WIND POWER
Finance & Investment
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EUROPE

Risk Management of renewable assets

London - 7 December 2022

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KYOS Energy Analytics

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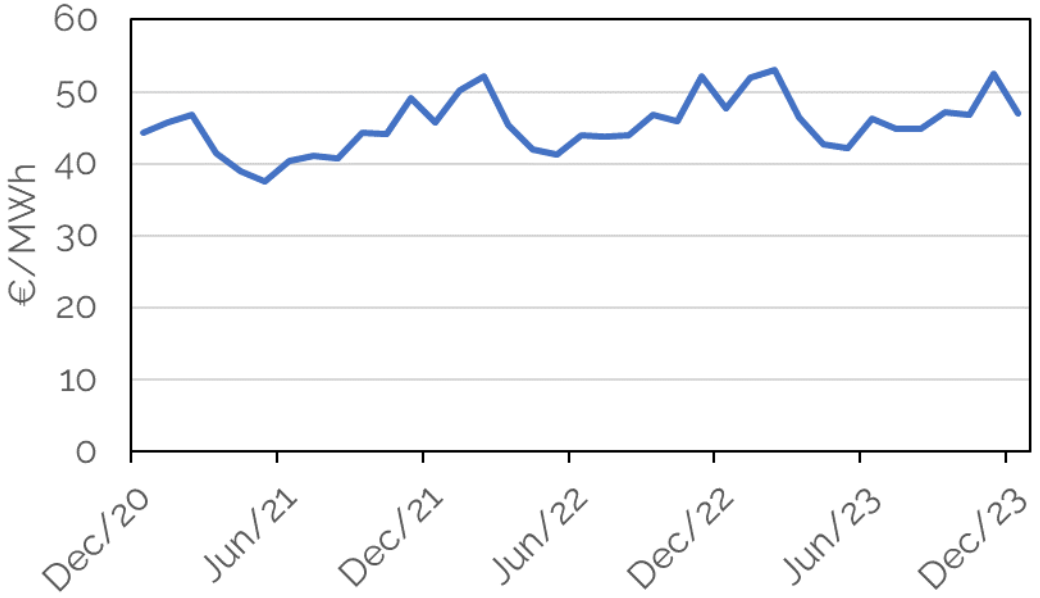
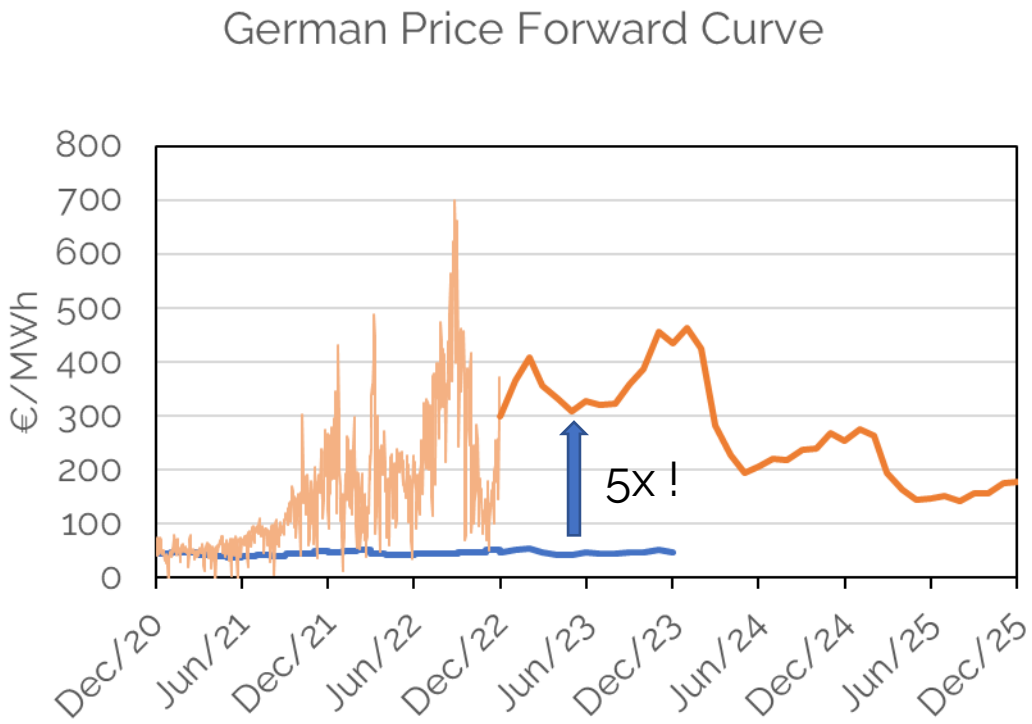
Why risk management?



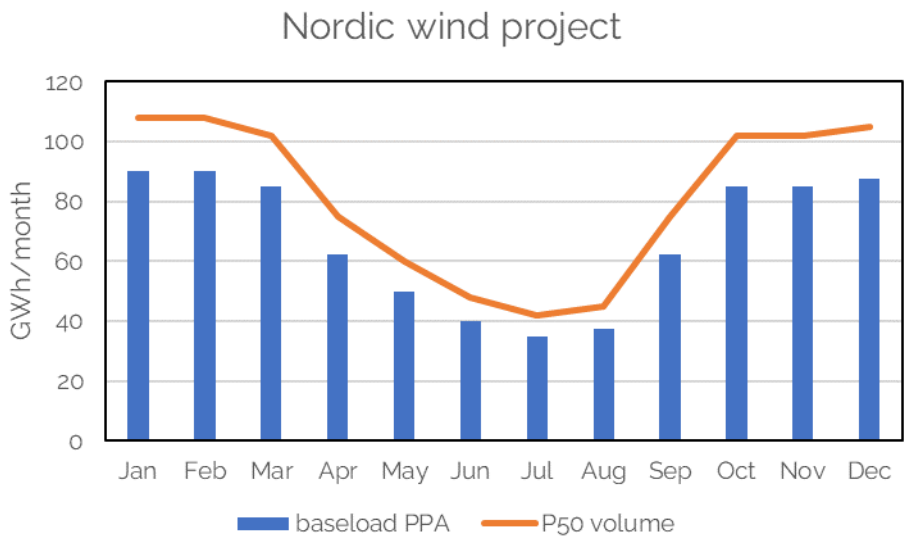


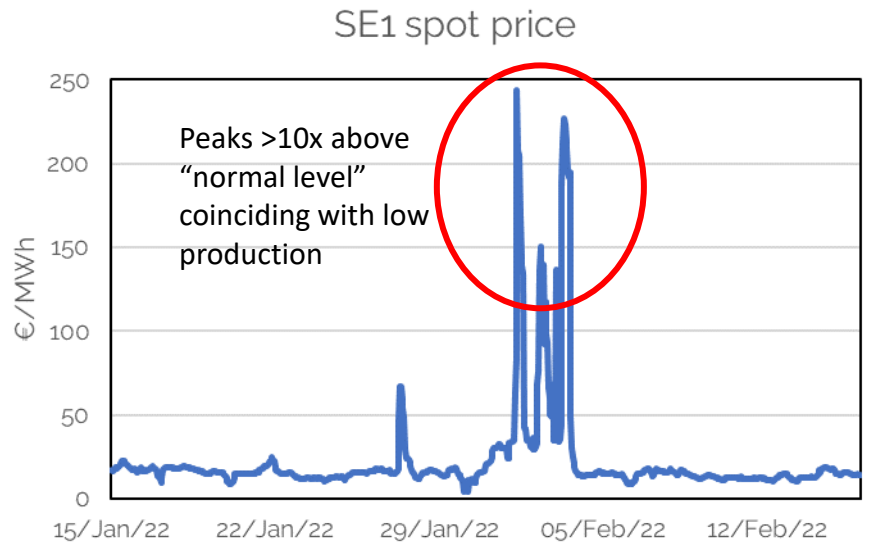
Electricity prices are extremely volatile -> proper risk management required!

Another example

Wind project in Nordics

- Sold 80% of P50 volume as monthly base load PPA
- Risk: low production -> buy back in market
- Especially risk in Winter months
  - Low wind periods affect region, lead to price spikes
- Questions to ask: how to reduce this risk?
  - Reduce hedge volume (PPA)?
  - Restructure hedge?
  - More active management?
- But first: quantify this risk!





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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

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KYOS renewable energy services

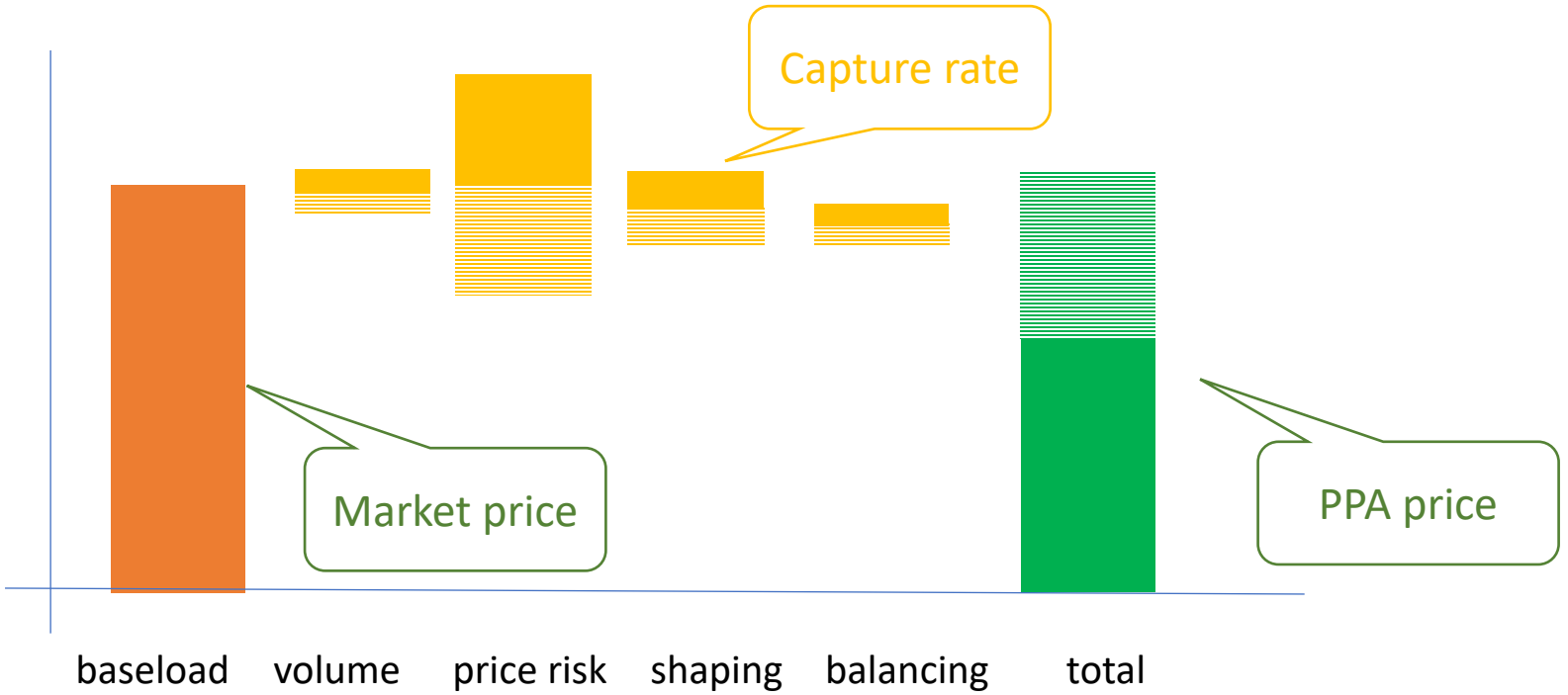
KYOS supports all players in the renewable energy sector

	Project developer	Bank or investor	Utility or Aggregator	Corporate off-taker
Software	• KYOS Analytical Platform - complete software system to price and manage renewable assets and PPAs • Make long-term power price projections and perform what-if analysis • Monitor and manage a complete portfolio of assets, PPAs and hedges • Analyse different hedging strategies before entering in new deals • Obtain detailed risk reports for managers, investors and analysts			
Advisory	• Get valuation support during PPA negotiation and M&A activities • Get regular PPA valuations for accounting and trading purposes • Get support with arbitration cases, re-financing and re-powering			

A simulation approach to assess risks

Renewable asset/PPA value components and risk

- Complex product
- Some risk components are easier to value.
- Power price risk is typically largest risk component



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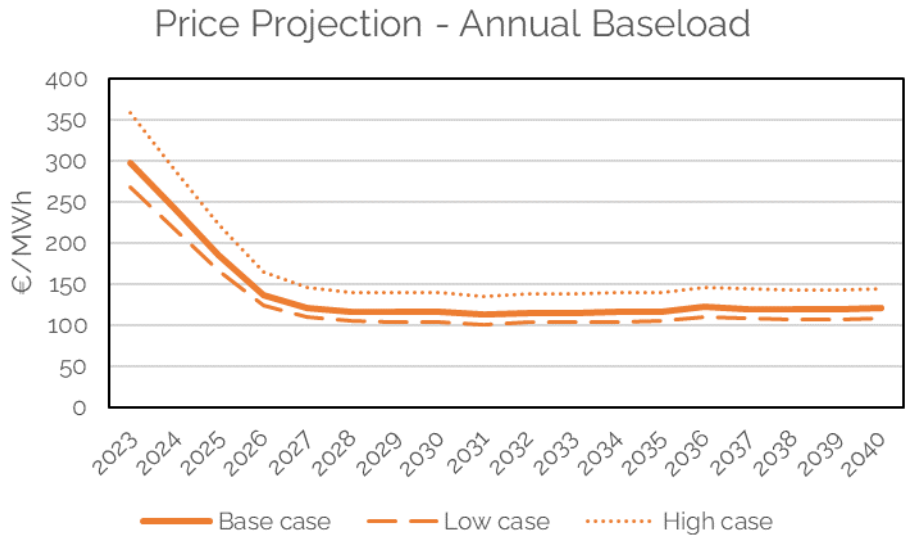
How to quantify price risks of renewable project?

- Classical approach:
  - Use long-term price projections
    - Vendor A, B, C
    - Scenario X, Y, Z



- Disadvantages:
  - As good as the inputs
  - One or limited scenarios
  - Does not cover extreme/unexpected events (see current market)
  - Not easy to model cannibalization/shape risks

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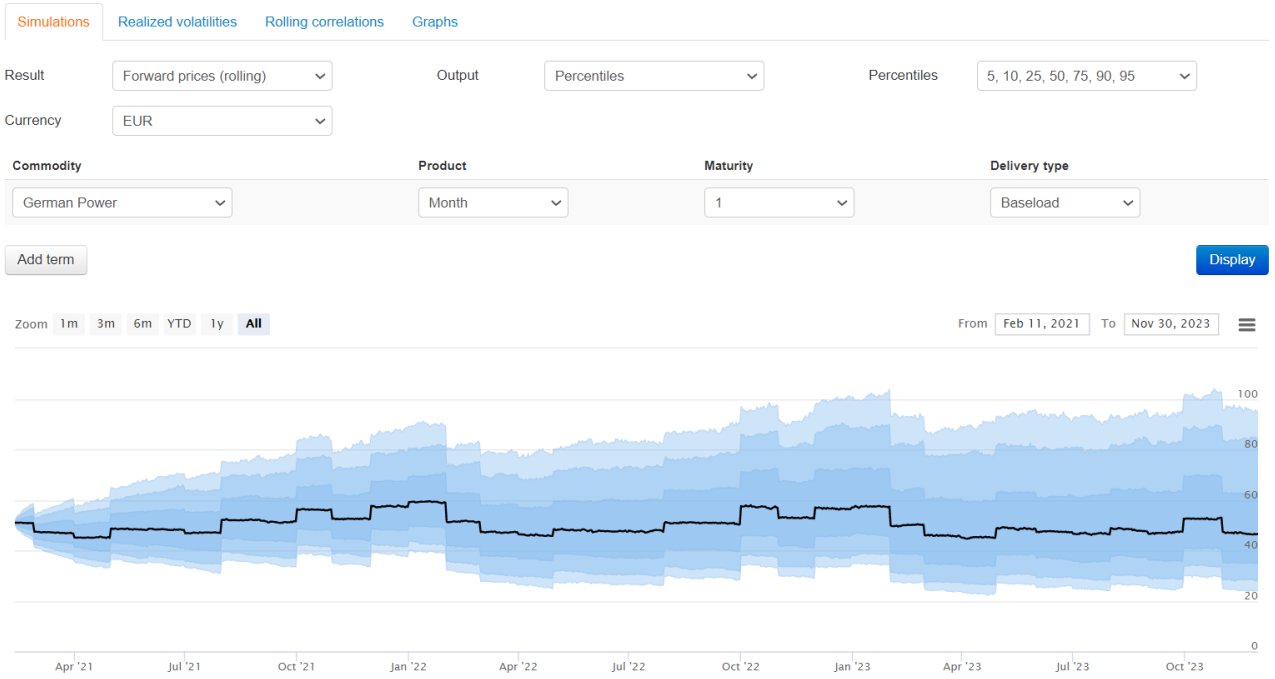
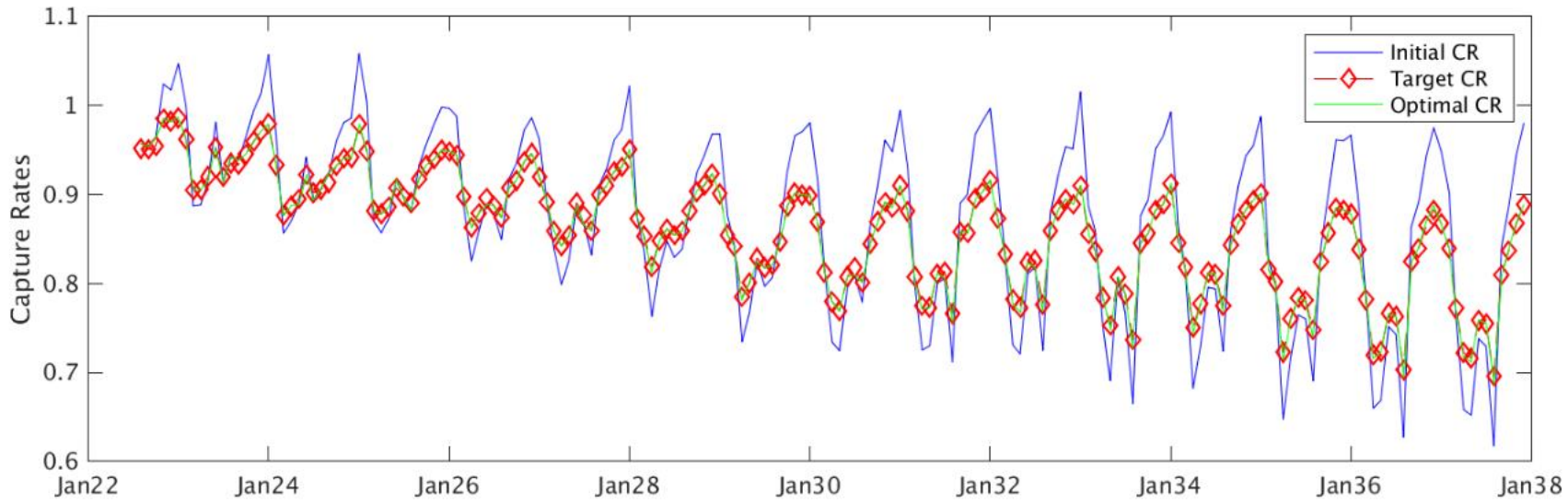
Why simulate prices?

- A single forecast of power prices is not enough
- Price simulations allow for large number of possible scenarios, also edge cases
- 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



How can this help you?

Systematic risk assessment framework

Define your asset → Create simulations → Set-up PPA and hedges → **Risk analysis**

- Historical data
- Expected P50
  - Given
  - Estimated by model
- Capture rate development
  - Given
  - Estimated by model

- Forward curve!
- Accurate model
- Calibration!
- Multiple commodities to portfolio view
- `Also volumes

- Capture PPA details
- Standard contracts
- Flexible!

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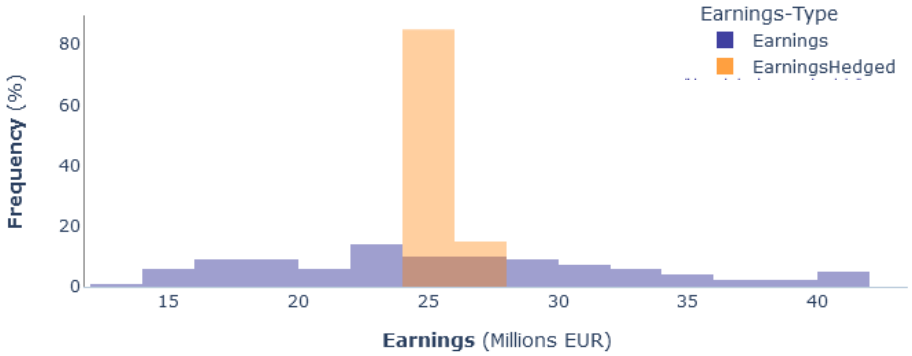
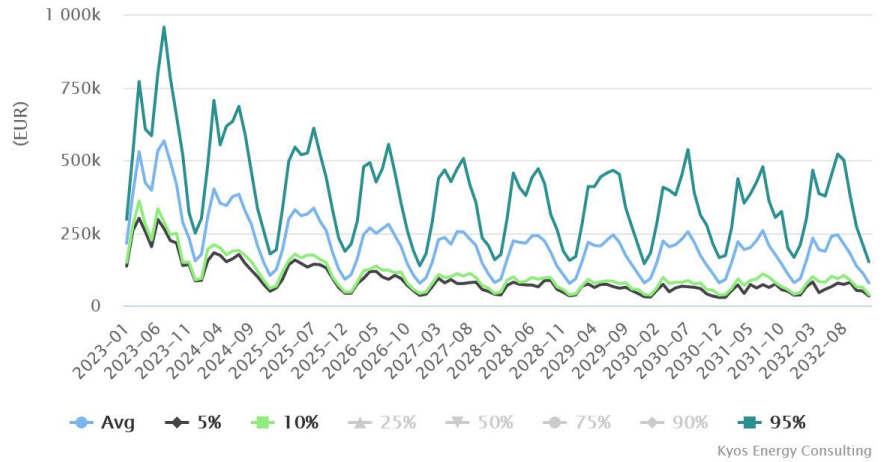
Risk analysis

Define your asset → Create simulations → Set-up PPA and hedges → **Risk analysis**

- Cashflow/earnings distribution
  - Aggregated over longer time horizon
  - On monthly level
- Unhedged asset
- Hedged asset
- Portfolio effect
  - Assets in different locations/countries and technologies
- Clear metrics, e.g. EaR





Earnings at Risk | Cash-flow at Risk | Volumes at Risk

Earnings at Risk Summary	Commodity	Currency	95% at Risk
Commodity	Total	EUR	54 419 254

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How does this help you?

Pre-deal/FID

- Financing:
  - Monthly cashflow distribution gives view on worse case project cashflows
  - Help to assess DSCR
- Structure your PPA:
  - Change PPA parameters and see impact on risk distribution
- Holistic portfolio view
  - How does this asset change overall portfolio risk? (technology/location diversification)

Asset in operation

- Risk reporting
  - Continuous monitoring of expected revenues in changing markets
- Test portfolio adjustments
  - Assess effect of additional hedges on risk profile
- Implement portfolio adjustments

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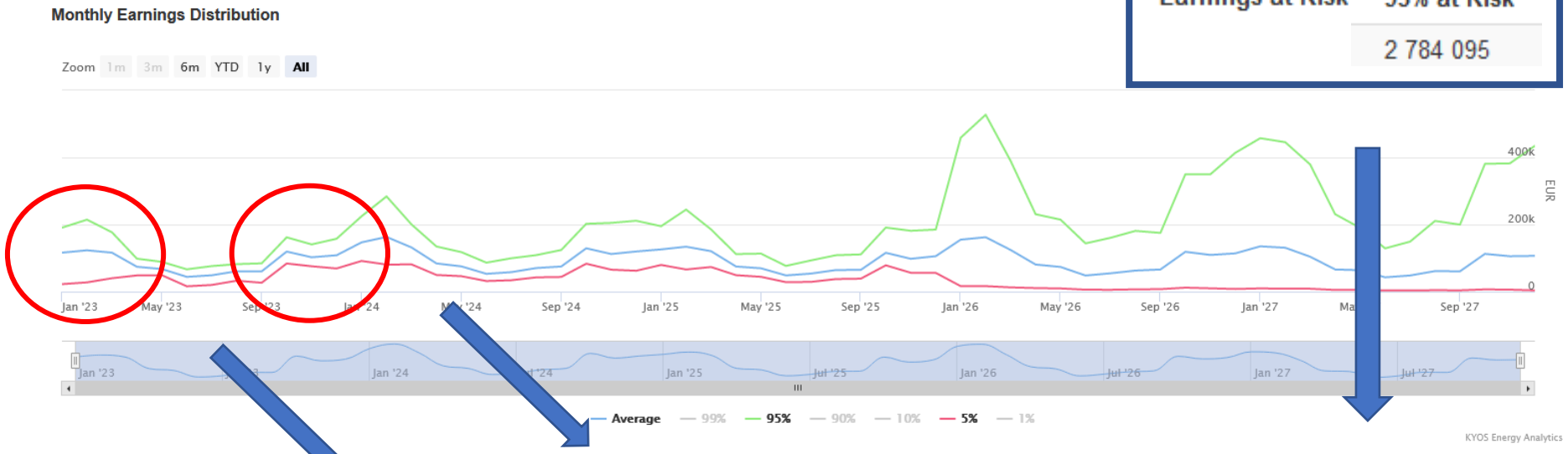
Example

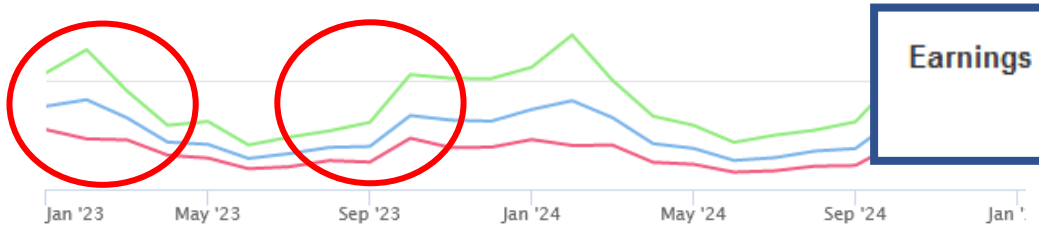
On-shore wind project

- 75% P50 volume hedged with 3 year PaP fixed price PPA
- Expected revenue distribution too wide for company risk appetite



Earnings at Risk	95% at Risk
	2 784 095

- Add additional Q1-23 + ca23 baseload hedge



Earnings at Risk	95% at Risk
	2 515 118

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.

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We look forward to supporting you with the right tools and advice!

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