



Who can best carry the risk of the future Energiewende?

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

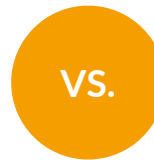
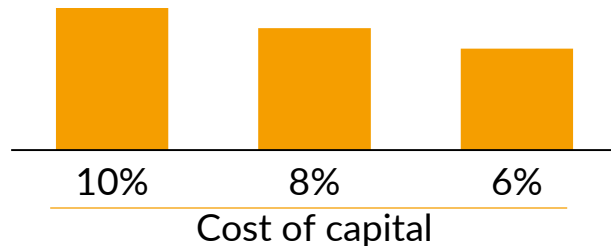
January 2019

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

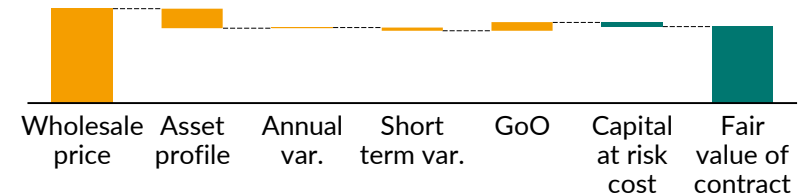
Developers take the perspective of **technology cost** during PPA negotiations...

...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 with the right trade-off between guaranteed cash flow (reducing the financing cost for asset) and the value-at-risk and energy market value for the off-taker.

A fixed price enables debt finance leverage and can reduces project WACC by 4.3%

Debt Perspective

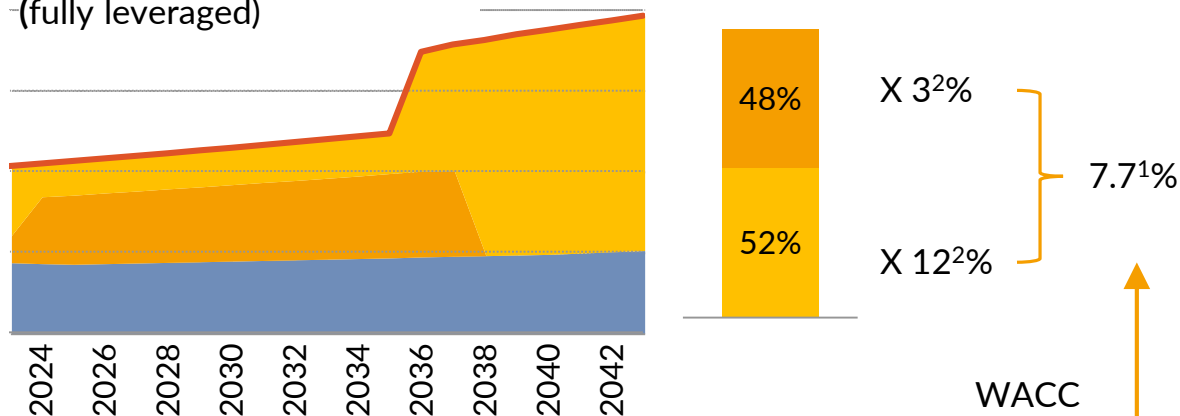
- Lender interested in secured repayment of debt & interest
- Debt sizing based on conservative estimation of repayment ability:
 - Based on P90 wind year
 - Guaranteed cash flow (fixed or floor price)
 - Additional buffer applied through Debt Service Coverage Ratio DSCR (secured cash flow needed to repay e.g. 1.1 - 1.4 x debt & interest in each period)

Offshore wind farm, COD 2023
 PPA: 12-year, volume as-produced
 Debt: tenor 15 years at 3%, DSCR 1.2

■ Equity returns
 ■ Debt service
 ■ O&M cost
 — Expected revenue

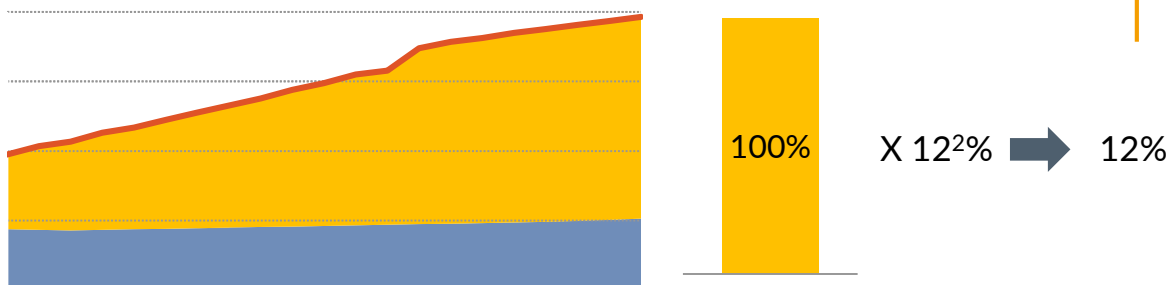
Example 1: fixed price PPA enables debt financing

Schematic project cash flows (fully leveraged)



Example 2: without PPA asset is financed all equity

Schematic project cash flows



WACC decrease by 4.3%

1) All interest rates are nominal. 2) The rates represents a generic assumption and can vary depending on project parties and details.

Fair market value of an offshore wind fixed price 12-year PPA is around 45 EUR/MWh for volume as-produced

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

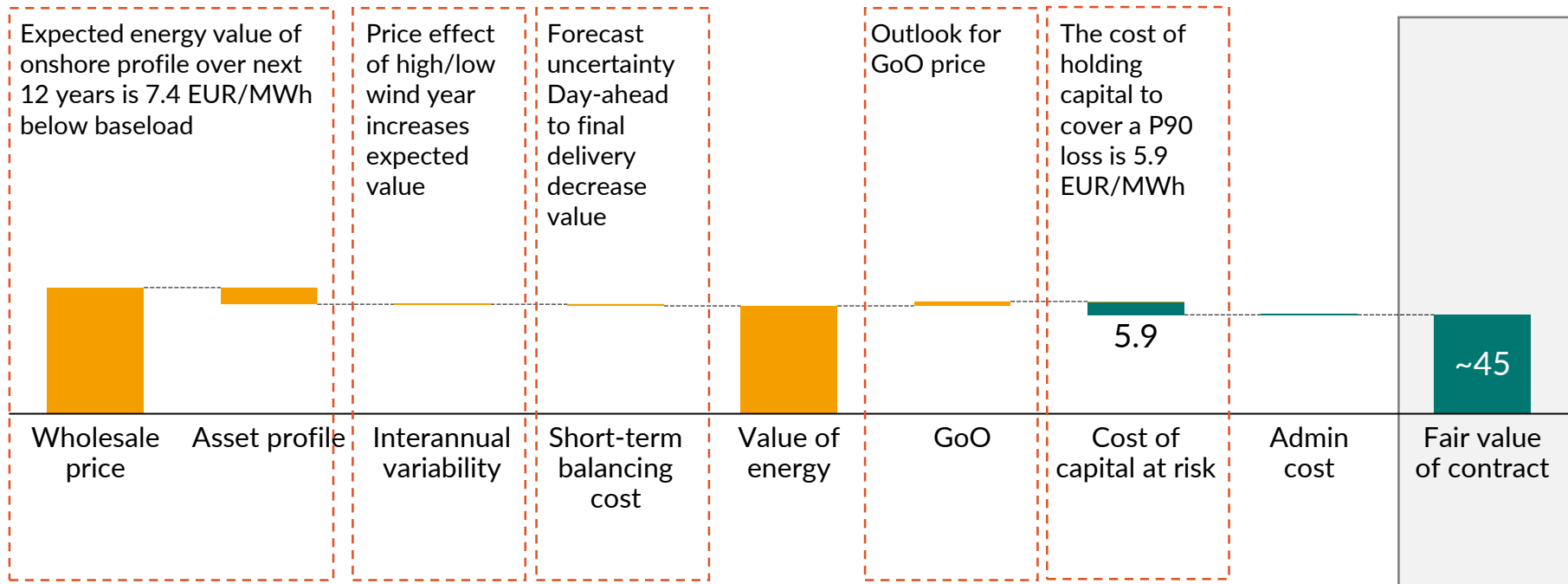
Fair price calculation for offshore wind with fixed price PPA, EUR/MWh



Value at risk
(EUR/ MWh)

11.2

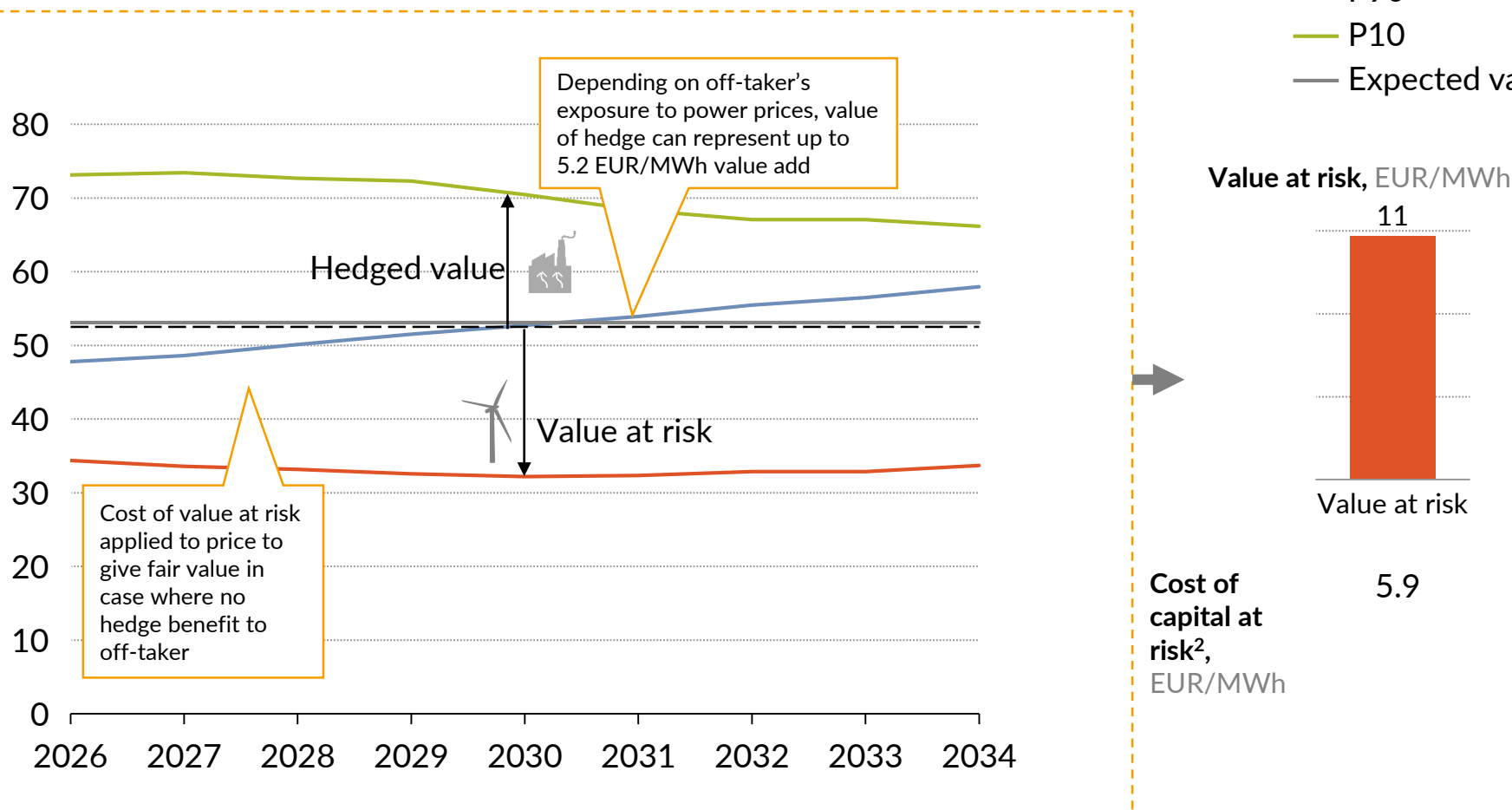
Off-taker holds downside risk if market price falls below contract value



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

Market scenario: — P50
— P90
— P10
— Expected value



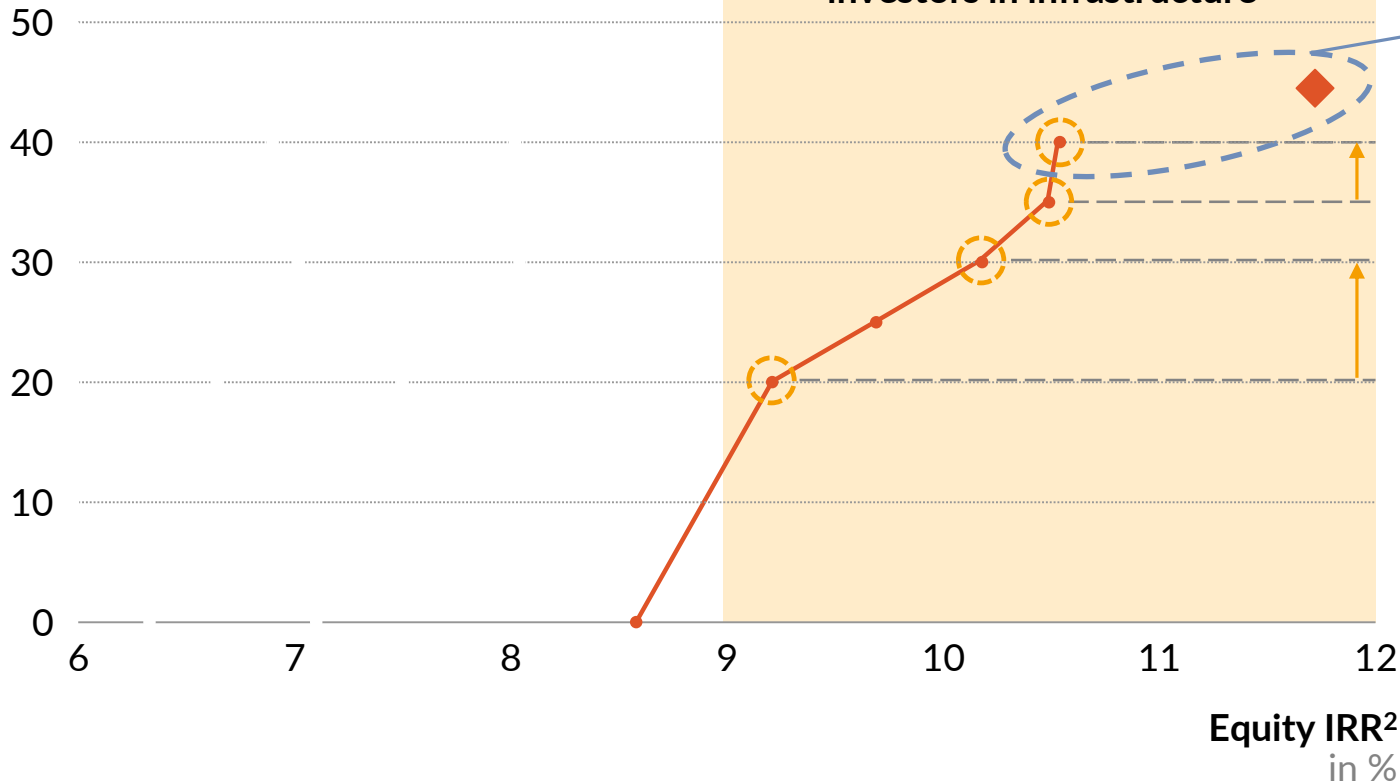
1) Capture prices shown for a representative asset, with GoO value added, and cost for short-term imbalance and interannual variability subtracted. 2) Based on corporate WACC of 9%

To a certain level a rising price floor improves project economics

Impact of price floors on equity IRRs

CAPEX assumptions: ■ Strong reduction (-33%) ◆ 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



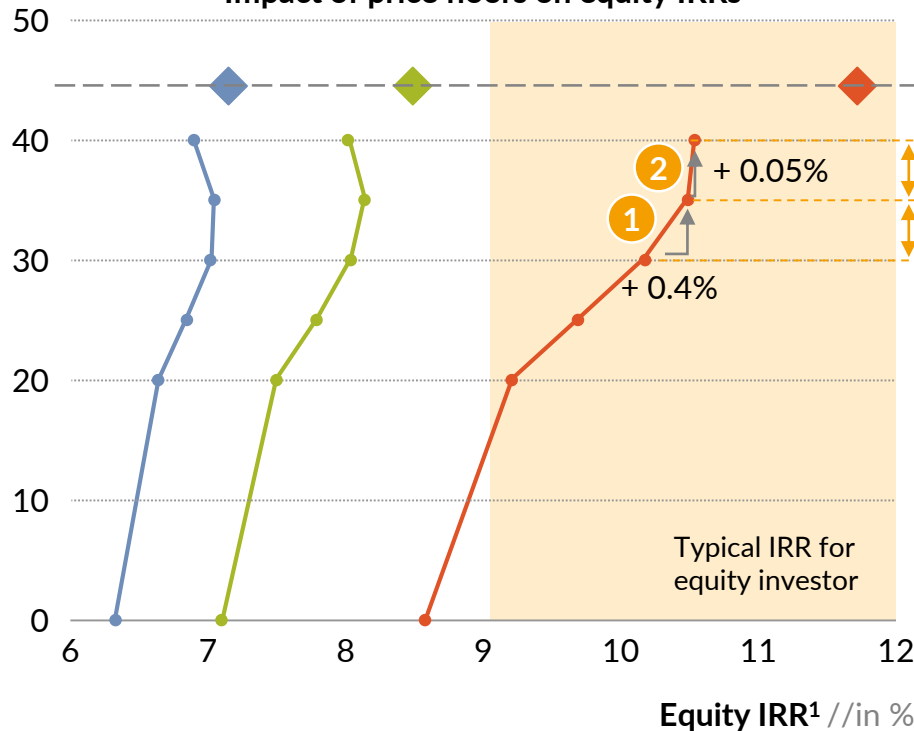
1) EDHEC Infrastructure Institute (2017). 2) Nominal IRR for fully leveraged equity

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

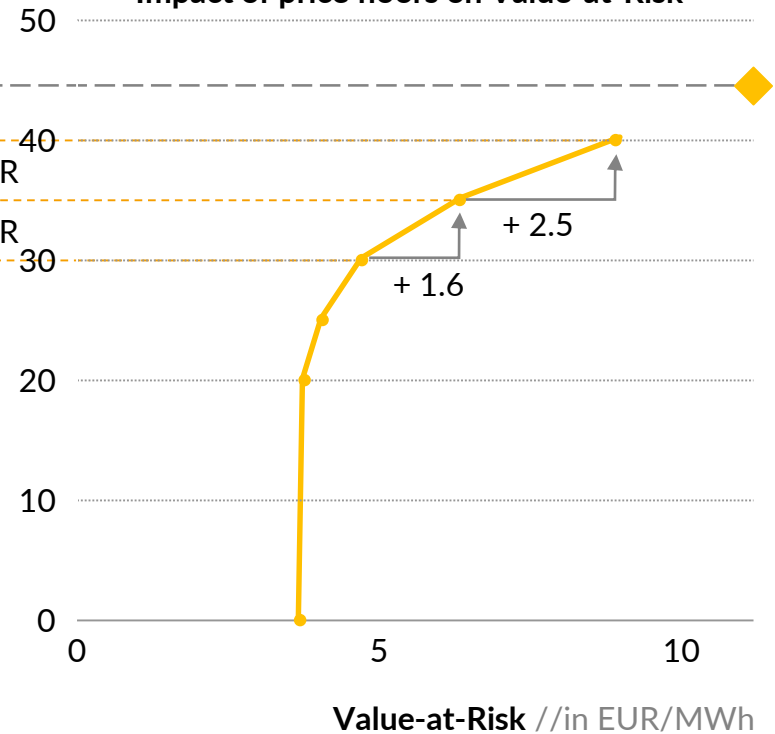
CAPEX assumptions:
■ Moderate reduction (-12%)
■ Medium reduction (-20%)
■ Strong reduction (-33%)
■ Value-at-Risk
◆ Fixed price contract

Price floor in EUR/MWh

Impact of price floors on equity IRRs



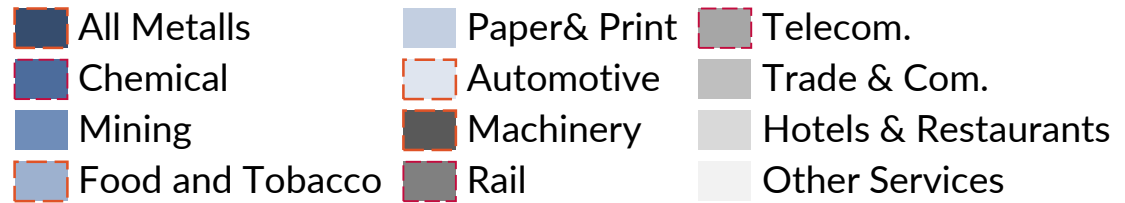
Impact of price floors on Value-at-Risk



Who can best carry the long-term value at risk?

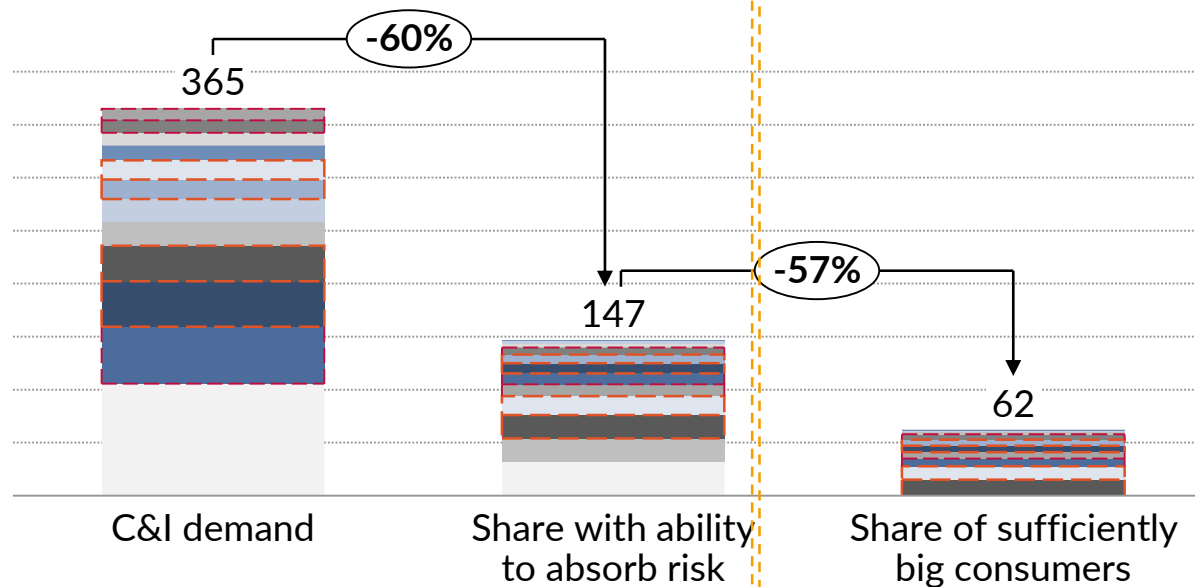
C&I ability to take power price risk is estimated to be limited to ~60 TWh/a or 1 bn EUR value at risk

Rough 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 are of sufficient size²



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

= ~ 14 GW offshore

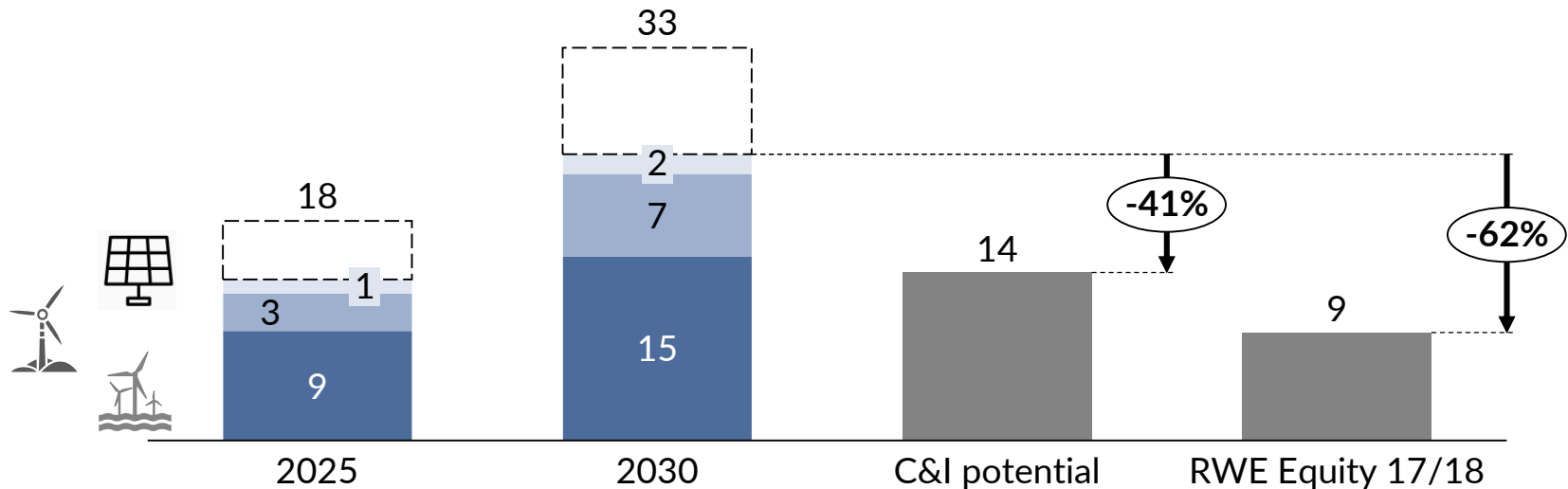


1) We defined a hurdle rate per industry as maximum EBIT impact of P90 risk realisation between 0.5 - 1.5% depending on level of competition. 2) Assumed discount based on fragmentation of industry

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

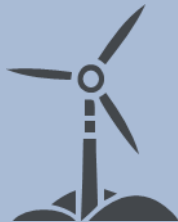
Outlook for the future

Industry



- Large off-taker who are able to absorb power price risk are likely a scarce resource and thus have a strong negotiation power

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 would favour the classical 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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