PROJECT-FINANCE MODEL · REPORT

Windpark Musterhöhe

Fictional onshore wind farm · 5 × 6.3 MW = 31.5 MW · Hesse, Germany

Base case, as published on the website

Data as of	30 Sep 2026
Engine	2.1.0
Inputs	`388d9b67b9e5fe67`
Calculator	igorsabodakha.com/wind-farm-calculator/

CONTENTS

2 Summary and status
3 Project and timeline
4 Key assumptions
5 Energy yield
6 EEG market premium
7 Power prices and capture
8 Construction and funding
9 Operating costs and decommissioning
10 Financing and loan size
11 Debt service cover and liquidity
12 Taxes and cash waterfall
13 Returns
14 Scenarios
15 Sensitivity
16 Bid price
17 Risks and limitations
18 Methodology and sources

A model by Igor Sabodakha

Illustrative calculation — not investment, tax or legal advice. The wind farm is fictional. The results depend on the assumptions shown on slide 4.

Summary and status

At 4.79 ct/kWh the owners earn 3.1% a year — below an 8% cost of equity

Equity IRR
3.1%
KG, after the company's taxes; cost of equity 8%

Project IRR
3.7%
Unlevered, after tax (pre-tax 4.0%)

Equity NPV
−€16.1m
At 8%, to financial close

LCOE
7.25 ct/kWh
Real 2026 money (nominal 9.22 ct/kWh)

Min DSCR
1.44x
In 2030; covenant 1.05x, P90 1-yr 1.14x

Debt
€20.6m
34.8% of uses; equity €38.7m

Key messages

- The EEG floor (AW 6.30 ct/kWh) stays below the expected market value, so revenue comes from the market; the premium works as insurance and is paid in 15 years of the downside.
- The bank lends €20.6m (35% of uses), limited by the P90 (1-year) DSCR target on the EEG floor; the owners fund €38.7m.
- Debt lowers the owners' return: 3.1% against 3.7% for the project without debt, which earns less than the loan's 5.35%.
- Bid calculator: an 8% equity IRR needs an award of 7.41 ct/kWh — above the 7.25 ct/kWh ceiling.

Validity

Valid: fully funded, covenant met

Calculation	OK · 9 checks
Funding	OK · 2 checks
Covenant	OK · 2 checks
Inputs	OK · 6 checks
Model scope	Warning · 6 checks

⚠ Book equity stays positive (limits on distributions) — not met in 2043–2050 (slide 12)

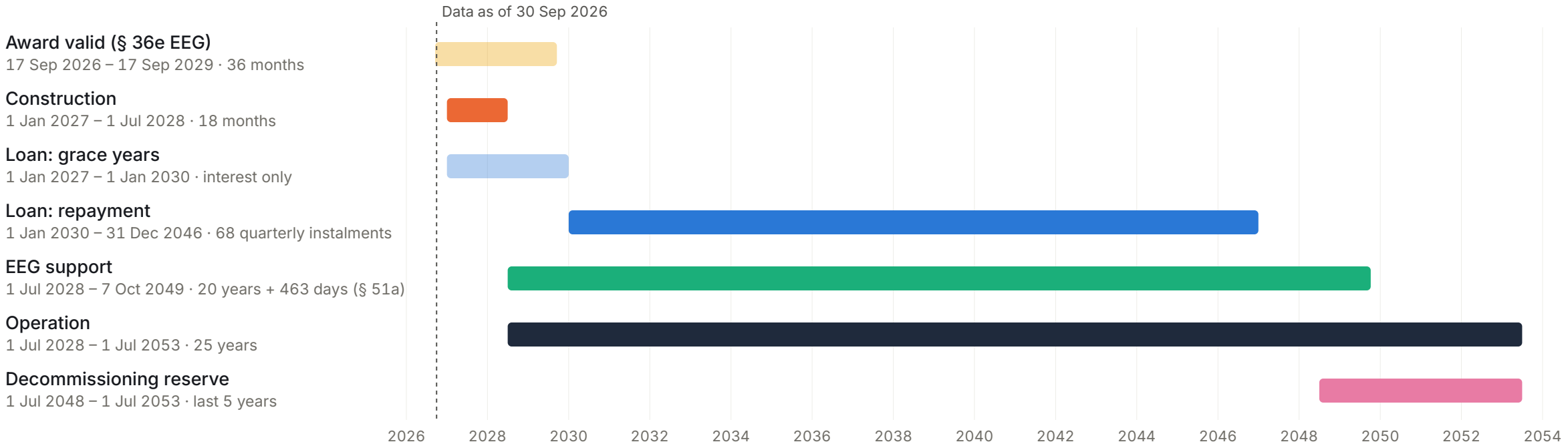
Scenarios

	Equity IRR	Min DSCR
Base	3.1%	1.44x
P90 1-yr	0.6%	1.14x
P90 10-yr	1.2%	1.20x
Downside	−2.1%	1.18x

The stress scenarios keep the base-case loan — the lender's view after financial close.

Project and timeline

Commissioning on 1 Jul 2028, 18 months after financial close; the loan is repaid by 31 Dec 2046



Capacity	5 × 6.3 MW = 31.5 MW	Hub height / rotor	159 m / 165 m	Site quality	68% → 2,439 h at P50
Award announced	17 Sep 2026; COD after 21 months	Financial close	1 Jan 2027 (valuation date)	First instalment	31 Mar 2030
Loan term	20 years, 3 grace years	Legal form	GmbH & Co. KG	EEG support ends	7 Oct 2049

Key assumptions

40 inputs drive the answer: 36 from public sources, 4 documented assumptions

PROJECT

Number of turbines	5	A
Turbine rating	6.3 MW	S6, S8
Operating life	25 years	S6, S14
Financial close	Jan 2027	A
Construction period	18 months	S8

ENERGY YIELD

Reference yield	3,623 h/yr	S6
Site quality (Gütefaktor)	68%	S7
Availability	97.0%	S20
Degradation	0.20%/yr	S21
Uncertainty, 1 year	12.8%	S22 · A
Output at negative prices	5.0%	S19 · A

REVENUE

Award price (Zuschlagswert)	4.79 ct/kWh	S1
Tender ceiling (Höchstwert)	7.25 ct/kWh	S2
Futures 2027–29	128 / 99 / 83 €/MWh	S12, S36
Long-term power price	75 €/MWh	S30 · A
Wind capture factor	0.80	S11 · A
Direct-marketing fee	0.20 ct/kWh	S6, S31 · A
Municipal payment (§ 6 EEG)	0.20 ct/kWh	S3
Premium settlement lag	3 months	S5 · A

COSTS

Total capex	1,814 €/kW	S6, S14
Contingency	3.0%	A
Fixed opex, years 1–10	25.0 €/kW/yr	S6
Land lease	10.0% of revenue	S6, S23 · A
Decommissioning cost	50 €/kW	S24 · A
Generator grid fee	0.0 €/kW/yr	S35

FINANCING

Interest rate	5.35%	S9
Loan term	20 years	S6, S9, S10
Grace years	3 years	S9, S10
Repayment	Equal instalments (KfW)	S10
Target DSCR (P50)	1.20x	S26 · A
Target DSCR (P90)	1.00x	A
Maximum gearing	80%	S6, S27
Revenue the bank counts on	EEG floor	S28 · A
Debt service reserve	3 months	S26 · A

TAX AND VALUATION

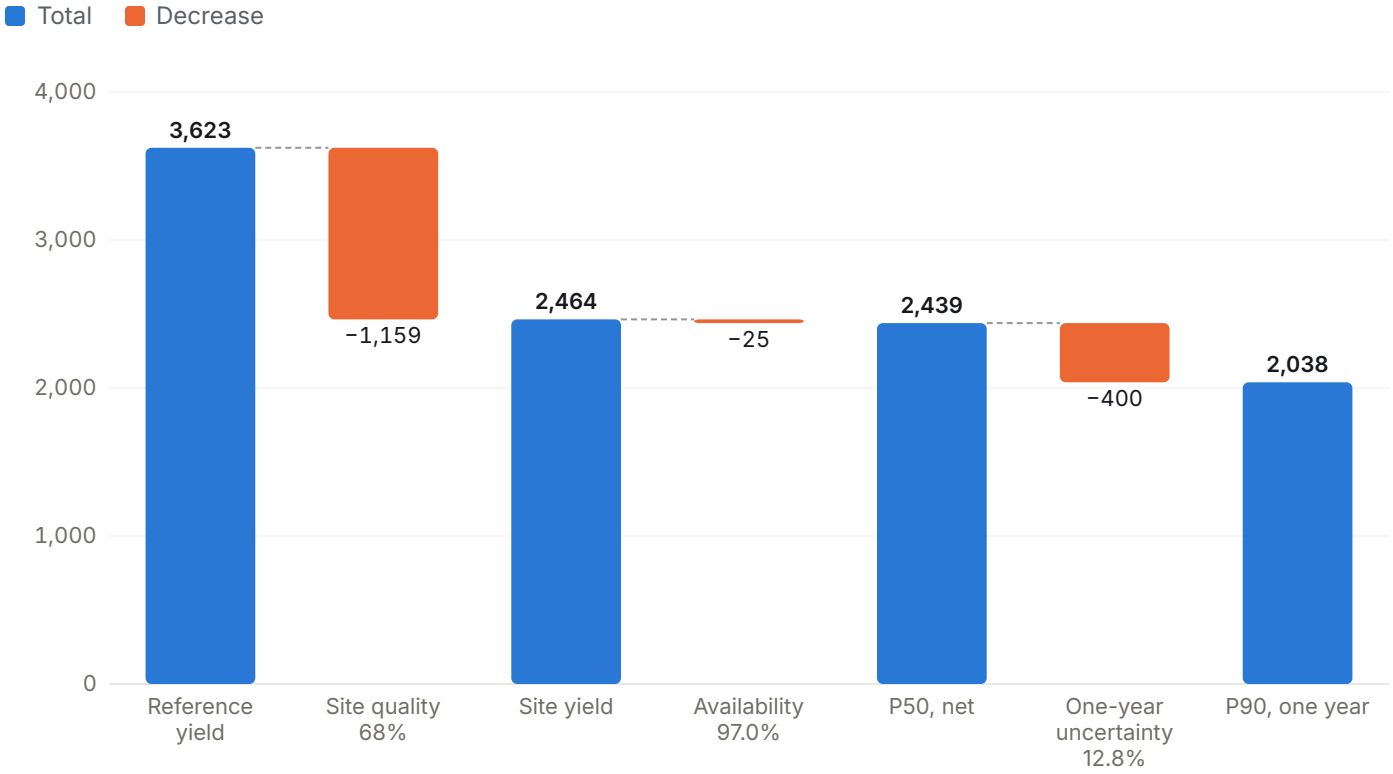
Legal form	GmbH & Co. KG	S15, S16
Trade-tax multiplier (Hebesatz)	400%	S15 · A
Depreciation period	16 years	S17
Cost of equity	8.0%	S6, S14
Inflation from 2029	2.0%	S33
Real WACC for the LCOE	3.9%	S14

S1–S36: sources listed on slide 18 · A: assumption — no public value for this case; see the methodology. All inputs, with hints and ranges, are in the calculator and the Excel workbook.

Energy yield

2,439 full-load hours at P50; in a bad year (one-year P90) the farm produces 84% of that

Full-load hours a year, before degradation



Output in 2029, the first full year (GWh)

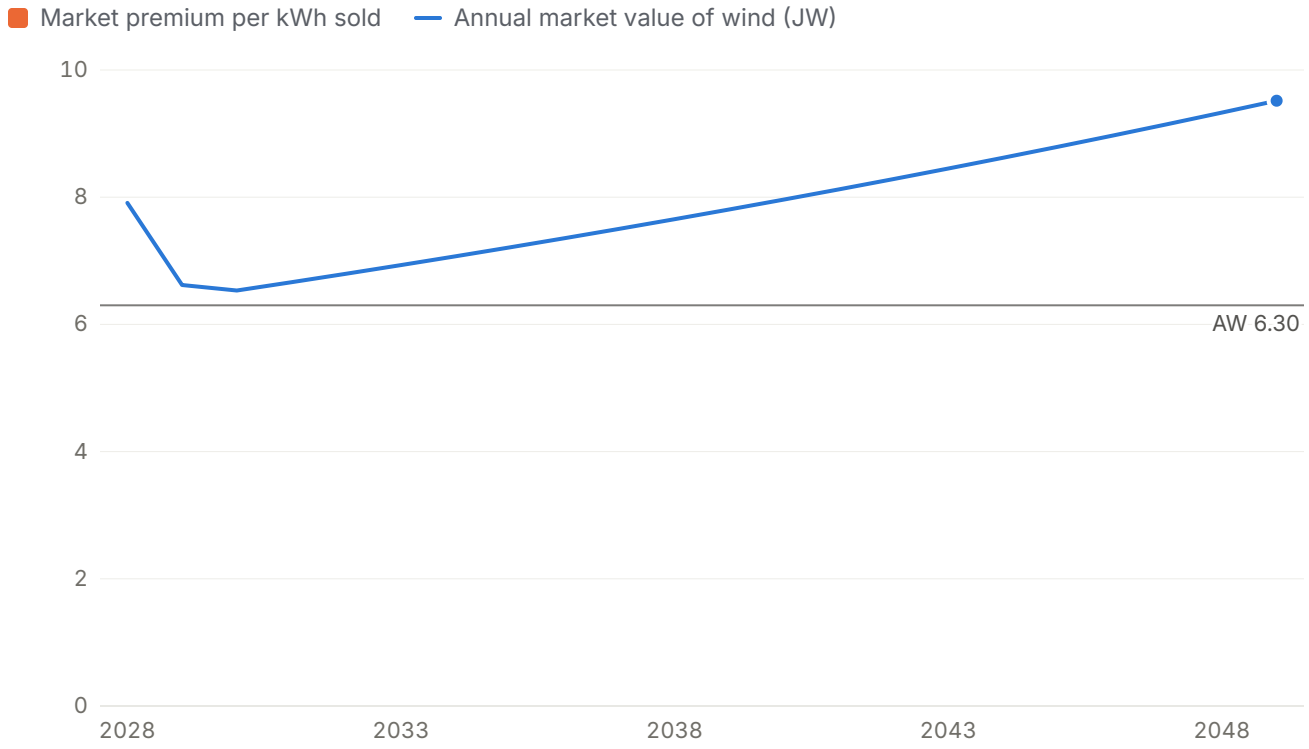
P50 output	**76.7**
Sold: 5% falls into negative prices	72.8
P90, one year (83.6% of P50)	64.1
P90, ten years (86.8% of P50)	66.5
P50 in 2052, after 0.2% a year of degradation	73.2

- By law the site yield already excludes wake losses, up to 2% unavailability, electrical losses and curtailment required by the permit (Anlage 2 Nr. 7 EEG); the model deducts only availability below 98% and other losses.
- Site quality sets both the output and the correction factor of the AW: a better site produces more but receives less per kWh.
- P90 = P50 × (1 − 1.2816 × σ). The one-year value tests debt service in a bad year; the ten-year value describes a weaker wind resource.
- Grid curtailment under Redispatch 2.0 is compensated (§ 13a EnWG) and is not deducted.

EEG market premium

The AW of 6.30 ct/kWh stays below the expected market value in every year: the base case earns no premium

Base scenario during support, ct/kWh (nominal)



How the premium is set

Award price (tender of 1 Aug 2026)	4.79 ct/kWh
× correction factor at 68% site quality (§ 36h)	1.316
= AW, 6.3036 rounded (§ 36h (5))	**6.30 ct/kWh**
Premium = max(0, AW − annual market value)	Anlage 1
No premium at negative prices: output share	5%
Support: 20 years + § 51a extension	+463 days
Support ends	7 Oct 2049

Premium by scenario

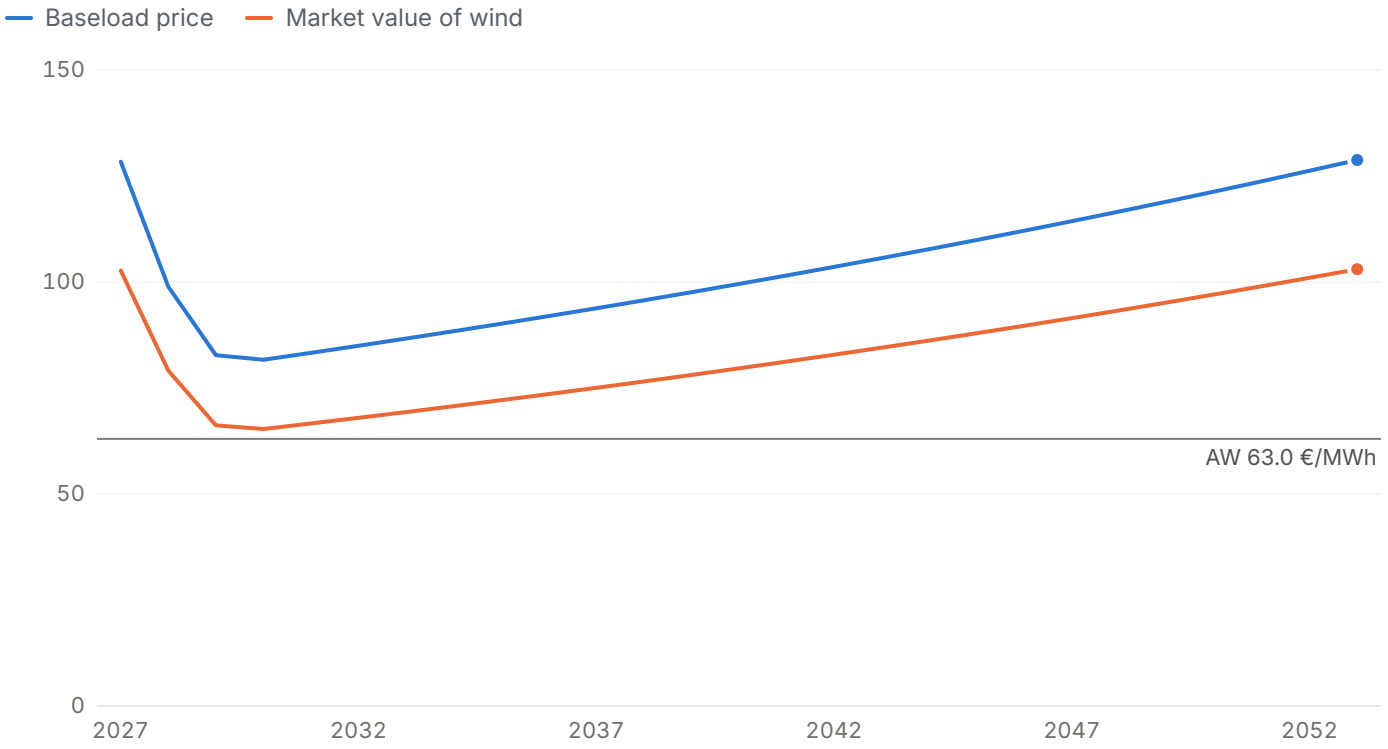
	Years paid	Total	AW from year 6
Base	0 of 22	€0.0m	6.30 ct/kWh
P90 1-yr	0 of 22	€0.0m	6.30 ct/kWh
P90 10-yr	1 of 22	€0.4m	6.80 ct/kWh
Downside	15 of 22	€8.4m	6.80 ct/kWh

Advances follow the previous year's market value (§ 26); the rest arrives with the final settlement, assumed 3 months after the year end. The multi-year stresses re-determine the AW from year 6 (§ 36h (2)).

Power prices and capture

Futures fall from 128 €/MWh (2027) to a long-term 75 €/MWh in 2026 money; wind earns 0.80 of the baseload price

Power prices, €/MWh (nominal)

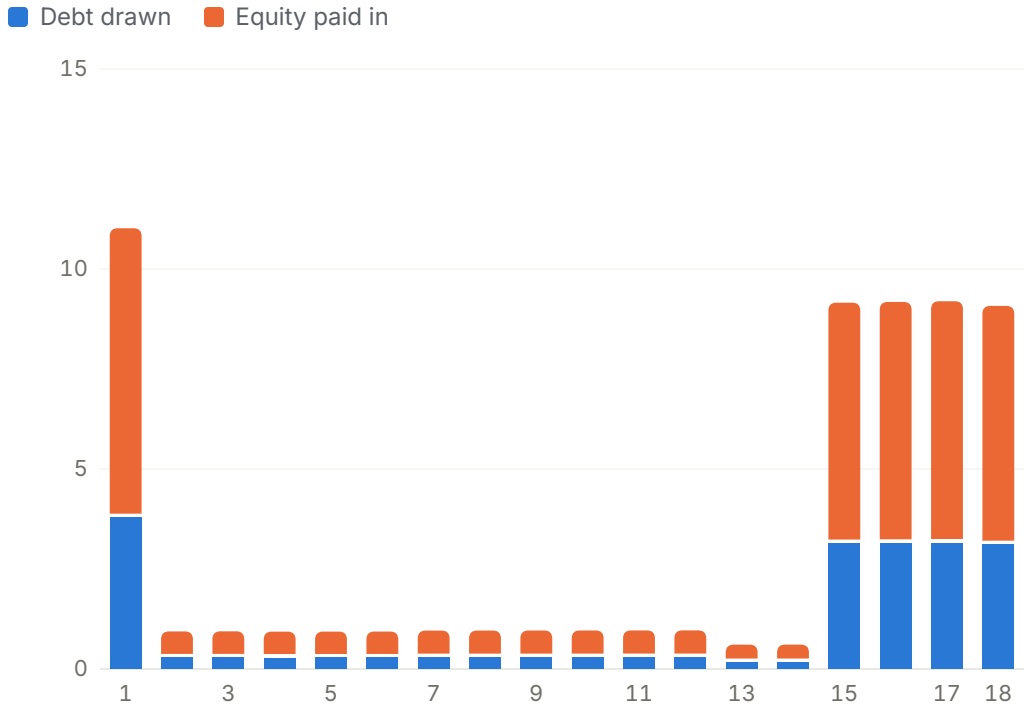


Price inputs	
EEX baseload futures 2027	128.37 €/MWh
EEX baseload futures 2028	98.88 €/MWh
EEX baseload futures 2029	82.74 €/MWh
Long-term baseload from 2030, 2026 money	**75 €/MWh**
Wind capture factor (market value ÷ baseload)	0.80
Market value of wind in 2035 (nominal)	72.1 €/MWh
Direct-marketing fee, 2026 money	0.20 ct/kWh
After the EEG period	Market prices
Inflation 2026/2027/2028, then	2.9% / 2.7% / 1.9%, 2.0%

- The long-term price is the model's strongest assumption. Published scenarios range from about 65 to 101 €/MWh (Ariadne, Prognos, Agora).
- The farm's own capture price is assumed equal to the market value of all onshore wind; the 2023–2025 average factor was 0.81.
- Negative-price periods: 6.5% of the time, 5% of the output; the farm is curtailed then.

Total uses of €59.3m — €57.1m capex, €1.1m financing costs, €1.1m reserves — funded with €20.6m of debt and €38.7m of equity

Funding by month after financial close, € million



Turbines: 10% at close, 70% on delivery, 20% at commissioning; civil works in thirds; development at close. VAT of 19% is bridged by a VAT loan for 2 months. Debt and equity are drawn pro rata.

Capex, net of VAT

	€/kW	€m
Turbines incl. transport and installation	1,163	36.64
Foundations	88	2.77
Roads and crane pads	119	3.75
Grid connection	133	4.19
Development and permits	163	5.14
Compensation measures	35	1.10
Other	60	1.89
Contingency 3%	53	1.66
Total capex	**1,814**	**57.14**

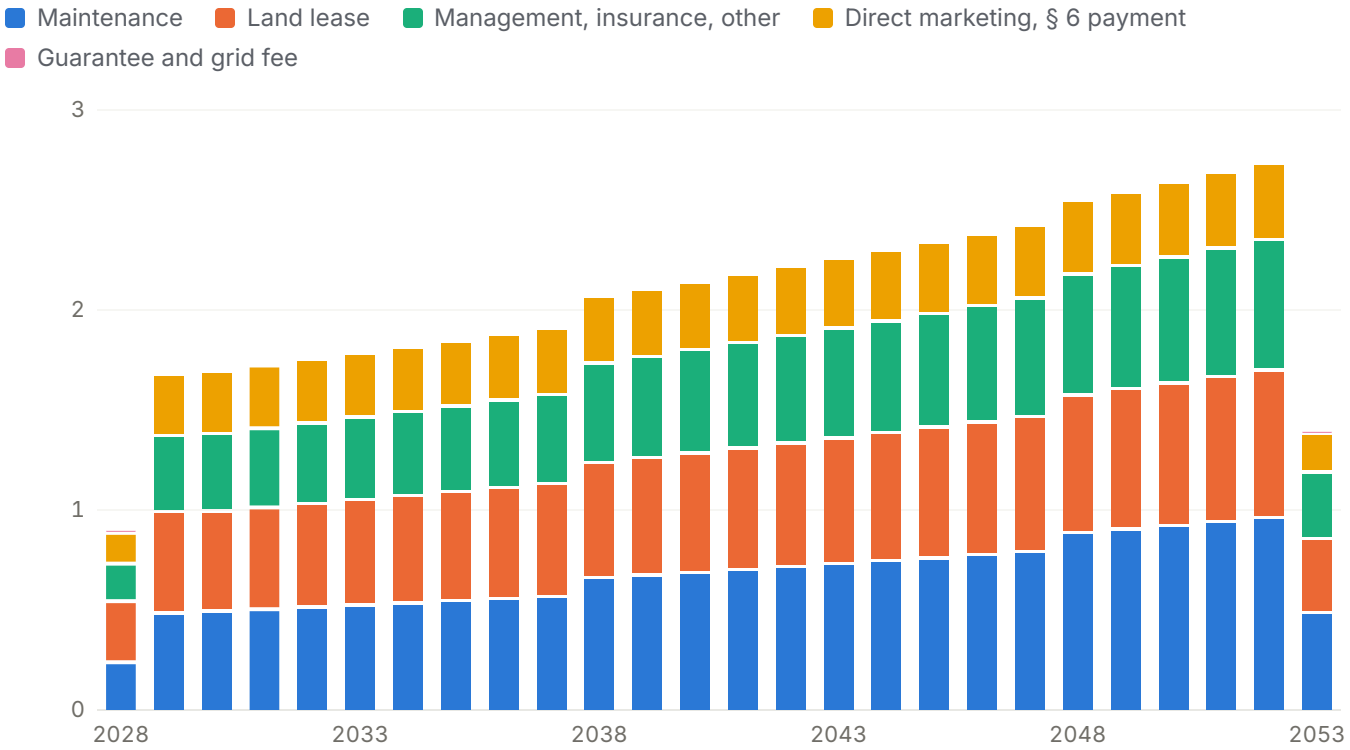
Sources and uses, € thousand

Capex	57,136
Upfront fee	207
Commitment fees	216
Interest during construction	562
VAT bridge interest	112
Debt service reserve	573
Start-up liquidity	498
Total uses	**59,304**
Senior loan	20,633
Equity	38,671
Total sources	**59,304**

Gearing 34.8% · check: sources − uses = 0

Operating costs of €1.7m in 2029, rising with inflation; decommissioning costs €2.7m at the end of life

Operating costs by year, € million (nominal)



Fixed items step up after years 10 and 20 (full-service maintenance ages). The first and last years are part years.

2029, the first full year

	€ thousand	€/MWh sold
Maintenance	484	6.65
Management	138	1.90
Insurance	35	0.47
Other	208	2.85
Land lease	507	6.97
Direct marketing	156	2.13
Municipal payment § 6	153	2.11
Guarantee fee	10	0.14
Operating costs	**1,691**	**23.22**
§ 6 refund	0	0.00

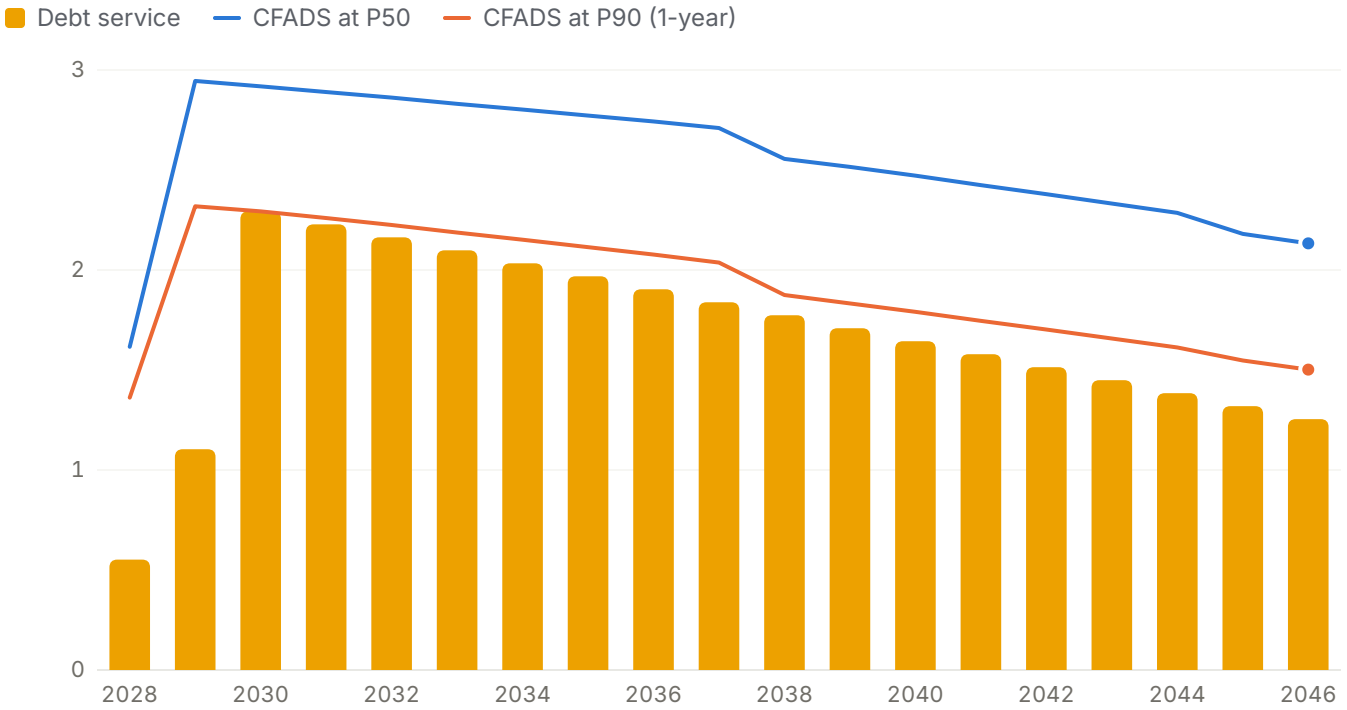
Decommissioning

Security: 159 m hub × €1,000 × 5	€795k
Guarantee fee 1.25% a year	€10k
Cost 50 €/kW (2026 money), paid 2053	€2.70m
Cash reserve built over the last	5 years

Financing and loan size

Debt of €20.6m (35% of uses) is limited by the P90 (1-year) DSCR target on the EEG floor

Lender's case: revenue on the EEG floor, € million



The loan is the largest that keeps CFADS at least 1.20x × debt service at P50 and 1.00x × at P90 in every year of the lender's case, and at most 80% of uses. Taxes, fees and the reserve depend on the loan: the model iterates.

Loan terms

Interest rate, fixed	5.35%
Term from financial close / grace years	20 / 3 years
Repayment	Equal instalments (KfW)
Target DSCR P50 / P90 (1-year)	1.20x / 1.00x
Revenue the bank counts on	EEG floor
Maximum gearing	80%
Upfront / commitment fee	1.00% / 0.15% a month
Debt service reserve	3 months

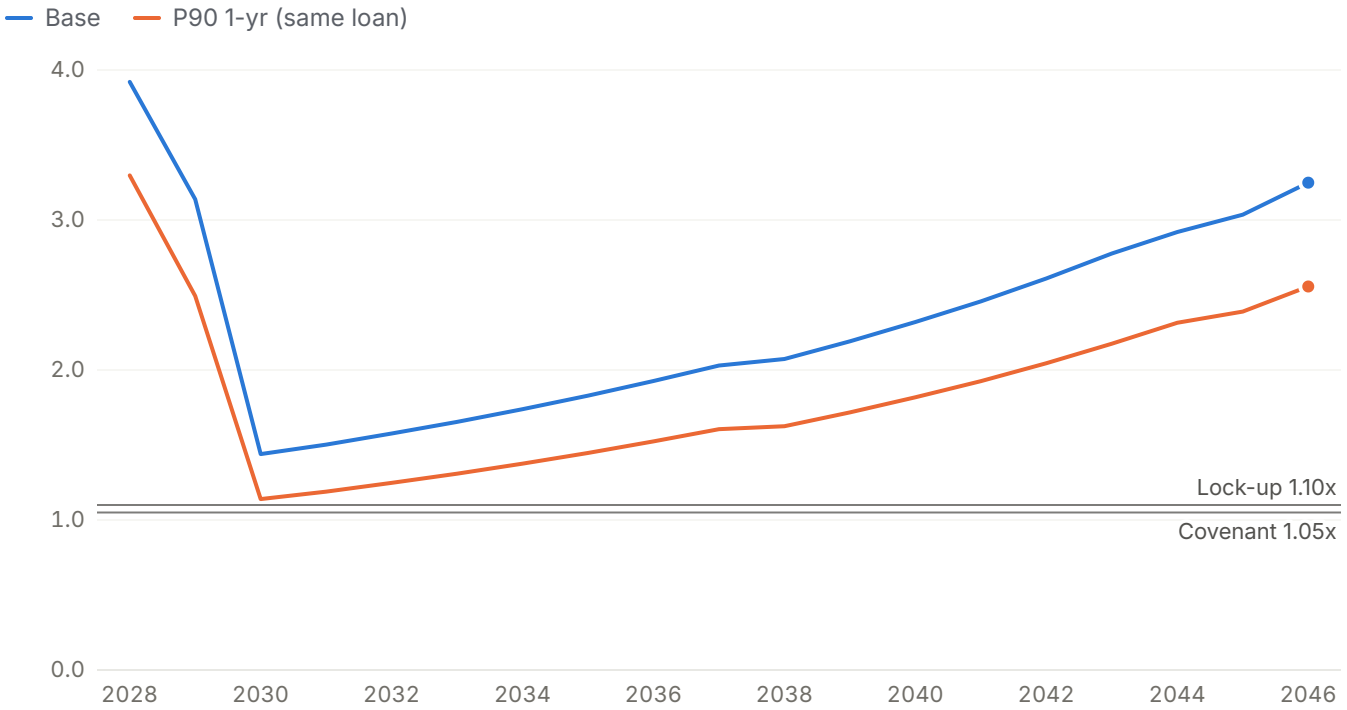
Result

Loan	**€20.63m**
Gearing (loan ÷ uses)	34.8%
Limited by	P90 (1-year) DSCR target on the EEG floor
Lowest lender DSCR, P50 / P90	1.27x / 1.00x

Debt service cover and liquidity

Lowest DSCR 1.44x in 2030 against a covenant of 1.05x; 1.14x in a one-year P90 stress

DSCR by year, operating cases with the base-case loan



DSCR = CFADS ÷ (interest + principal); CFADS = EBITDA − change in working capital − taxes. Grace years carry interest only, so their DSCR is high.

Cover and lock-up by scenario

	Min DSCR	Year	Lock-up	LLCR
Base	1.44x	2030	0 yr	2.06x
P90 1-yr	1.14x	2030	0 yr	1.63x
P90 10-yr	1.20x	2030	0 yr	1.73x
Downside	1.18x	2032	0 yr	1.48x

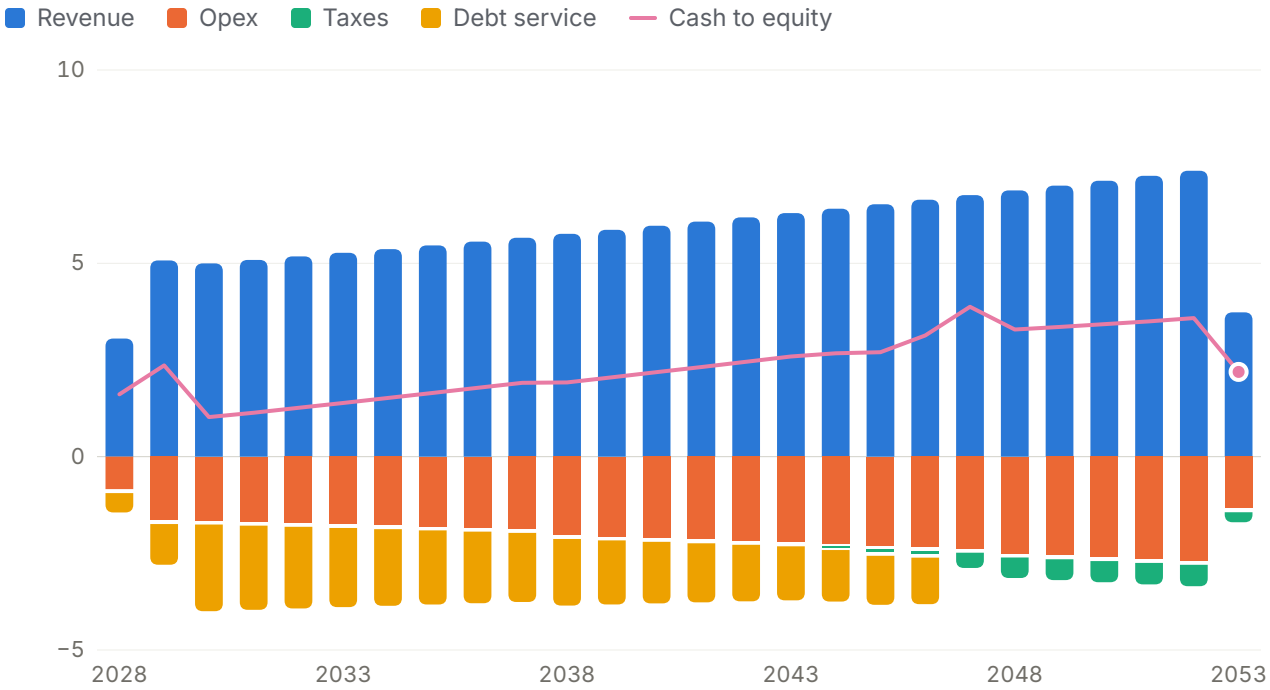
Liquidity

Debt service reserve (3 months), funded at COD	€573k
Start-up liquidity for first-year receivables	€498k
Average DSCR over the repayment years	2.20x
Distributions held back below 1.10x	0 years
Lowest cash balance	never negative

Taxes and cash waterfall

Tax is first due in 2044; over the life the owners receive €60.9m for €38.7m invested

Annual cash flows, € million (nominal)



A GmbH & Co. KG pays trade tax only (3.5% × 400% multiplier); its partners' income tax is not modelled. Straight-line depreciation over 16 years and loss carry-forwards keep taxable profit low in the early years.

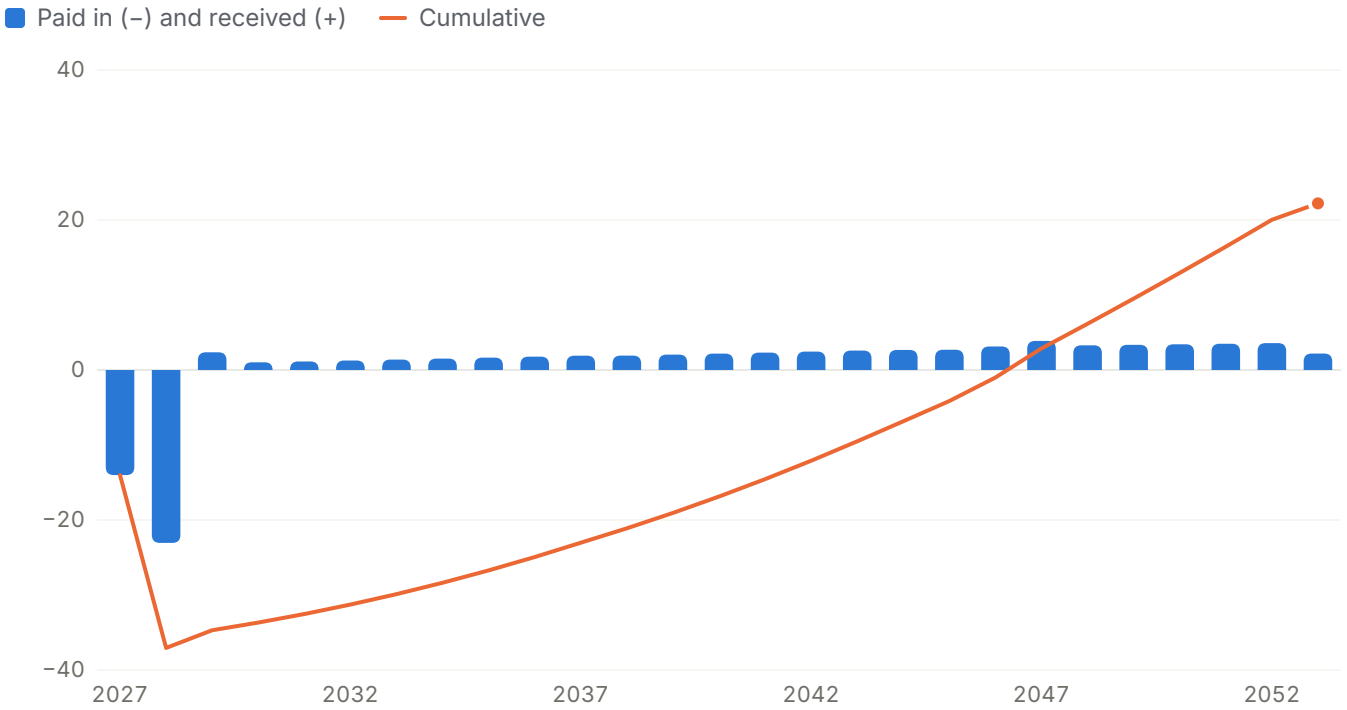
Over the life, € million (nominal)	
Revenue	152.7
Operating costs net of the § 6 refund	−54.2
EBITDA	**98.5**
Taxes	−4.2
Change in working capital	0.5
CFADS	**94.8**
Interest	−11.2
Principal	−20.6
Decommissioning paid	−2.7
Reserves released (debt service reserve)	0.6
Cash available to equity	**60.9**
Equity paid in during construction	−38.7

Cash available to equity is before legal limits on distributions: § 30 GmbHG for a GmbH, § 172 (4) HGB for the limited partners of a KG. The model's book equity is negative in 2043–2050: a sign that such limits could bite, not a legal test.

Returns

Equity IRR 3.1% and NPV −€16.1m at 8%; the owners are paid back after 18.8 years

Owners' cash flows by year, € million (nominal)



Returns use the exact dates: monthly contributions during construction, cash to equity on 31 December (XIRR and XNPV, Actual/365).

Returns, base case

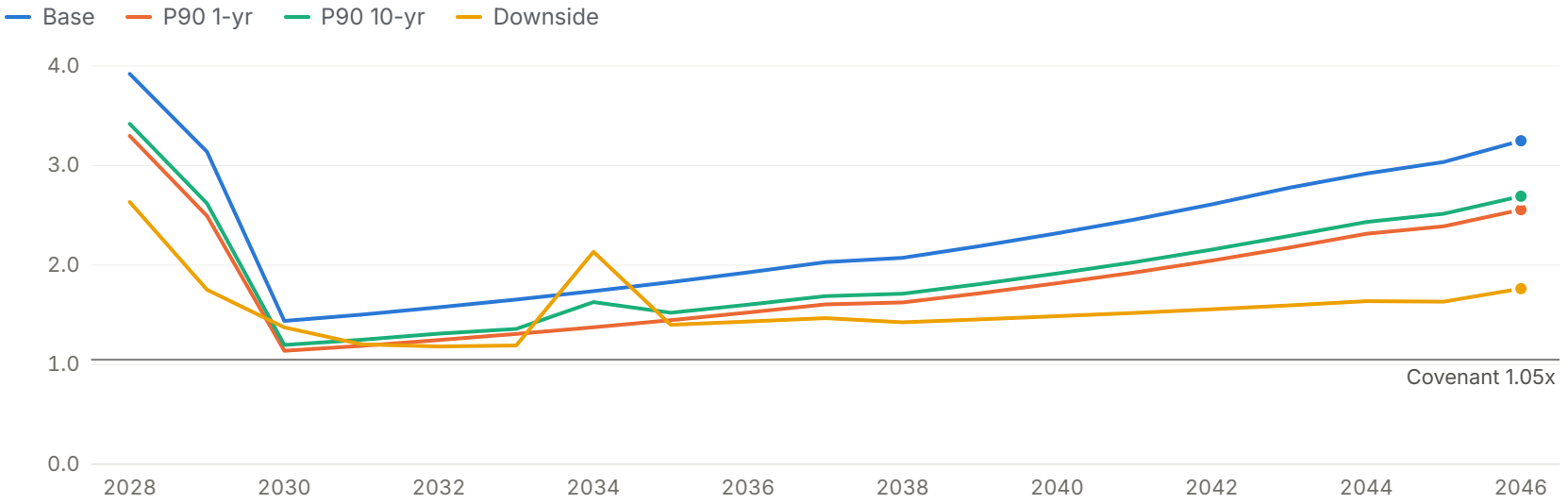
Equity IRR (KG, before the partners' taxes)	**3.09%**
Project IRR, pre-tax / after tax	4.04% / 3.67%
Equity NPV at 8%	−€16.1m
Project NPV at 5.8% (nominal WACC)	−€11.2m
Payback after commissioning	18.8 years
LCOE, real 2026 money at 3.9%	7.25 ct/kWh
Anzulegender Wert (the EEG floor)	6.30 ct/kWh

- Negative leverage: the equity IRR (3.09%) is below the project IRR after tax (3.67%) — the project earns less than the loan's 5.35%.
- The LCOE of 7.25 ct/kWh is above the AW of 6.30 ct/kWh: the EEG floor alone does not cover the cost; the case relies on market prices.

Scenarios

In the downside the equity IRR falls to −2.1%; the lowest DSCR is 1.18x

	Base	P90 1-yr	P90 10-yr	Downside
What changes	P50 output, base prices and costs; sizes the loan	One-year P90 output in every year (83.6% of P50) — the lender's stress	Ten-year P90 output in every year (86.8%), with the § 36h review	Ten-year P90, power prices −20%, fixed opex and grid fee +10%, capex +5% paid by the owners, § 36h review
Equity IRR	**3.09%**	**0.61%**	**1.16%**	**−2.12%**
Project IRR, after tax	3.67%	1.79%	2.22%	0.01%
Equity NPV	−€16.1m	−€23.1m	−€21.5m	−€28.8m
Min DSCR (year)	1.44x (2030)	1.14x (2030)	1.20x (2030)	1.18x (2032)
Status	Funded, covenant met	Funded, covenant met	Funded, covenant met	Funded, covenant met

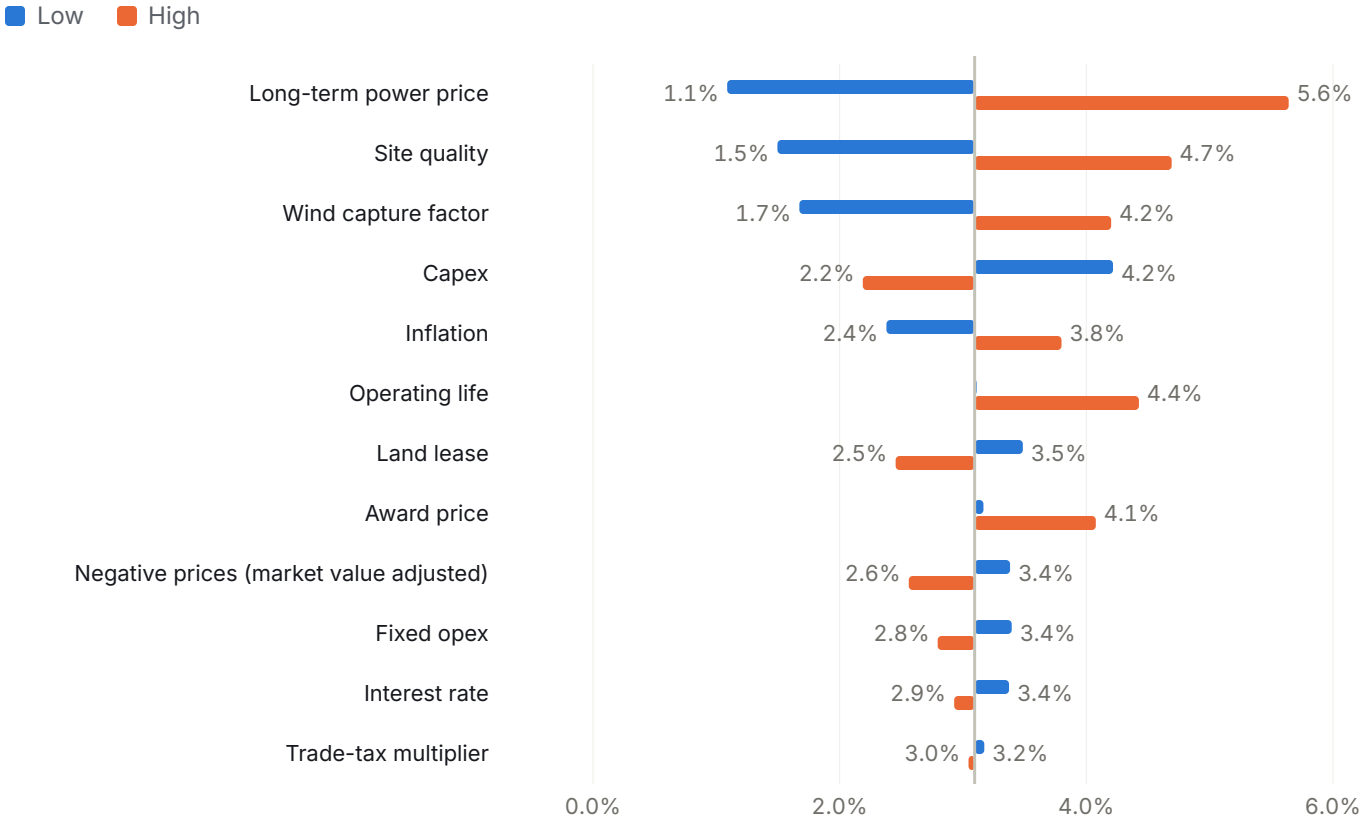


DSCR by year in each scenario. The stress scenarios keep the base-case loan — the lender's view after financial close. Applying a P90 output to every year is a stress, not a 90% probability for the whole life.

Sensitivity

Long-term power price moves the equity IRR most: from 1.1% to 5.6%

Equity IRR, each driver at its low and high value



Base: 3.09%. Colour marks the side of the input (low / high), not better or worse.

Settings

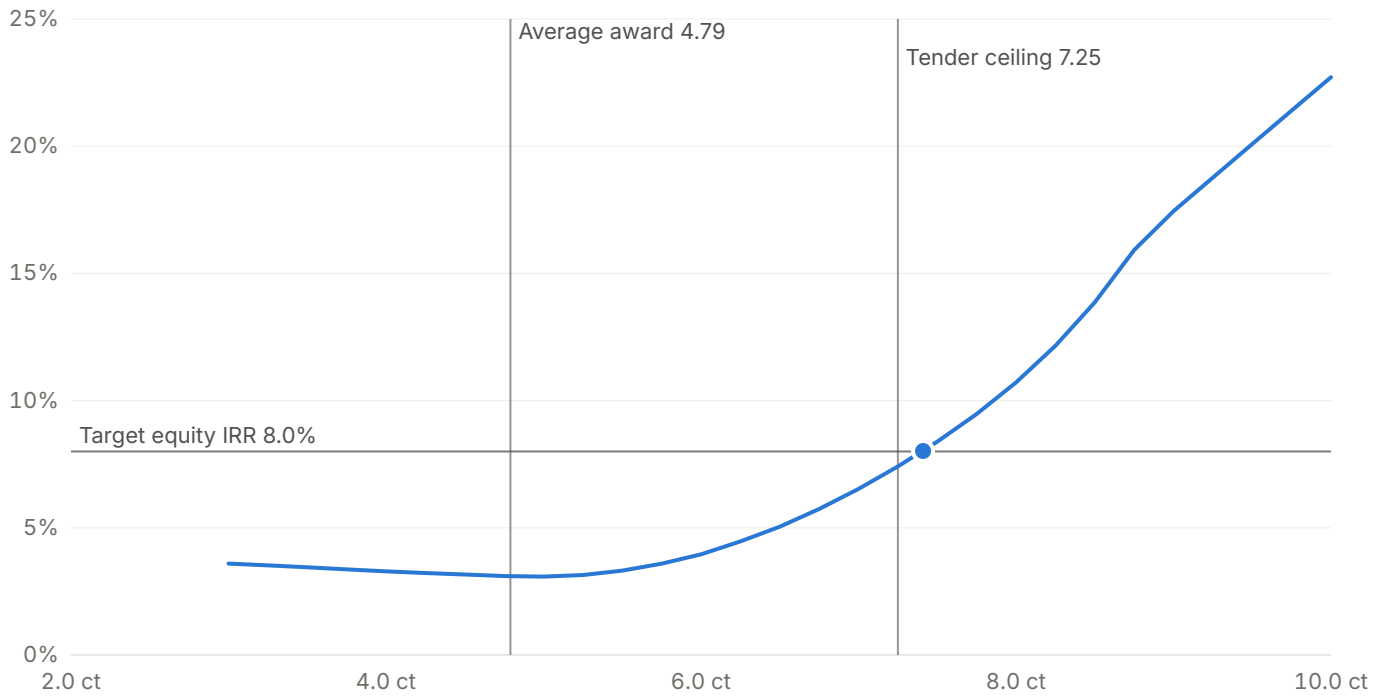
Driver	Low	High
Long-term power price	60 €/MWh	90 €/MWh
Site quality	60%	76%
Wind capture factor	0.72	0.86
Capex	−10%	+10%
Inflation	−0.5 pp	+0.5 pp
Operating life	25 yrs	30 yrs
Land lease	6%	14%
Award price	4.49 ct	6.06 ct
Negative prices (market value adjusted)	3%	9%
Fixed opex	−10%	+10%
Interest rate	4.40%	6.05%
Trade-tax multiplier	320%	450%

Each bar re-runs the model with the loan re-sized — the view before financial close. The negative-price driver also moves the capture factor with (1 − share). Drivers are sorted by the swing of the equity IRR.

Bid price

An 8% equity IRR needs an award of 7.41 ct/kWh — above the 7.25 ct/kWh ceiling

Equity IRR by award price, loan re-sized at every price



Search: a 0.25 ct grid, then bisection. Bids carry two decimals: the price shown is the lowest such price that qualifies.

Minimum award price

7.41 ct/kWh

AW 9.75 ct/kWh at this site · target equity IRR 8.0%

- Target return reached: **yes**
- Financeable: fully funded, covenant met, award still valid (§ 36e): **yes**
- Above the tender ceiling — such a bid would not be admitted.

Average award, 1 Aug 2026 (announced 17 Sep 2026)	4.79 ct/kWh
Tender ceiling	7.25 ct/kWh
Award price in this case	4.79 ct/kWh

The IRR is not monotonic in the award price: a higher floor allows more debt at 5.35%, which can lower the equity return. The search therefore scans a 0.25 ct grid for the first qualifying price, bisects, and shows the lowest two-decimal price that qualifies.

Risks and limitations

8 risks you can test in the calculator, and 8 simplifications of the model to keep in mind

Risks the calculator lets you test

- **Power price after the futures.** The long-term price is the strongest assumption; the tornado shows its weight.
- **Wind resource.** One-year and ten-year P90; a weaker site also re-sets the AW in the § 36h (2) reviews.
- **Negative prices.** No premium in those periods (§ 51 EEG); more of them also lower the capture factor.
- **EEG 2027 draft.** A two-sided premium is a switch — a simplified stress, not the draft's calculation; 18 banks warned of financing risks (Sep 2026).
- **Interest rate and loan terms.** KfW 270 at 5.35%; DSCR targets, gearing and the revenue the bank counts on are inputs.
- **Timing.** The award lapses 36 months after its announcement (§ 36e); a penalty applies after 30 months (§ 55). The checks flag late commissioning.
- **Generator grid fees.** Proposed in the regulator's AgNes process (4–7 €/kW a year); 0 in the base case, an input.
- **Distributions.** Cash to equity is before § 30 GmbHG and § 172 (4) HGB; negative book equity is flagged.

What the model leaves out

- Operations are annual; output is spread evenly over the year (winter is in fact windier).
- The farm's capture price equals the market value of all onshore wind.
- The partners' income tax of a KG is not modelled; taxes are paid in the year they arise.
- One senior loan: no tranches, shareholder loans, refinancing or cash sweep; instalments during construction are not supported.
- Not modelled: the § 55 penalty for late commissioning, interest on § 36h paybacks, the interest barrier, and payments by the owners to cure a shortfall.
- Uncompensated grid curtailment (a draft of the grid package) and generator grid fees are not in the base case; the fee is available as an input.
- In the Excel workbook the loan, the total uses and the sculpted principal are solved on the website; the tornado and the bid calculator are included as values.
- The wind farm is fictional and the results are illustrative.

Methodology and sources

25 checks on every run, 36 public sources, a formula workbook checked in 40 variants

- Deterministic and nominal: the same inputs always give the same result. Construction runs monthly, operations by calendar year.
- Returns from dated cash flows (XIRR and XNPV, Actual/365). The loan is sized on the lender's case and iterated until it changes by less than €0.50.
- 25 checks in five groups on every run: calculation, funding, covenant, inputs and model scope.
- The Excel workbook rebuilds the model in formulas. Recalculated by Microsoft Excel in 40 variants, its roughly 26,000 formula cells agree with the engine: money to the cent.
- Every input has a public source, checked on 30 Sep 2026, or is a documented assumption.

Full methodology: igorsabodakha.com/wind-farm-calculator/methodology/
Source code: github.com/sabodaha/windpark-rechner

S1 Bundesnetzagentur: onshore wind tender of 1 Aug 2026 · bundesnetzagentur.de, 17 Sep 2026

S2 Bundesnetzagentur: ceiling prices 2026 · bundesnetzagentur.de, 16 Dec 2025

S3 Erneuerbare-Energien-Gesetz (EEG 2023), consolidated text · gesetze-im-internet.de, 18 Dec 2025

S4 EEG §§ 36e, 36i, 55: award lapses 36 months after its announcement; penalty after 30 months · gesetze-im-internet.de, 18 Dec 2025

S5 EEG § 26: monthly advances, may use the previous year's market value; final settlement next year · gesetze-im-internet.de, 18 Dec 2025

S6 Deutsche WindGuard: Kostensituation der Windenergie an Land – Stand 2025 · windguard.de, 2 Dec 2025

S7 Fachagentur Wind und Solar: site quality of turbines with a tender award · fachagentur-wind-solar.de, 30 Jun 2025

S8 Fachagentur Wind und Solar: Status des Windenergieausbaus an Land, H1 2026 · fachagentur-wind-solar.de, 23 Jul 2026

S9 KfW programme 270 – rate sheet (price class A, 20 years, 3 grace years) · kfw-formularsammlung.de, 29 Sep 2026

S10 KfW Merkblatt 270 (05/2025): quarterly equal instalments, grace years, drawdown period, commitment fee · kfw.de, 1 May 2025

S11 Netztransparenz: annual market values (JW) Wind an Land · netztransparenz.de, 30 Sep 2026

S12 EEX Phelix-DE baseload futures Cal-27 and Cal-28 (via Tacto, 25 Sep 2026) · tacto.ai, 25 Sep 2026

S13 Deutsche Bundesbank: macroeconomic projections, June 2026 · publikationen.bundesbank.de, 12 Jun 2026

S14 Fraunhofer ISE: Stromgestehungskosten Erneuerbare Energien (July 2024) · ise.fraunhofer.de, 1 Jul 2024

S15 Gewerbesteuergesetz · gesetze-im-internet.de, 29 Jun 2026

S16 Körperschaftsteuergesetz § 23 · gesetze-im-internet.de, 4 Feb 2026

S17 BFH IV R 46/09 (14 Apr 2011): wind-park assets depreciated over 16 years · bundesfinanzhof.de, 14 Apr 2011

S18 Einkommensteuergesetz §§ 6, 7, 10d (provisions, depreciation, loss offset) · gesetze-im-internet.de, 29 Jun 2026

S19 SMARD (Bundesnetzagentur): negative day-ahead prices 2023–2025 · smard.de, 5 Jan 2026

S20 Deutsche WindGuard for LEE NRW: full-load hours of onshore turbines (availability, losses) · lee-nrw.de, 27 May 2026

S21 Hamilton et al. (LBNL, Joule 2020): how does wind project performance change with age? · emp.lbl.gov, 1 May 2020

S22 Pryor et al., Wind Energy Science 3 (2018): inter-annual variability of wind · wes.copernicus.org, 1 Oct 2018

S23 top agrar (Sep 2026): what land leases wind farms can still afford · topagrar.com, 26 Sep 2026

S24 Bundestag research service WD 5-3000-087/25: decommissioning costs of wind turbines · bundestag.de, 23 Oct 2025

S25 Hessian Landtag Drucksache 21/2671: decommissioning security = hub height × €1,000 · starweb.hessen.de, 9 Sep 2025

S26 Community wind-farm prospectuses 2023–2026 (DSCR, reserves, fees, gearing) · beteiligung.l-projekt.com, 29 Aug 2023

S27 Energie-Atlas Bayern: banks usually finance 75–85% of the investment · energieatlas.bayern.de, 1 Feb 2026

S28 Solarserver (17 Sep 2026): 18 banks warn about financing risks of the EEG 2027 draft · solarserver.de, 17 Sep 2026

S29 Bundestag, 24 Sep 2026: first reading of the EEG 2027 bill (two-sided premium) · bundestag.de, 24 Sep 2026

S30 Long-term power price scenarios (Ariadne 70–80, Prognos 73–86, Agora 65–101 €/MWh) · cubeconcepts.de, 8 Oct 2025

S31 Netztransparenz: statutory marketing deduction 2026 for plants after support (0.228 ct/kWh) — a reference point, not a market offer · netztransparenz.de, 1 Jan 2026

S32 Energie & Management PPA index: onshore wind, 2-year PPAs (53–74 €/MWh) · energie-und-management.de, 9 Apr 2026

S33 European Central Bank: 2% inflation target; staff projections September 2026 · ecb.europa.eu, 10 Sep 2026

S34 Umsatzsteuergesetz §§ 12, 18 (VAT rate, returns) · gesetze-im-internet.de, 29 Jun 2026

S35 Solarserver (17 Sep 2026): generator grid fees under BNetzA AgNes, corridor 4–7 €/kW/yr · solarserver.de, 17 Sep 2026

S36 EEX Phelix-DE baseload futures Cal-29 (power2market, 31 Aug 2026) · power2market.com, 31 Aug 2026