THE TIME VALUE OF IGNORANCE: HOW DISCOUNTING AND DATA SCARCITY MADE LONG-DATED LIABILITIES APPEAR IMMATERIAL

Endenex, 2 March 2026

There is a number in every wind farm financial model that nobody argues about.

It appears in the development-stage cash flow as a terminal cost — the decommissioning obligation, discounted back to the present at the project's weighted average cost of capital over a twenty-five-year horizon. It is small. Depending on the assumptions, it may represent less than one per cent of total project cost. In the investment committee paper, it occupies a single line. In the sensitivity analysis, it does not feature. In the funding decision, it is irrelevant.

This is arithmetically correct. At an 8% discount rate over 25 years, a future cost of any magnitude is reduced to a fraction of its nominal value. A decommissioning allowance of EUR50,000 per megawatt (MW) has a present value at inception of roughly EUR7,000 per MW. Against a project generating EUR150,000 per MW per year in revenue, that present value is noise. It could be wrong by a factor of five and it would still be noise.

And so nobody interrogates it. The investment committee does not challenge the decommissioning cost assumption because even a large error does not change the investment decision. The lender does not stress-test it because even an extreme scenario does not breach the debt service coverage ratio. The sponsor does not commission a detailed cost estimate because the expense is not justified by the materiality of the line item. The number is set, discounted, noted, and forgotten.

This is the origin of the decommissioning data gap. Not negligence. Not oversight. Rational indifference — produced by the mathematics of discounting — applied at the one moment in the project's life when the cost could have been investigated at leisure, with time and resources available, and with no commercial pressure to minimise the figure.

Twenty years later, the arithmetic is different. The number that was noise has become the most consequential figure in the asset's financial future. And nobody got it right, because nobody needed to.

The mathematics of irrelevance

To understand how the decommissioning data gap was created, it is necessary to understand the mathematics that created it.

A typical onshore wind project generates approximately 3 gigawatt-hours per MW of installed capacity per year. At a power purchase agreement price of EUR50 per MW-hour this produces annual revenue of approximately EUR150,000 per MW.

Over a 25-year operating life, the undiscounted cumulative revenue per MW is approximately EUR3.75m. The project's total capital expenditure — turbine, foundation, balance of plant, grid connection, development costs — is typically between EUR1m and EUR1.5m per MW. The operating expenditure over the life of the project adds another EUR750,000 to EUR1m per MW. The project generates substantial value over its life.

Against this, the decommissioning provision — the amount set aside to fund removal at end-of-life — is typically less than 2% of cumulative revenue. In present value terms at inception, discounted at 8% over 25 years, the provision is

reduced by a factor of nearly seven. For illustration, a EUR50,000 per MW nominal obligation equates to a present value of approximately EUR7,300 — economically negligible at financial close.

The decommissioning cost could be EUR250,000 per MW — five times the typical provision — and its present value at inception would still be only EUR36,000. Against a project generating EUR150,000 per MW per year, this is less than three months' revenue. It does not change the investment decision. It does not change the financing structure. It does not change the return profile. It changes nothing.

This is why the number has never been properly investigated. The mathematical structure of project finance — long-duration assets, high discount rates, terminal obligations — ensures that the decommissioning cost is immaterial at the point when the investment decision is made. The rational response to an immaterial number is to accept a reasonable estimate and move on. And that is precisely what every project sponsor, lender, investor, and advisor has done for the past two decades.

The mathematics of materiality

Now move the clock forward twenty years.

The same project. The same turbines. The same obligation. But the discounting horizon has collapsed from 25 years to five.

The decommissioning cost — whatever it actually is — is no longer a distant terminal obligation. It is an imminent capital expenditure. At an 8% discount rate over five years, the discounting factor is 1.47, not 6.85. A nominal cost of EUR250,000 per MW has a present value of approximately EUR170,000. That is more than one full year of revenue from the asset.

But the revenue is no longer EUR150,000 per MW per year. The turbines are 20 years old. Availability has declined — from 97% per cent in the early years to perhaps 90%-92%. Component failures are more frequent. Major repairs — gearbox replacements, generator rewinds, blade repairs — have consumed capital and may recur. The power purchase agreement may have expired, exposing the project to merchant prices that may be lower than the original contract. The maintenance cost curve has steepened as the turbines age and spare parts become harder to source.

The asset that generated EUR150,000 per MW per year in its prime may now generate EUR110,000 or EUR120,000. The operating cost that was EUR40,000-EUR50,000 per MW has risen to EUR60,000 or EUR70,000. The net cash flow — the surplus available to fund obligations including decommissioning — has compressed.

Into this compressed cash flow, the decommissioning obligation is arriving at its undiscounted magnitude. The provision — set 20 years ago, escalated by CPI — may cover 50%-70% of the actual cost. The shortfall must be funded from somewhere: from the project's remaining cash flow, from the operator's balance sheet, from equity injection, or from the proceeds of a sale or repowering transaction that has its own cost structure.

The number that was irrelevant at inception is now the dominant variable in the asset's financial future. It determines whether the project can fund its own end-of-life. It determines the economics of repowering. It determines the residual value of the asset in a sale. It determines whether the operator faces a manageable expenditure or a material shortfall.

And the number is wrong. Not because anyone was dishonest. Because no one needed it to be right twenty years ago.

The provision escalation illusion

The standard defence against the time-value problem is escalation. The provision was set at inception, yes — but it has been escalated

annually, typically by CPI or a fixed percentage, to approximate the future cost at the time of execution. The escalated provision, the argument goes, should be closer to the actual cost than the original estimate.
This defence fails for two reasons.

First, escalation by CPI does not track the cost drivers of decommissioning. The inputs that determine what the work actually costs — heavy-lift crane day-rates, specialist demolition labour, landfill tipping fees for composite waste, transport costs to remote sites, environmental remediation rates — move independently of consumer price inflation. Some have increased faster than CPI. Some have moved in step. Some have exhibited volatile, cyclical behaviour that CPI cannot capture. Escalating a decommissioning provision by CPI is like escalating a turbine procurement budget by the retail price index — the correlation is too weak to be useful.

Over 20 years, the divergence between CPI-escalated provisions and actual cost drivers can be substantial. If CPI has averaged two per cent and the relevant cost inputs have averaged four per cent, the provision is underestimated by roughly fifty per cent — not because the original estimate was wrong, but because the escalation mechanism was wrong. The provision has been growing, but not fast enough.

Second, and more fundamentally, escalation adjusts the magnitude but not the basis. If the original estimate was prepared using an incorrect scope — foundation removal to one metre when the actual requirement at end-of-life is full removal; blade disposal by landfill when the regulatory environment now requires recycling; cable removal excluded when the planning authority now expects it — then escalating that estimate by any index produces a larger version of the wrong number.
Escalation is a mechanism for adjusting a known cost for inflation. It is not a mechanism for correcting an unknown cost for error. The decommissioning provision was unknown at inception — an estimate based on assumptions about scope, method, and market conditions that have since changed. Escalating it preserves the original error at a larger scale.

The information failure

The time-value dynamic creates a structural information failure that persists throughout the asset's life.

In the early years, the decommissioning cost is immaterial. No one investigates it because the effort is not justified by the impact. This is rational.

In the middle years — years ten through fifteen — the obligation is still distant enough to be discounted significantly, and the asset is still generating strong cash flows. The operator's attention is on performance optimisation, maintenance planning, and power marketing. Decommissioning is a line item in the long-term financial model, reviewed annually, escalated automatically, and set aside. The provision is growing, but it is not tested. No one commissions a fresh cost estimate because there is no trigger to do so — the planning authority has not asked for one, the auditor has accepted the methodology, and the board has not questioned the number.

In the later years — years fifteen through twenty — the obligation begins to loom. The asset's remaining life is visible on the horizon. The operator may begin to consider end-of-life options: life extension, repowering, or decommissioning. For the first time, the decommissioning cost estimate is consulted not as a modelling input but as a decision variable. And for the first time, the operator discovers how little confidence they can place in it.

The estimate is old. The scope may not reflect current requirements. The cost rates are stale. The salvage assumptions are untested. The operator looks for a benchmark — a reference dataset of actual decommissioning costs from comparable projects — and finds that none exists. They commission an independent cost

assessment, which produces a figure that may differ significantly from the provision. But even this independent assessment is based on engineering estimates and market intelligence, not on empirical data from completed projects, because the industry has not collected that data.

The operator now has a number they are more confident in — but it is too late for the number to be painless. If the independent estimate exceeds the provision, the operator must fund the shortfall. The cash flow that would have funded the shortfall was distributed in earlier years, when the obligation was immaterial and the provision appeared adequate. The money that should have been reserved was, rationally and in good faith, allocated elsewhere.

This is the information failure: the number was wrong when it didn't matter, and by the time it matters, the resources that would have corrected it have been consumed. The time value of money created the illusion of irrelevance. The time value of ignorance created the reality of exposure.

The compounding error

The annual escalation of the provision is often presented as a growing reserve — a fund that accumulates over time to meet the eventual obligation. In accounting terms, this is accurate. The provision balance increases each year. The operator can point to a number that is larger than it was the year before.

But the actual cost of decommissioning is also changing each year — driven by real-world factors that the escalation index does not capture. If the actual cost is growing faster than the provision, the gap between the two is widening, not narrowing. The provision is increasing in absolute terms while decreasing in adequacy.

This is a compounding error. Each year that the provision grows at 2% while the actual cost grows at 4%, the shortfall increases. Over 20 years, the cumulative effect is not a small adjustment. It is a structural deficit that may represent 40%-50% or more of the actual cost at the point of execution.

The operator who checks the provision balance and sees a growing number receives a false signal of adequacy. The balance is increasing. The obligation is being funded. The trajectory looks correct. But the trajectory is wrong — the provision and the actual cost are diverging, and the divergence is invisible because the actual cost has never been independently measured.

This is perhaps the most insidious feature of the decommissioning data gap. The absence of cost data does not produce an obvious alarm. It produces a quiet, compounding understatement that is indistinguishable from adequacy until the moment of truth arrives.

The moment of truth

The moment of truth is the point at which the provision meets reality — when the operator commits to a decommissioning programme, procures the work, and discovers what it actually costs.

For the first generation of wind farms, this moment is arriving now. Projects permitted in the early 2000s are reaching the end of their consented lives. Some will be life-extended. Some will be repowered. The remainder must be decommissioned. In each case, the operator will confront the actual cost of the obligation that has been sitting in their financial model for two decades.

The early evidence — from completed projects in Denmark, Germany, and in the United States — suggests that actual costs are materially higher than typical provisions. The gap is not uniform. It varies by site, by scope, by turbine type, and by market conditions at the time of execution. But the direction is consistent: the provisions are low.

This early evidence is fragmented. It has not been systematically collected, structured, or published. Individual operators know what their projects cost. Individual contractors know what they charged. But the market as a whole does not have access to a dataset that would allow provisions to be tested against a distribution of observed outcomes.

The moment of truth, when it arrives at scale, will be a market-wide repricing of decommissioning risk. Provisions will be revised upward. NAVs will be adjusted. Transaction prices will shift. Financing terms will tighten. The cost that was immaterial at inception will assert its materiality retrospectively, across every asset class, every jurisdiction, and every participant in the value chain.

The question is whether the market learns this lesson gradually — through proactive investigation, independent data collection, and voluntary provision adjustment — or abruptly, through a succession of cost overruns, funding shortfalls, and stranded obligations that force the correction.

The perverse incentive structure

The time-value dynamic does not merely create an information gap. It creates a perverse incentive structure that actively discourages investigation at every stage of the asset's life.

At inception, the sponsor has an incentive to minimise the decommissioning cost estimate. A lower estimate means a smaller provision, which means a higher project return, a lower equity requirement, and a more attractive investment case. The sponsor is not lying — the estimate is within the range of reasonable assumptions. But among the range of reasonable assumptions, the sponsor selects the lower end, because the present value impact is negligible and the commercial benefit is tangible.

The lender accepts this estimate because the present value impact on debt service coverage is negligible. The independent engineer reviews it and finds it "within a reasonable range" — a phrase that accommodates wide variation when no empirical benchmark exists. The auditor accepts the methodology. No one has an incentive to challenge the number, because the challenge would not change any decision.

During the operating life, the operator has an incentive to avoid revisiting the provision. A higher provision means lower distributable cash flow, a higher liability on the balance sheet, and an uncomfortable conversation with shareholders or limited partners. The operator escalates the provision by the agreed index and reports it as adequate. The auditor confirms the methodology. The board notes the number.

At end-of-life, the incentive structure reverses — the operator desperately wants to know the actual cost, because the funding decision depends on it. But by this point, the provision is set, the cash has been distributed, and the operator's options are constrained.

The market has produced, through entirely rational behaviour at each stage, a systematic understatement of a material liability — and has done so for two decades across an entire asset class. Every participant behaved rationally. The aggregate outcome is irrational.

The cross-stakeholder blindness

The time-value dynamic does not affect only the project sponsor. It creates parallel information failures across every participant in the value chain, all driven by the same mathematical cause.

The lender at financial close examines the decommissioning cost in the context of the debt sizing. At a 25-year horizon, the discounted decommissioning cost is immaterial to the debt service coverage ratio. The lender does not commission independent analysis because the sensitivity is negligible. 20 years later, a

different lender — financing the repowering of the same project — discovers that the decommissioning line item is the most uncertain component of the capex budget and has the least contractual protection. The original lender's rational indifference created the successor lender's problem.

The insurer who issues a decommissioning bond at project inception bonds an amount based on the original cost estimate. The premium is modest because the bonded amount is modest. 20 years later, the bonded amount may be a fraction of the actual obligation, and the insurer's exposure — the gap between the bond and the true cost — has grown without any corresponding adjustment in the premium or the underwriting.

The investor who acquires the project in a secondary transaction credits the decommissioning provision at face value in the transaction model. The provision represents a small deduction from the asset value. The investor does not commission a detailed assessment because the impact on the acquisition price is marginal. 10 years later, the provision's adequacy is the determining factor in the asset's terminal value — and the investor is holding a liability they did not properly price.

At every point in the asset's ownership chain, the time-value dynamic produces the same result: the decommissioning cost is examined at the moment when it is least material and accepted at the moment when it is least understood. By the time it becomes material, the opportunity to understand it has passed — and the consequences of not understanding it are borne by whoever is holding the asset when the music stops.

What this means

The decommissioning data gap is not a market failure in the conventional sense. It is a predictable consequence of rational behaviour within a mathematical structure that systematically devalues distant obligations.

No individual participant was wrong to treat the decommissioning cost as immaterial at inception. The mathematics justified the indifference. No individual participant was wrong to escalate the provision by CPI rather than commissioning annual cost assessments. The effort was not proportionate to the impact. No individual participant was wrong to accept the provision at face value in a transaction, a financing, or an insurance underwriting. The number was immaterial in every context where it was examined.

But the aggregate consequence of these individually rational decisions is a market-wide understatement of a liability that is now approaching materiality. The first-generation fleet is ageing. The obligations are crystallising. The provisions that were set in a different era, escalated by an inappropriate index, and never tested against empirical data, are about to be tested by reality.

The time to correct the information failure is now — before the moment of truth arrives at scale. The correction requires a single thing that has never existed in the market: independent, structured, empirical data on what decommissioning actually costs. Data that allows a provision to be tested against observed outcomes. Data that allows the escalation error to be measured. Data that allows the scope gap to be quantified. Data that allows every participant — sponsor, lender, insurer, investor, operator — to replace the comfortable indifference of the early years with the informed preparedness that the approaching obligation demands.

The time value of money made the decommissioning cost irrelevant for 20 years. The time value of ignorance made it dangerous.

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