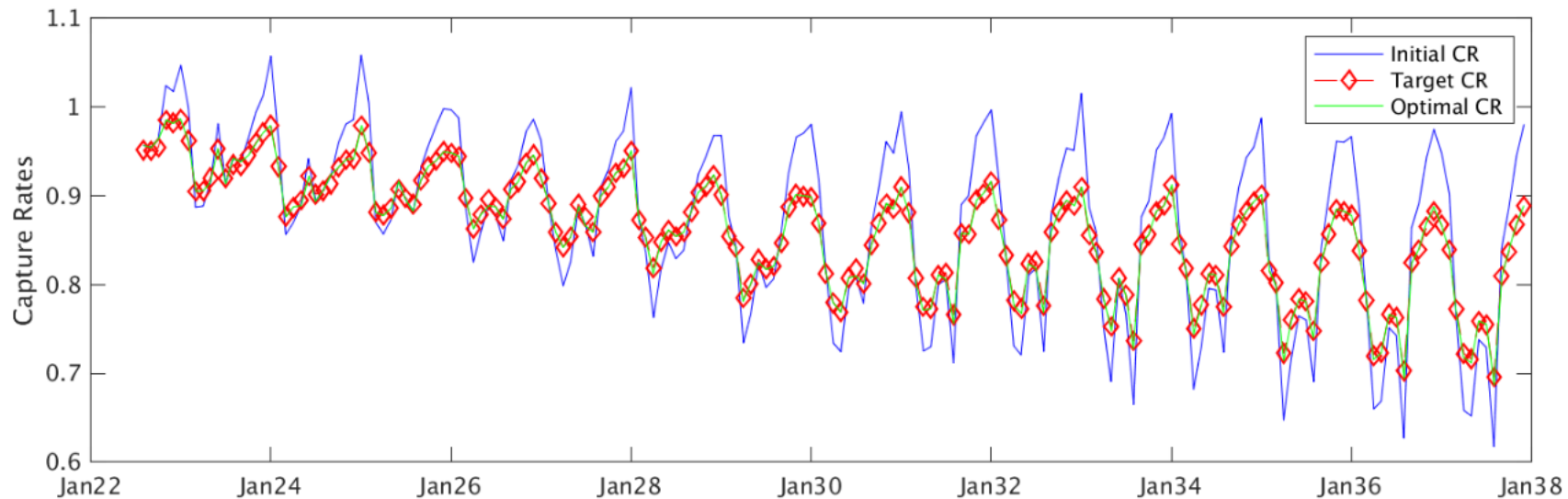
- A single forecast of power prices is not enough
- Risk should be measured and compared
- Monte Carlo simulations of power prices:
  - Forward prices and hourly spot prices
  - Arbitrage-free: on average equal to forward curve





# Why simulate volumes too?

- A single scenario of production forecast is not enough
- Renewable generation is negatively correlated to power prices
- Simulate renewable generation with a systematic approach:
  - Smart historical sampling from historical years
  - Imposing a negative correlation with the power prices to meet the expected capture rates



# Hedging price risks of renewable assets



# Gain an edge with a hedge



- **The challenge:**

- Huge investments in merchant projects
- Investors are exposed to long-term price risks
- Buyer's market for long-term contracts (3+ years)
- Long-term contracts are selling at a discount

- **Hedging capability creates a competitive advantage:**

- Reduce risk capital
- Attract external capital, incl. debt
- Maximize revenues
- Create a larger portfolio



# Hedging – many choices

- Long term PPA (e.g. with corporate) 5-10 year
  - Baseload or pay-as-produced
- Market hedges for shorter period (1-3 years)
  - Baseload or peakload
  - Calendars or more refined with quarterly and monthly contracts
  - In 'own' market or in 'proxy' market
- Dynamic:
  - Trade shorter dated products when available
  - Rebalance positions based on prices
  - Stack and roll

The size (volume) of the hedge is most important.  
Value-neutral is better than volume-neutral.

The optimal hedge volume is often even lower,  
e.g. <80% of P50 volume

# Hedging - analysis

- Hedging lowers your risk
- But optimal hedge requires sophisticated valuation, including using Monte Carlo simulations
  - KYOS Analytical Platform comes with out-of-the-box functionality to easily test different hedging strategies

Hedging strategy

Optimise hedge volumes



Delivery type of delta positions in reports

Select to add

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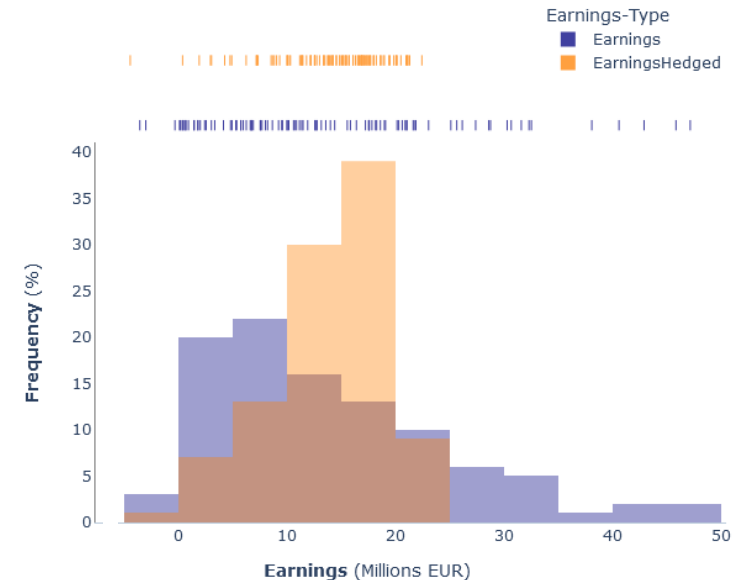
static-monthly-baseload [1]

static-yearly-baseload [2]

stack-and-roll [3]

dynamic-yearly-baseload [4]

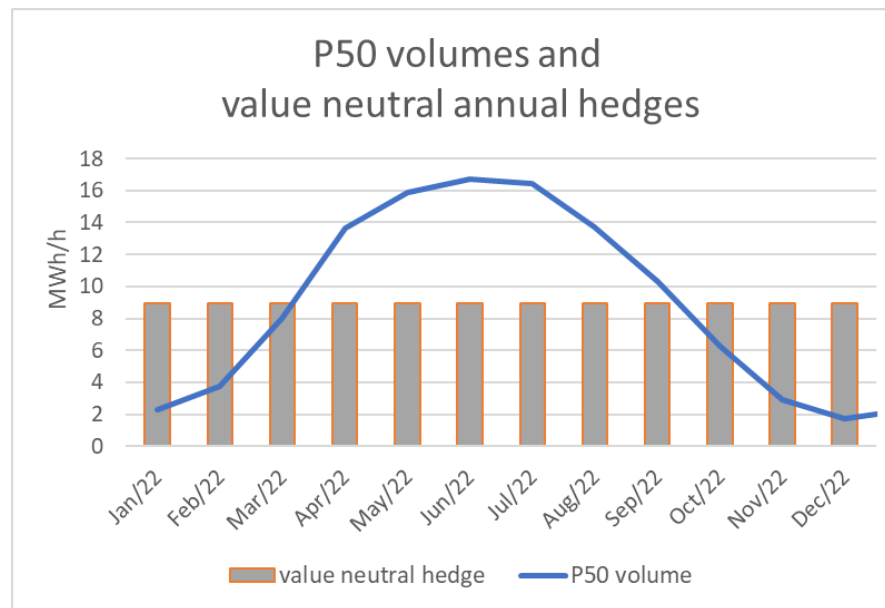
static-yearly-and-dynamic-short-term [5]



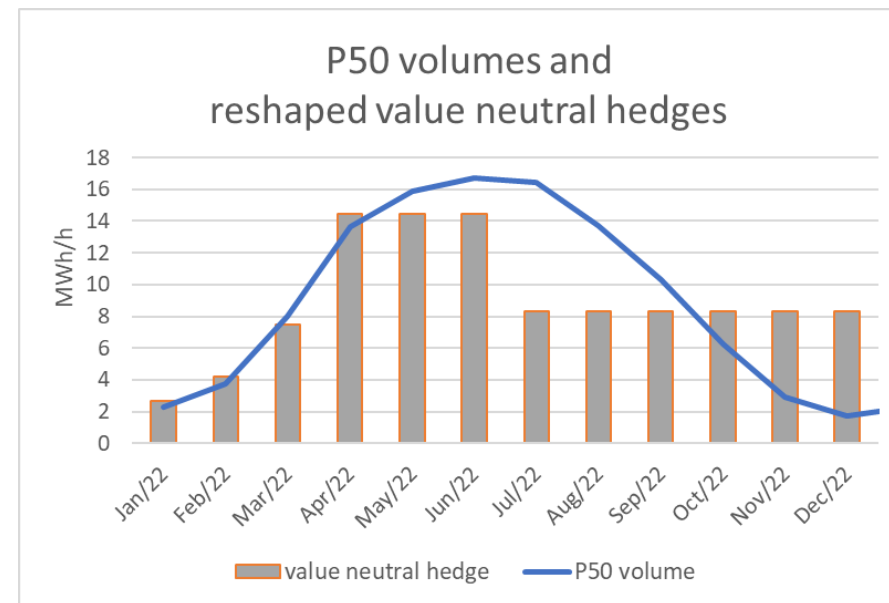
# Dynamic hedging (1/2)

- Refine hedging

- Rebalance hedge based on products becoming tradable
- Example: initially only years tradable, later this can be reshaped using months and quarters



Initial annual hedge



Reshaped hedge

# Dynamic hedging (2/2)

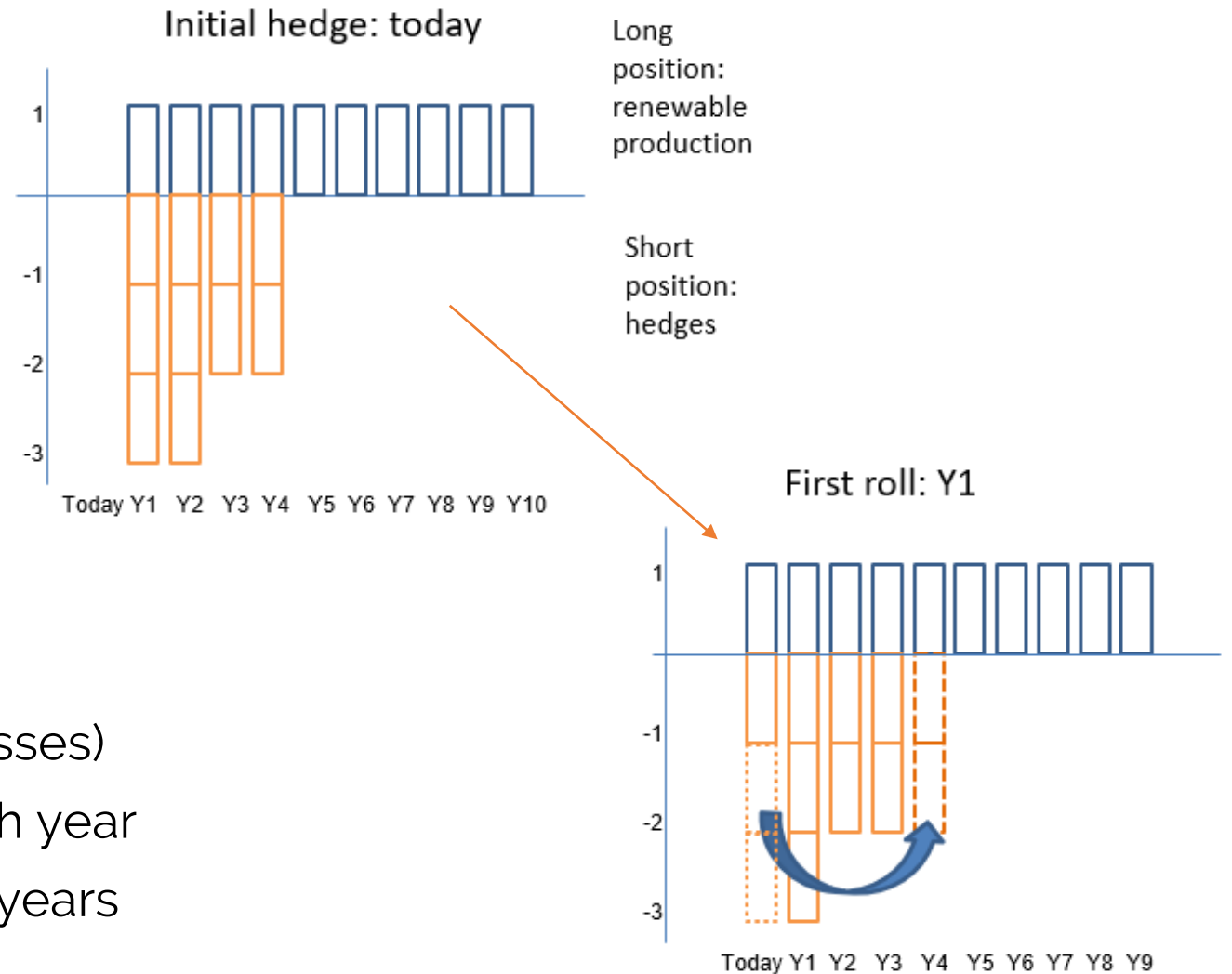


Hedge illiquid period  
with liquid periods

Roll position when they  
become tradable

## Challenges

- Liquidity in the forward market
- Capital for margin calls (MtM losses)
- Trading costs to make rolls each year
- Breaking correlations between years



# Case study





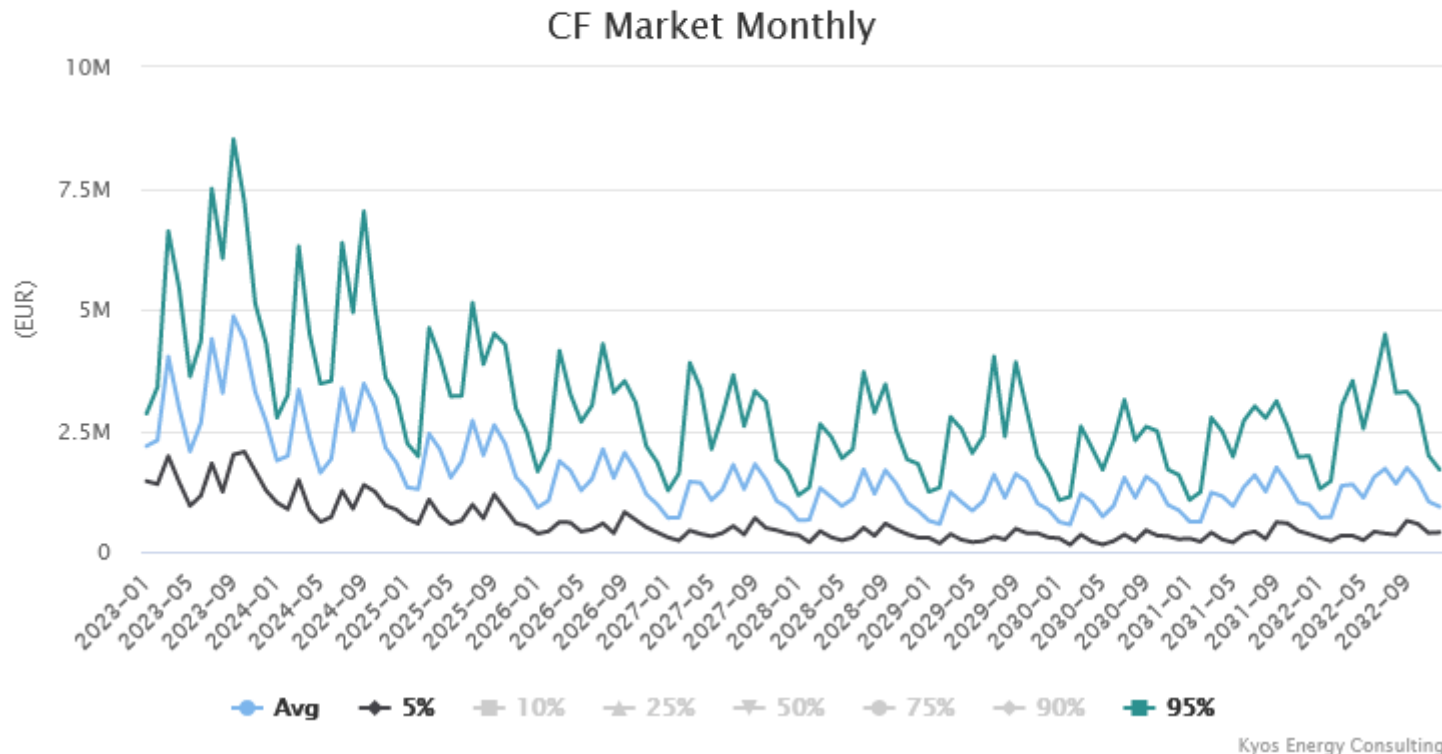
# Case study - outline

- We analyse in this example how a proper PPA risk management system can support a renewable asset owner making informed decisions!
- PV asset owner in France with 100 MWp
- Asset owner wants to assess effect of different PPAs on debt service coverage ratio



# Valuation asset in market

- In the first step we calculate (in KyPPA) the asset value in the (spot) market

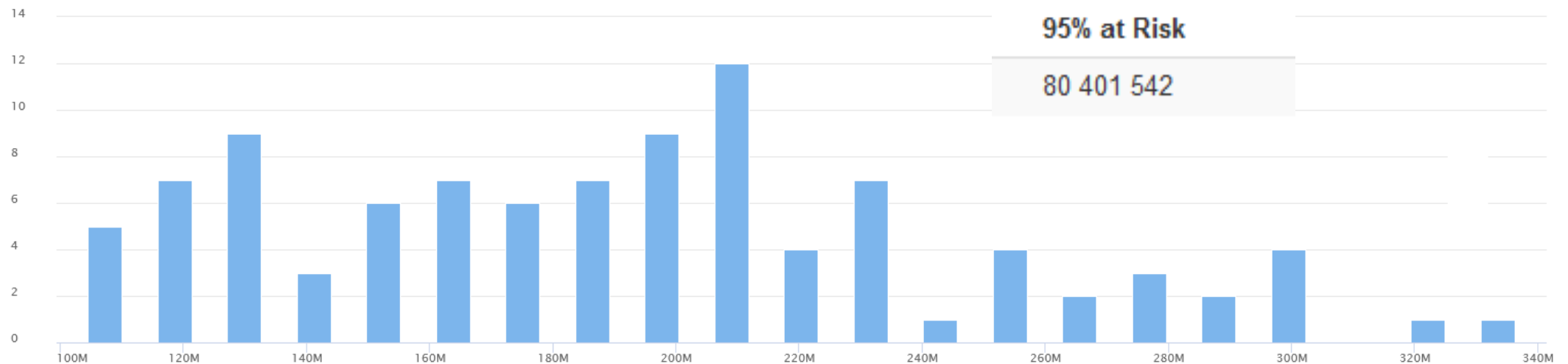


- Wide distribution of possible cashflows -> large risks

# Valuation asset in market



- High risk can also be seen when looking at distribution of cashflows over the 10-year valuation period

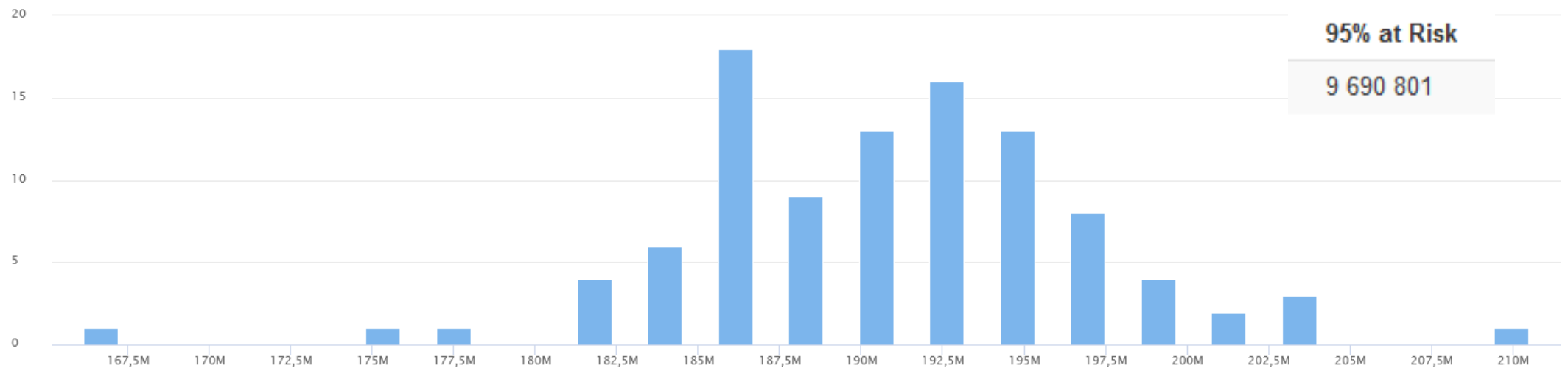


- Indicator for this risk is the Cashflow-at-Risk metric

# Hedging



- We now introduce an annual baseload hedge
  - Using a value neutral hedge as calculated by KyPPA
- Much tighter risk distribution

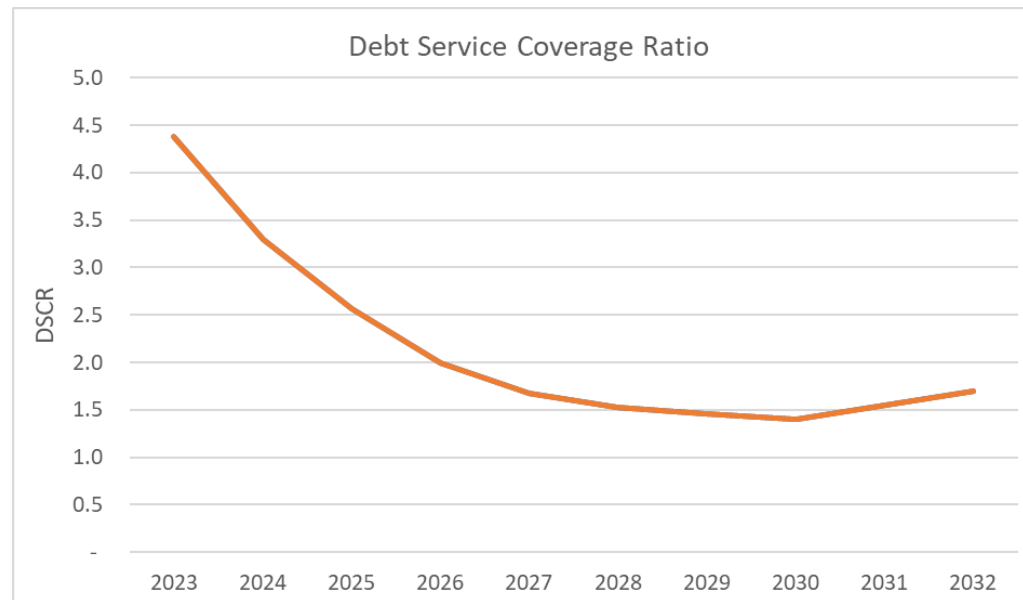


- CfaR metric is now only €9.6mln (from €80mln of unhedged asset)

# Supporting financing (1/3)

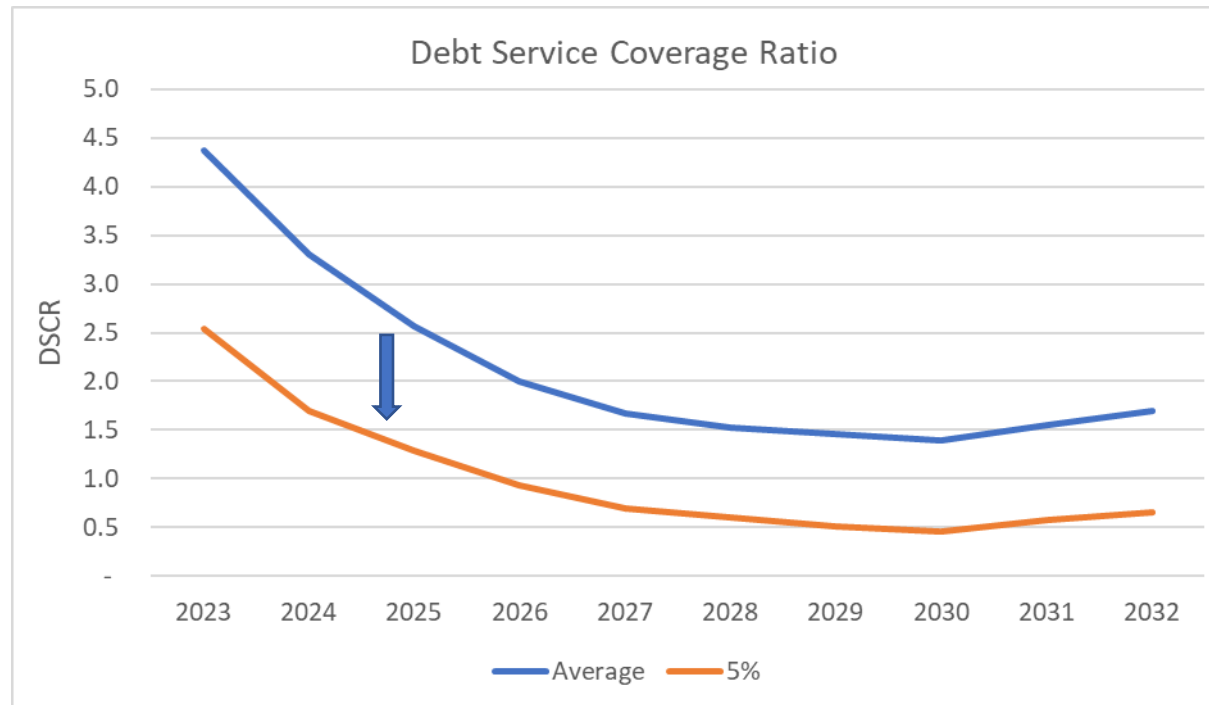


- Banks look at debt service coverage ratio (DSCR)
- Assume total investment around 800€/kW and debt repayment over 10 years
- Based on expected cashflows of the unhedged asset, DSCR looks healthy



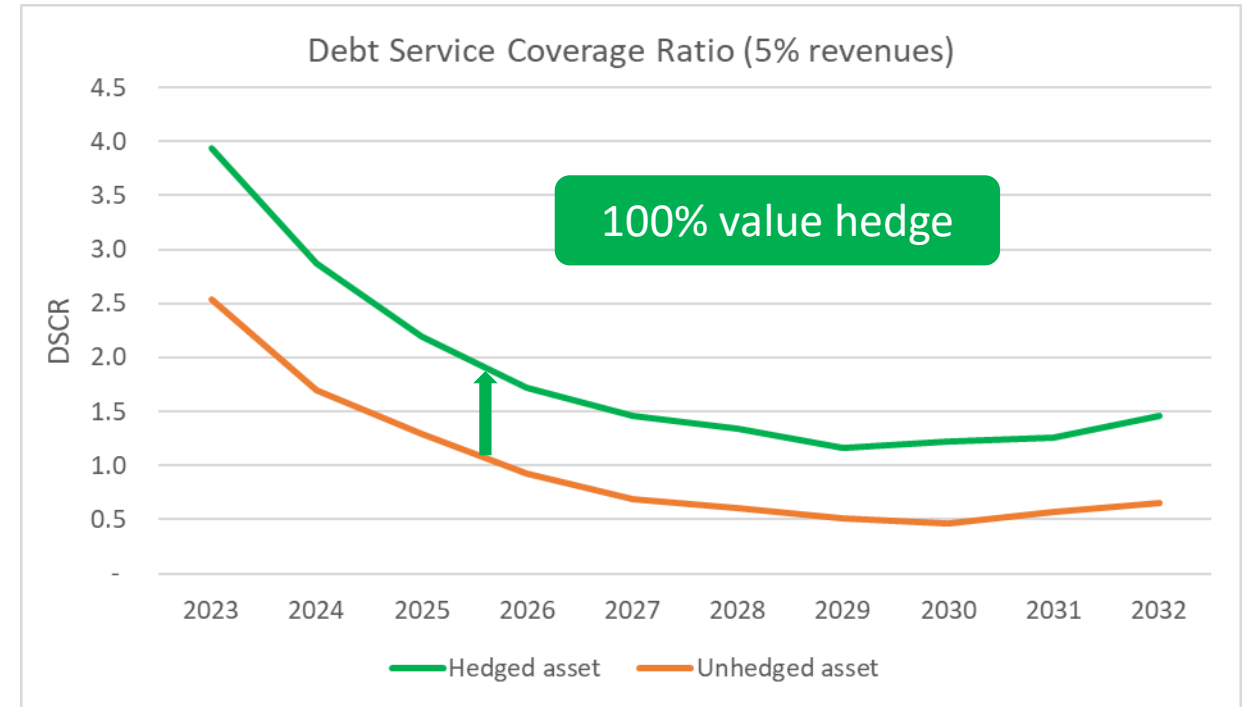
# Supporting financing (2/3)

- But banks want certainty and will not look at expected revenues, but at worst cases
  - E.g. 5% worst case of cashflows
- DSCR of unhedged asset becomes very low, making financing difficult



# Supporting financing (3/3)

- Same analysis with hedged asset
- Brings DSCR back to values close to “expected DSCR”
- KYOS software can be used to easily analyse different hedging strategies on DSCR.
- For example, hedging **91%** of the value neutral hedge maximizes the average DSCR.



# Summary

- Simulation based valuation of renewable assets and PPAs is key to understand price and volume risks
- Valuable tool for
  - Pricing PPAs
  - Defining PPA strategies
  - Optimizing market hedges
  - Supporting financing/investment analysis
  - Daily risk management and reporting
- Not only for aggregators, but more and more used by project developers, investment funds and banks.



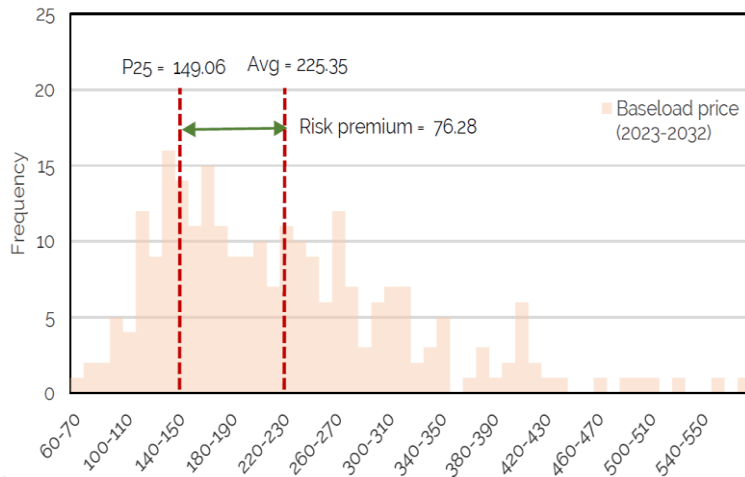
# Thank you



**Report** provides PPA assessments, covering almost whole of Europe

Includes a risk discount in the solar and wind PPA assessments (as of September issue)

Risk adjusted price = P25 price



<https://www.kyos.com/ppa-insights-european-solar-and-wind-power-prices/>

**PPA Insights**  
Price developments in Europe

KYOS Energy Analytics  
September 2022 – Issue Nr. 5



### Western Europe

	Baseload	Solar	Wind onshore
Netherlands	230.6	116.0	136.2
Belgium	240.1	133.0	146.9
Germany	240.8	135.9	143.8
France	218.4	124.2	133.4
Switzerland	253.9	143.9	169.5
Austria	255.5	147.6	166.4

**Book** describes systematic approach to renewable financing and PPA pricing / hedging

