



Who can absorb the investment risks of the Energiewende

PPAs as a tool to allocate risk to the most suitable parties

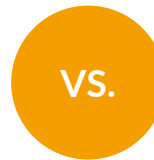
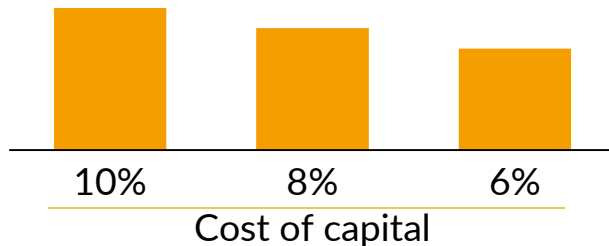
November 2018

PPA negotiations try to strike a deal between the technology cost and the fair market value perspective

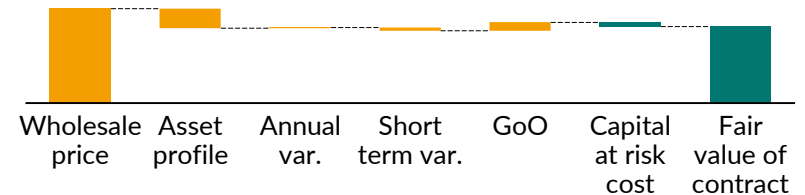
Developers take the perspective of **technology cost** during PPA negotiations...

...while off-takers should focus on the perspective of **fair market value** of power

Levelized cost of electricity (LCOE),
EUR/MWh



Fair value of PPA contract cash flows,
EUR/MWh



PPAs can create value for both parties if the right trade-off between fixed cash flow for asset to reduce financing cost and value-at-risk for off-taker is struck and priced according to market value.

Fair market value of an onshore wind fixed price 4-year post-subsidy PPA is 35.0 EUR/MWh for volume as-produced

Contract: Duration: 2020 for 4 years // **Price:** fixed price¹ // **Volume:** as-produced & no economic curtailment

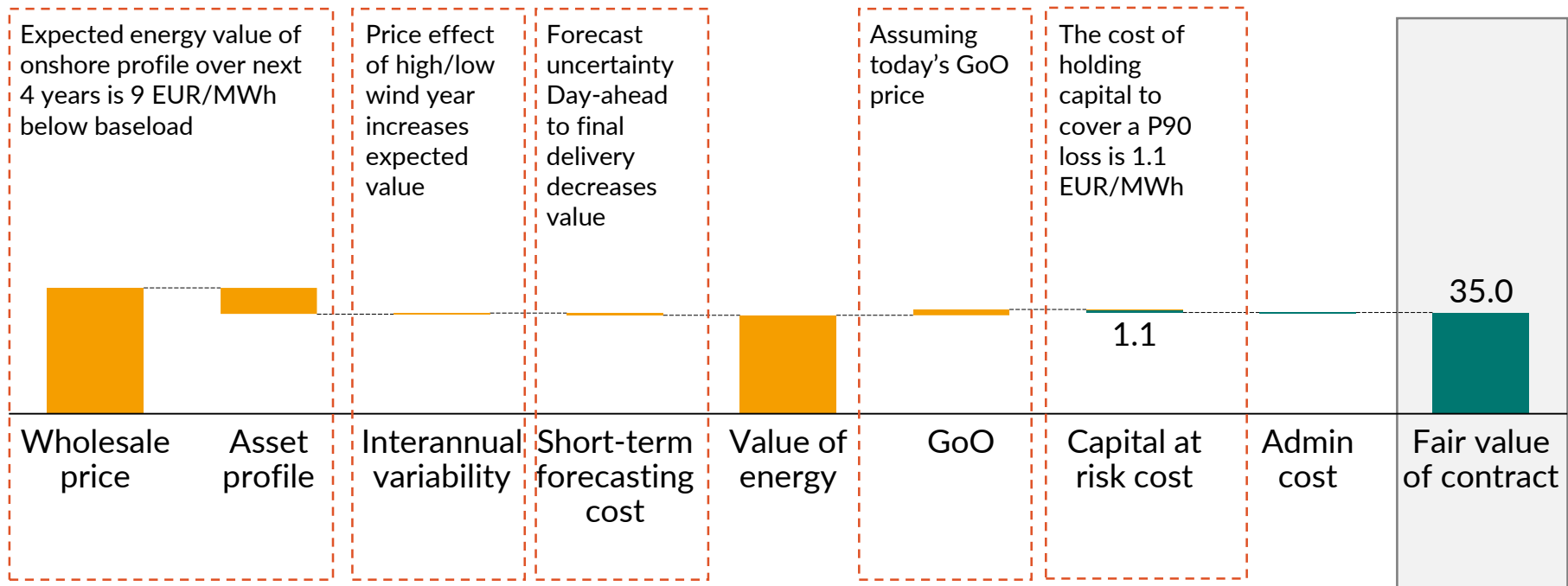
Fair price calculation for onshore wind fixed price PPA, EUR/MWh



Value at risk
(EUR/ MWh)

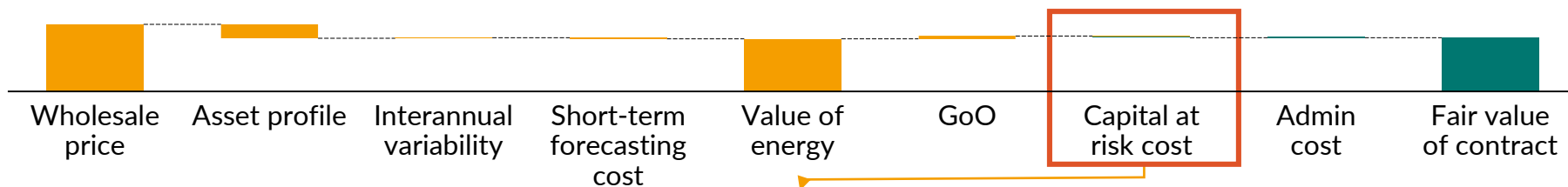
7.0

- Off-taker holds downside risk if market price falls below contract value



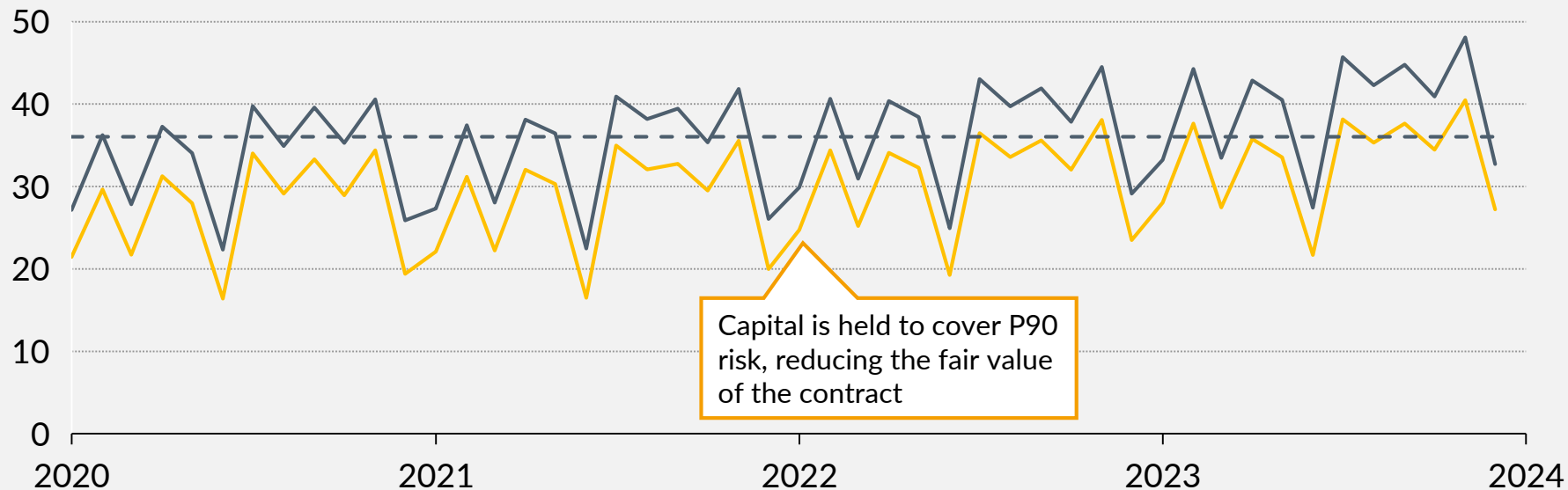
1) Prices expressed in real 2017. Fixed price always refers to an inflation-linked rate in this study

Risk of declining market value of contract needs to be covered with underlying capital



Onshore wind delivered energy value (energy and GoO)

EUR/MWh



- Key contract indicators:

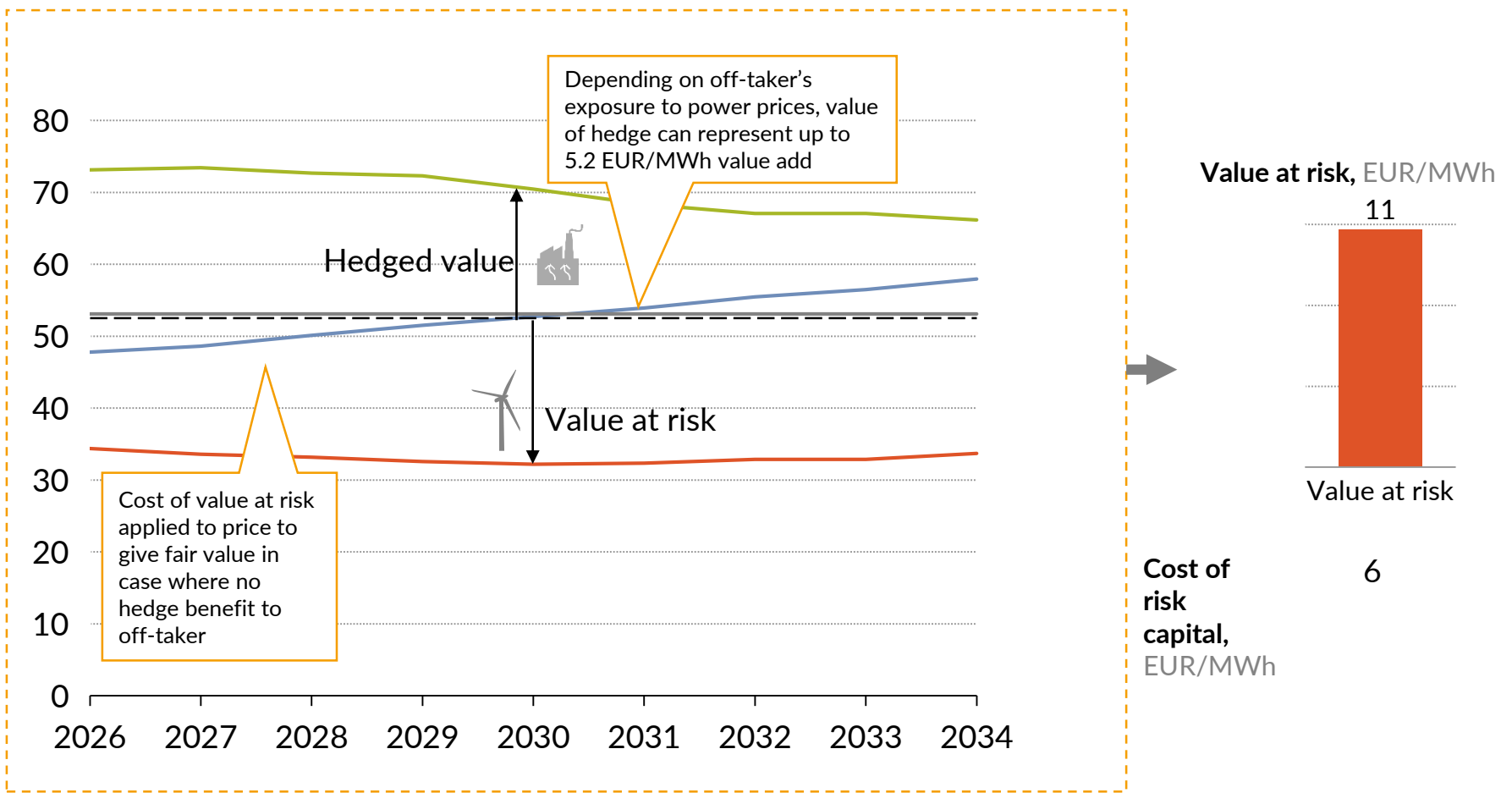
- **Value at Risk (VaR):** Average EUR/MWh contract value risk between P50 and P90 forecast
- **Cost of risk capital:** Cost of holding capital to cover expected cumulative value-at-risk

1) Contract price before accounting for risk

For long-term contracts which could enable green-field developments VaR rises to 11 EUR/MWh

Value of delivered energy in a offshore wind PPA¹,
EUR/MWh

— P50 — P90 — P10 — Expected value



1) Capture prices shown for a representative asset, with 2 EUR/MWh GoO value added, and intraday and interannual terms totaling 0.87 EUR/MWh subtracted

Fair market value of an offshore wind fixed price 12-year PPA is 44.4 EUR/MWh for volume as-produced

Contract clause: **Duration:** 12 years starting 2023 // **Price:** fixed price // **Volume:** as-produced & no economic curtailment

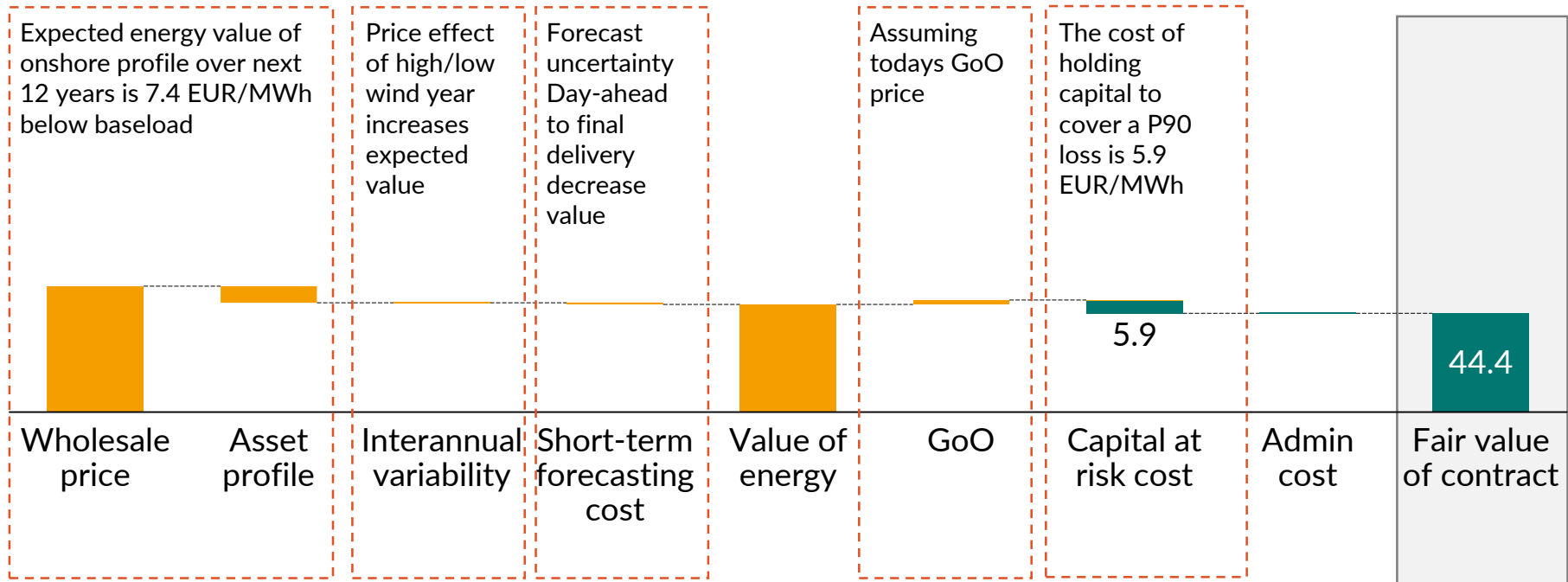
Fair price calculation for offshore wind with fixed price PPA, EUR/MWh



Value at risk
(EUR/ MWh)

11.2

- Off-taker holds downside risk if market price falls below contract value

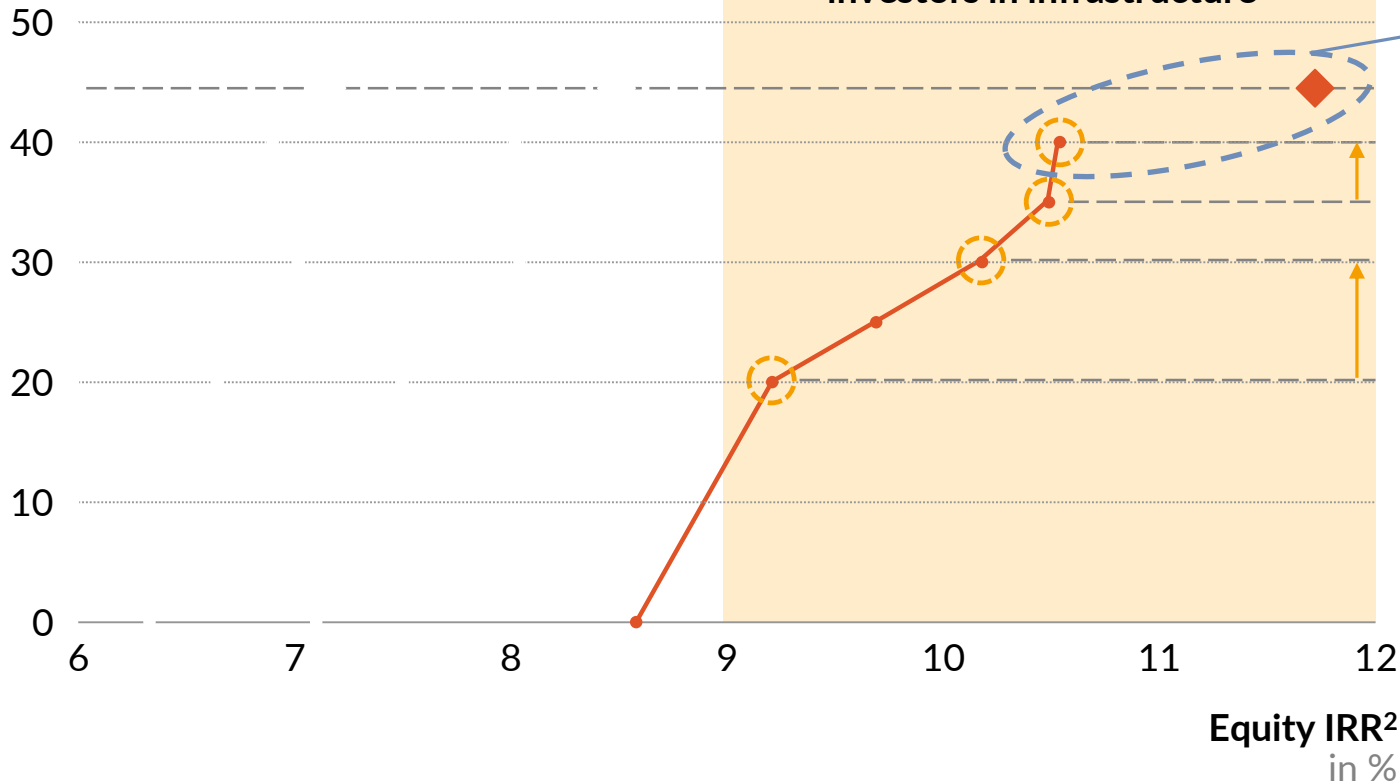


To a certain level a rising price floor improves project economics

Impact of price floors on equity IRRs

CAPEX assumptions: Aggressive(-25%) Returns for fixed price

Price floor
in EUR/MWh



Fixed price most profitable as off-taker is accepting all risk and discount is lowered by foregone upside

1

Raising floor returns little value

2

Benefit of higher price floor outweighs bigger value discount

Debt/Equity ratio



1) EDHEC Infrastructure Institute (2017). 2) Nominal IRR for fully leveraged equity

Increasing floor beyond 35 EUR/MWh has marginal return for equity but adds significant VaR for off-taker

CAPEX assumptions:

Returns for fixed price

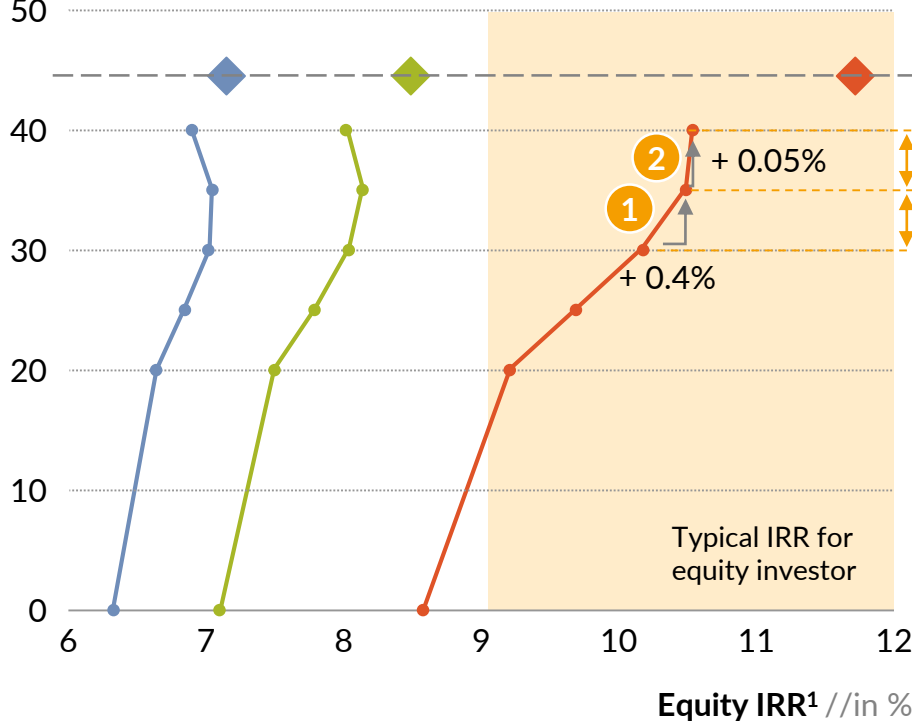
Value-at-Risk

Aggressive(-25%)

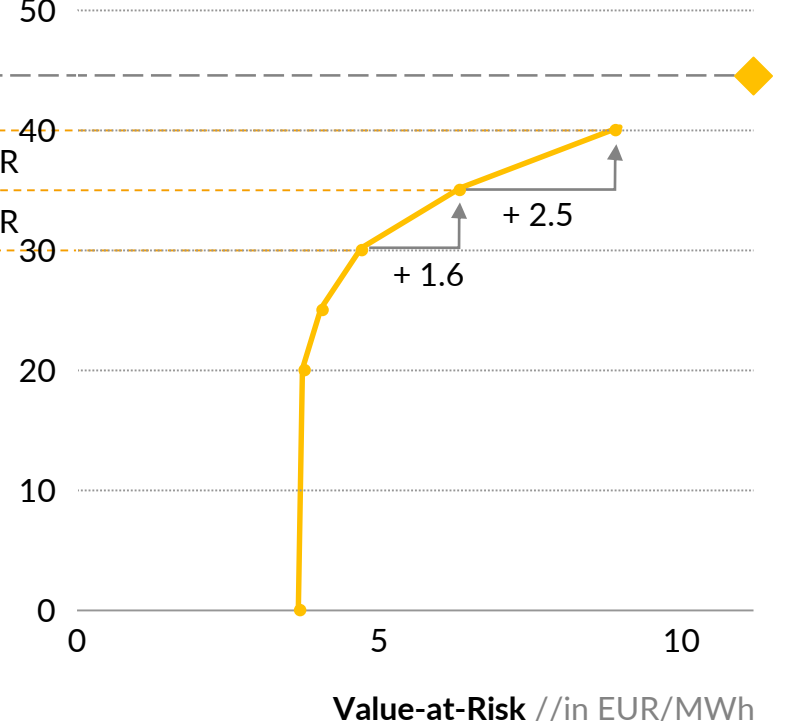


Price floor
in EUR/MWh

Impact of price floors on equity IRRs



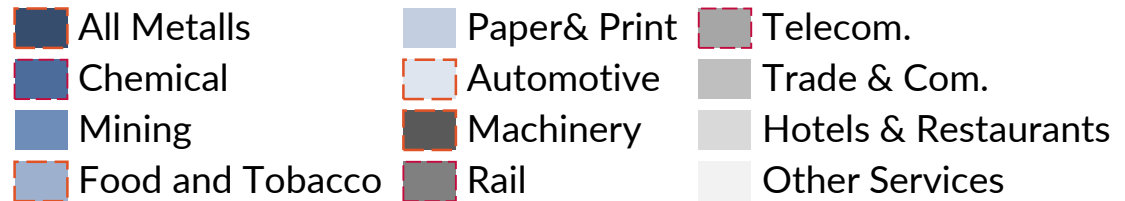
Impact of price floors on Value-at-Risk



Who is best able to manage long-term value at risk?

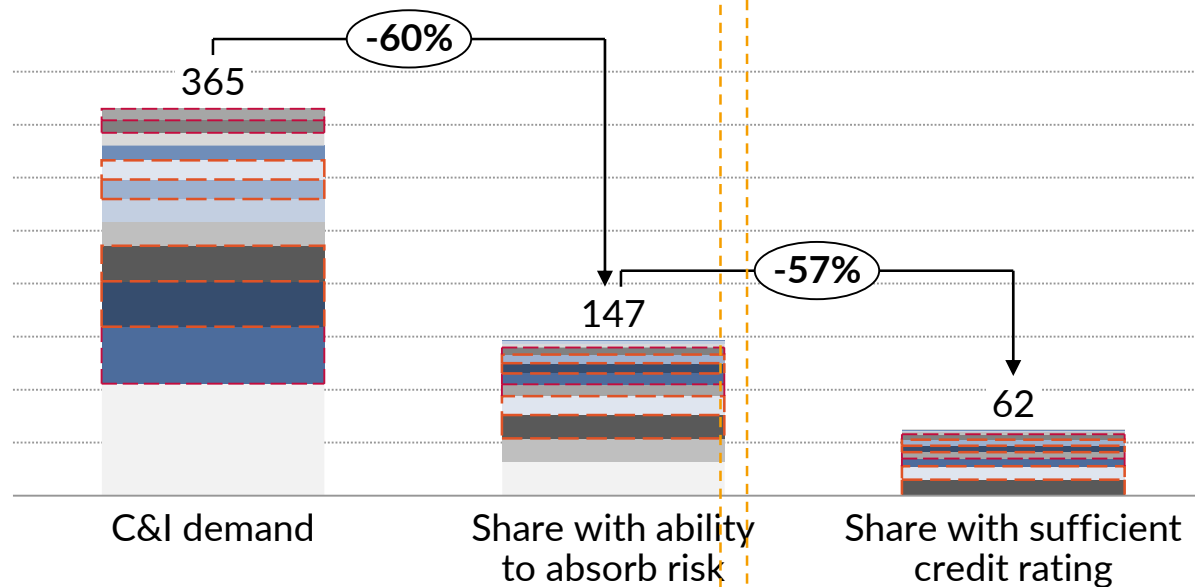
C&I ability to take power price risk is expected to be limited to ~62 TWh/a or 1 bn EUR value at risk

Estimate of C&I PPA market potential, TWh/a



Short duration PPA potential: Ability to absorb power price risk depends on share of power on total cost & level of competition¹

Long duration PPA potential: PPAs are only bankable if off-taker have sufficient credit-rating²



= 1 bn EUR value at risk p.a. or 12 bn of investment payback time

= ~ 14 GW offshore

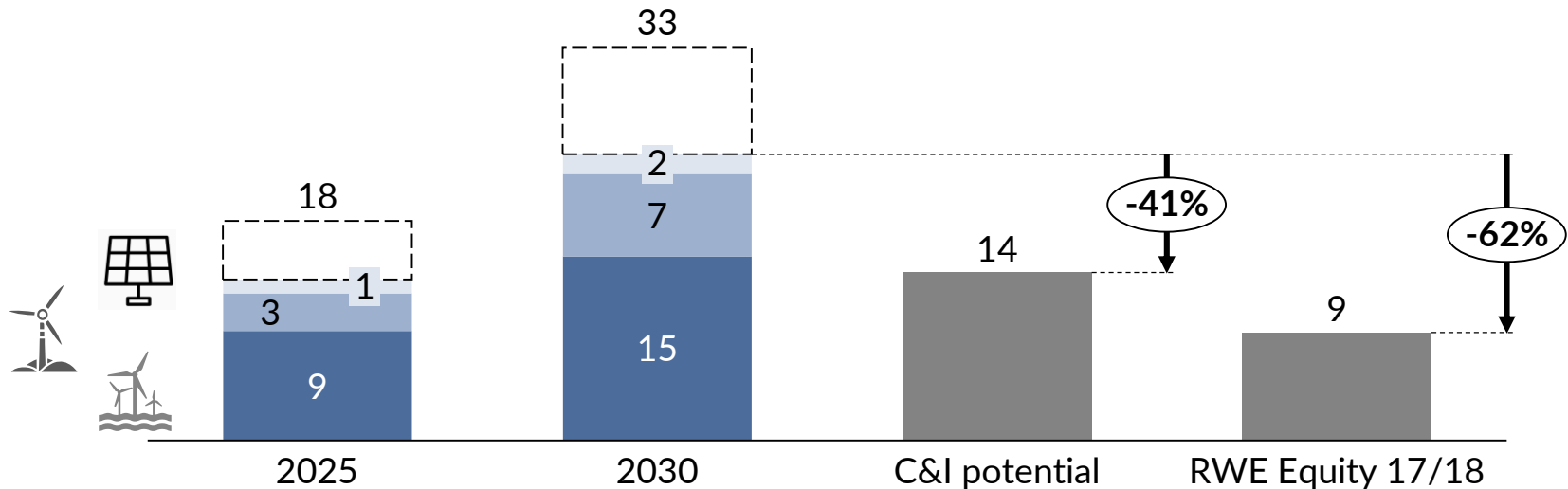


1) We defined a hurdle rate per industry as maximum EBIT impact of P90 risk realisation between 0.5 - 1.5% depending on level of competition. 2) Assumed discount based on fragmentation of industry

Until 2030 Energiewende requires investments with 24 - 33 bn EUR in value at risk, ca. twice C&I absorbability

Cumulative value at risk over investment payback time vs. ability to absorb risk, bn EUR

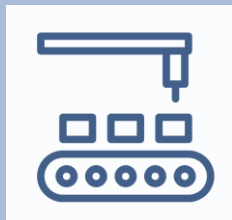
- 65% RE target
- Solar
- Offshore
- Onshore



Cumulative value at risk of RES investments with CoD 2020 until 2025/30

Food for thought

Industry



- Large off-taker who are able to absorb power price risk are a scarce resource and thus have a strong negotiation power
- Building up strong relationship with C&I player can be a key success factor for RES developer

Utilities



- To transition to a “subsidy free” Energiewende the market needs large risk accumulators who are able to manage long-term power price risks
- This favours a strengthening of the classic utility model.

Regulation



- If the aim is to transition away from subsidies regulator should focus on reducing downside risks e.g.: Carbon price floor, fixed long-term build out targets etc.

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