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In cooperation with
Green Investment Partners

Valuing Portfolios of Renewable Energy Assets with EV/MW multiples

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Based on a Master thesis by Faustine Douce and Jules Gallazzini, "Valuation of renewable energy project portfolios under information constraint", directed by Pascal Quiry

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Executive summary

Discounted cash flow is impractical for valuing renewable energy projects without insider information, since it requires a long explicit horizon. As an alternative, we utilise an M&A transactions database to build an enterprise value per megawatt (EV/MW) model for European wind and solar projects, based on project fundamentals — project status, technology, location. Building on these three primary factors, we derive a time-efficient asset-based estimate of portfolio value. We test this model on a recent public market transaction of a renewable energy portfolio.

Why DCF is inadequate

Market price fluctuations for listed assets portfolios — yieldcos — and for equity of developers and operators of renewable energy projects — independent power producers (IPPs) — seem too high to accurately reflect the evolution of fundamental asset values. Some market participants, based on their own fundamentals-based valuation, take advantage of this high market volatility in taking yieldcos or IPPs private [1]. In this context, having a robust method to estimate the asset value based on fundamentals, and requiring minimal externally available information, can be key to anticipating the actions of other market participants.

Discounted cash flow methods (DCF), widely used to value assets based on fundamentals [2], are inadequate for valuing project-financed infrastructure assets from an external standpoint: as this financing method involves backing construction debt with cash flows over 15 to 25 years, a rigorous DCF application requires an explicit horizon of 15 to 25 years. Project developers typically conduct valuation in this manner. However, when it comes to equity researchers and investors, DCF methods are usually employed with a short explicit horizon, and a terminal value based on long-term growth assumptions or income multiples, owing to limited data availability and time constraints [2].

The point for EV/MW multiples

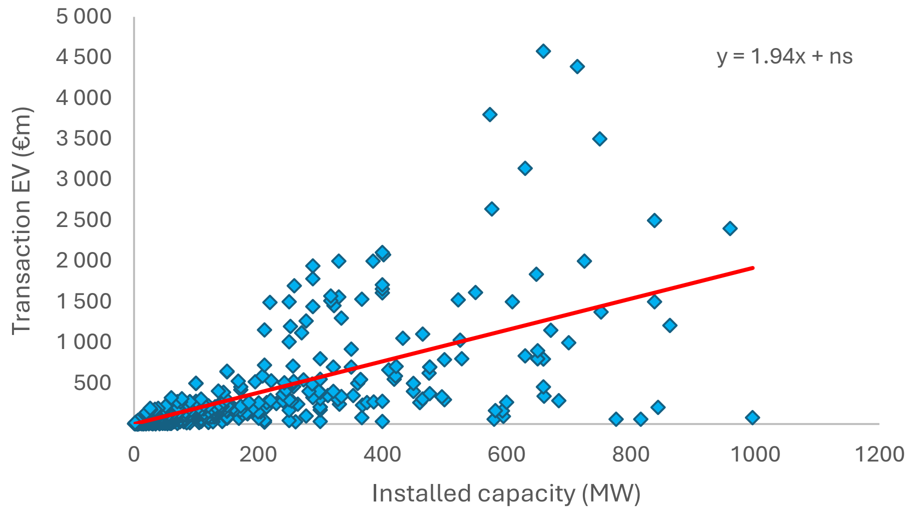
Multiples are often dismissed as a "shorthand for the process of valuation", contrasting with a detailed financial analysis that typically relies on discounted cash flows [2]. For instance, P/E or EV/EBITDA multiples rely on a "denominator that considers only the short term" [2]: EV and price reflect the cash flows to come, corrected for their distance in time, while recent net income or EBITDA do not provide information about cash flows order of magnitude beyond the next few months.

However, while P/E and EV/EBITDA are based on revenue-related metrics such as net income and EBITDA, EV/MW multiples are based on a fundamentals-related metric.

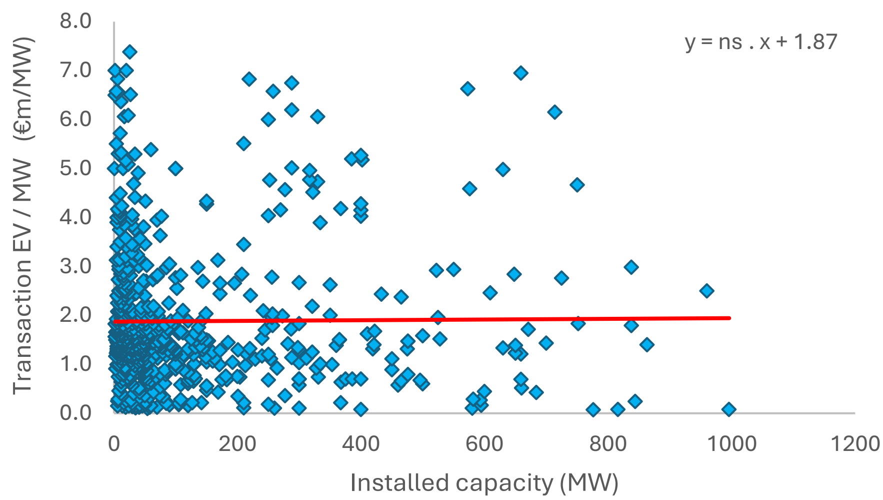
The installed power generation capacity, expressed in megawatts (MW), is an asset measure, referring to the fixed assets account on the balance sheet, which makes up most of the assets for an infrastructure company. MW of installed capacity are to MWh of monthly or yearly generated power what hectares of arable land are to monthly or yearly crop yield for a farming business. The logic behind EV/MW multiples involves normalising the asset value by asset size, relying on two key assumptions:

1. Value linked to asset size: Intuitively, the order of magnitude of the yearly power output, and thus that of the special purpose vehicle (SPV) bottom line, is heavily dependent on the capacity and number of generators. In that case, we can reason in unit prices by normalising the asset value by the asset size.
2. Direct linear relationship: No significant higher-order dependencies of asset value on asset size. In other words, when using EV/MW multiples, we make the implicit assumption that there are no significant economies of scale, as larger assets are assumed to have a unit price (EV/MW) comparable to that of smaller assets.

Both assumptions, tested using our M&A transaction multiples database (see Appendix A and B), hold statistically.



Linear Regression - Transaction EV vs Installed Capacity: Value depends on Asset size



Linear Regression - Transaction EV/MW vs Installed Capacity: No significant Economies of scale

Breaking down renewable energy projects fundamentals

A significant portion of valuation work relates to finding the best value drivers, a set of metrics that encompasses most of the information regarding project risk and return while keeping the number of metrics to a minimum, depending on the modeller's time constraints. For an equity investor valuing a developer's portfolio of hundreds of MWs, this equates to summarising the plethoric inputs of project finance DCF models used by developers, banks or investors at SPV level, to a dozen indicators.

We narrowed the input list to ten parameters: Capital expenditures, Capacity factor, Installed capacity, Project lifetime, Power price, Operational expenses, Inflation rate/indexation, Tax rate, Interest rate, Debt service coverage ratio (DSCR).

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	...	Year n
FCFF	- Capex	###	###	###	###	###	...	###

Project lifetime (Year 1 to Year n)

Schematic Cash Flow Profile, Wind or Solar Project

CFS		
	Installed capacity	MW
x	**Capacity factor**	%
x	8760	h
=	**Energy yield**	MWh
x	**Power price**	€/MWh
x	**Indexation**	Index
=	**Revenues**	€
-	**Opex**	€
x	**Indexation**	Index
-	**Tax rate**	%
x	Taxable income	€
=	**Operating CFs**	€
-	**Interest rate**	%
x	Debt	€
-	Debt repayment (sculpted using **DSCR**)	€
=	**Free Cash Flows during operations**	€

Schematic Cash Flow Statement, Wind or Solar Project

Since debt is usually sculpted to equal the maximum repayment capacity given DSCR or loan life coverage ratio (LLCR) required levels, the D/E ratio, or gearing ratio, is an internal variable of project finance models.

Furthermore, we can consider the debt covenants such as DSCR and LLCR, along with debt reserves such as DSRA and DSRF, as internal variables, not directly to project finance models, but to financing negotiations. Indeed, these debt covenants are determined by the project risk, in turn determined by the project fundamentals.

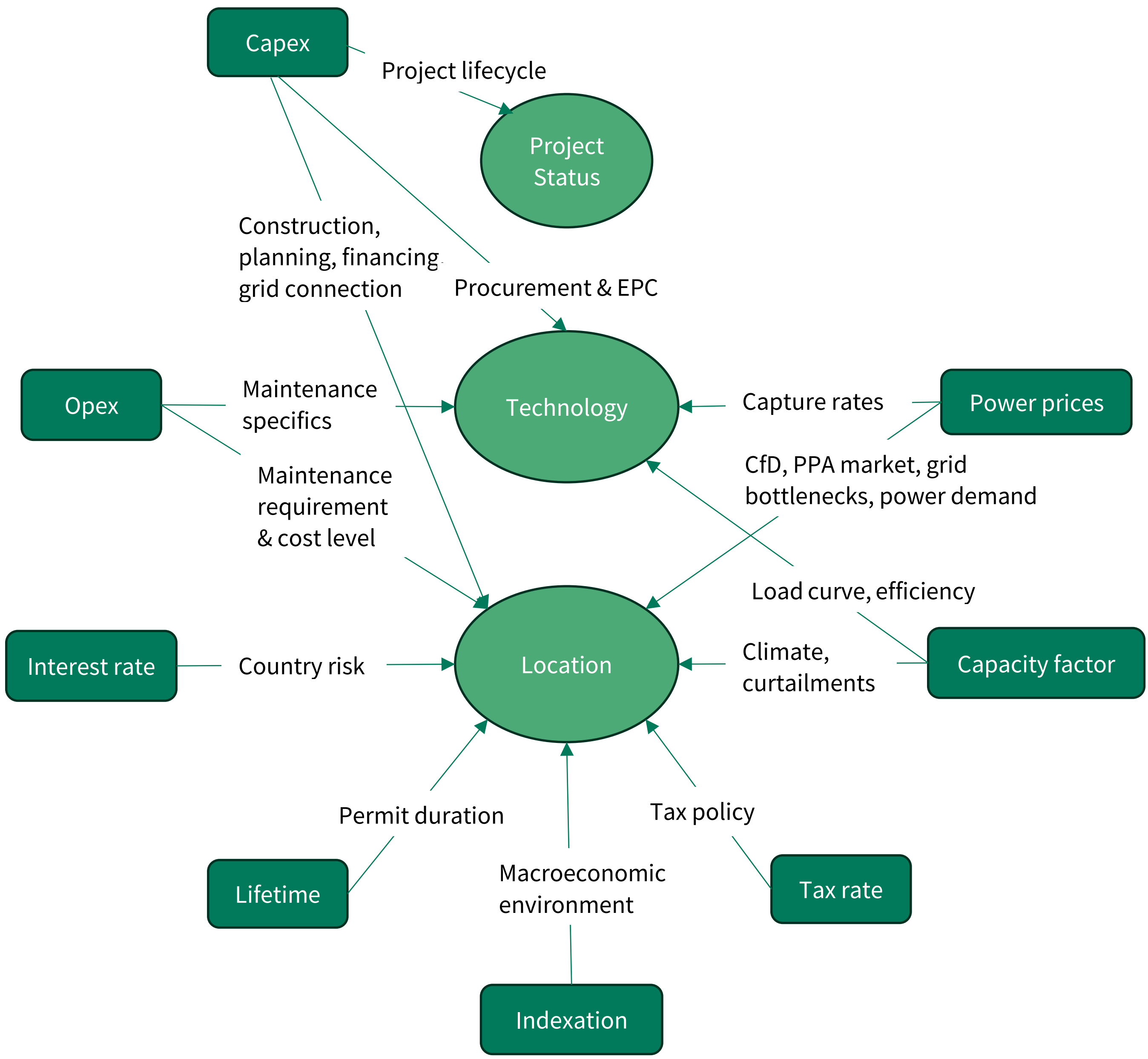
Since the installed capacity is known – or EV/MW cannot be used to get to EV, this leaves eight model parameters that provide a good approximation of project fundamentals and should be integrated into our valuation method: Capex, Project lifetime, Capacity factor, Power price, Indexation, Opex, Tax rate and Interest rate.

Proxying fundamentals with basic project characteristics

These model parameters are usually not public information. As a workaround, practitioners make an educated guess based on what is publicly known about the project. For instance, a French solar farm is likely subject to French construction costs and France's irradiance levels.

In our M&A transaction database, each transaction includes three readily available project characteristics: Project Status (permitted, under construction, operating), Technology (onshore wind, solar PV, offshore wind), and Location (geographical region).

Below is a schematic illustrating the economic relationships between the eight fundamental parameters and the three key project characteristics.



Economic Relationships between Model Parameters and Dataset Factors

The Project Status factor serves as a proxy for capital expenditures, specifically regarding the timing of cashing out the planned capital expenditures, i.e. the occurrence of debt drawdowns and equity injections depending on construction stage. In contrast, the Technology and Location factors serve as proxies for the level of planned capital expenditures.

Can we statistically assess the relevance of these factors? Using the transactions database, we perform an analysis of variance (ANOVA) test of EV/MW for each factor and compare the obtained p-values. ANOVA is a statistical method for testing categorical variables, assessing whether the mean EV/MW for each factor category significantly differs from the overall mean.

Factor	*F-stat*	*p-value*	
Project Status	44.53	1.13e-18	*Most significant* ↑
Technology	34.53	7.17e-15	
Location	8.50	6.62e-10	
Transaction Year	2.70	6.85e-05	

ANOVA test, EV/MW by Factor, 2001-2024

All our factors are significantly related to EV/MW, as the p-values are well below the standard 5% threshold. Project Status is likely the best predictor for EV/MW, before Technology and Location. These three factors are much better predictors of EV/MW than the year of the transaction, included as control variable.

Getting factor-dependent EV/MW multiples

We want to build estimates of EV/MW multiples dependent on Project Status, Technology and Location. We conduct a linear regression with linear time decay on past transaction multiples, categorised by Project Status, Technology and Location (see Appendix C).

$$\mathrm{EV/MW}_{\textit{Status, Technology, Location}} = \sum \beta_{\textit{Status, Technology, Location}} \cdot 1_{\textit{Status, Technology, Location}}$$

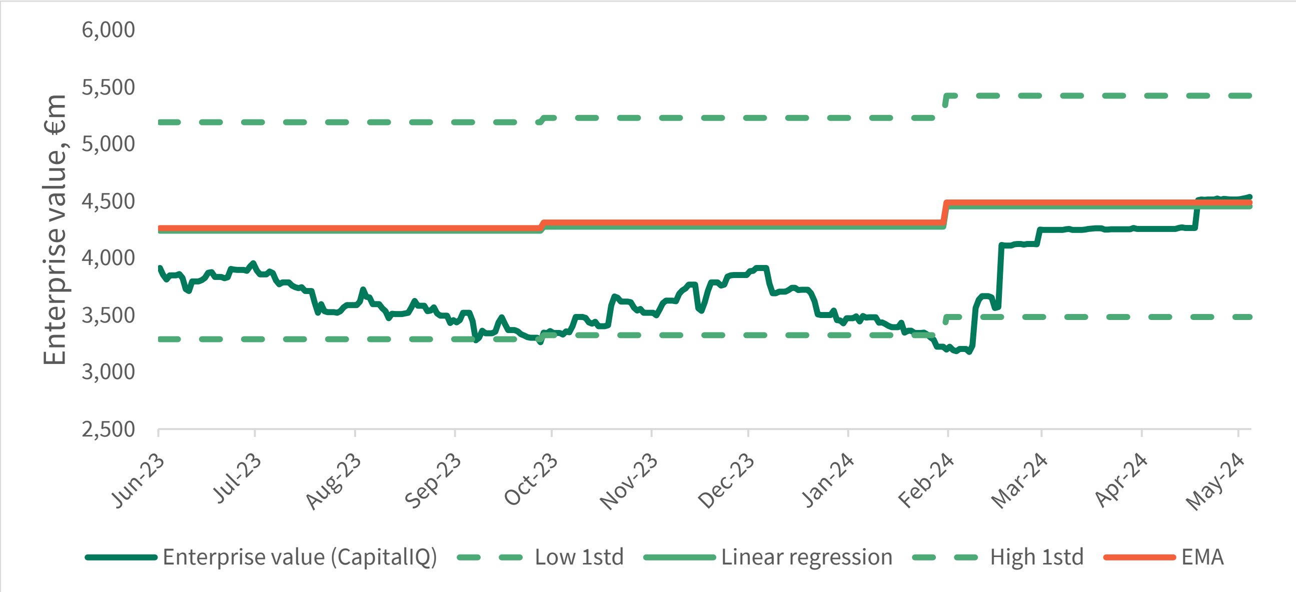
We also calculate an exponential moving average (EMA) of the transaction multiples (see Appendix C).

Then, we multiply those estimates by the installed capacity of relevant projects and sum up to get a portfolio enterprise value.

$$\text{Portfolio EV} = \sum \mathrm{EV/MW}_{\textit{Status, Technology, Location}} \cdot \mathrm{MW}_{\textit{Status, Technology, Location}}$$

Testing on a recent take-private

In May 2024, KKR investment firm made public a bid on European developer Encavis at 17.5€/sh, or 2.1€m/MW [3]. We tried to see if the bid price coincides with our valuation of Encavis assets. Encavis is a pure play developer of onshore wind and solar projects in Europe, which matches the scope of our model.



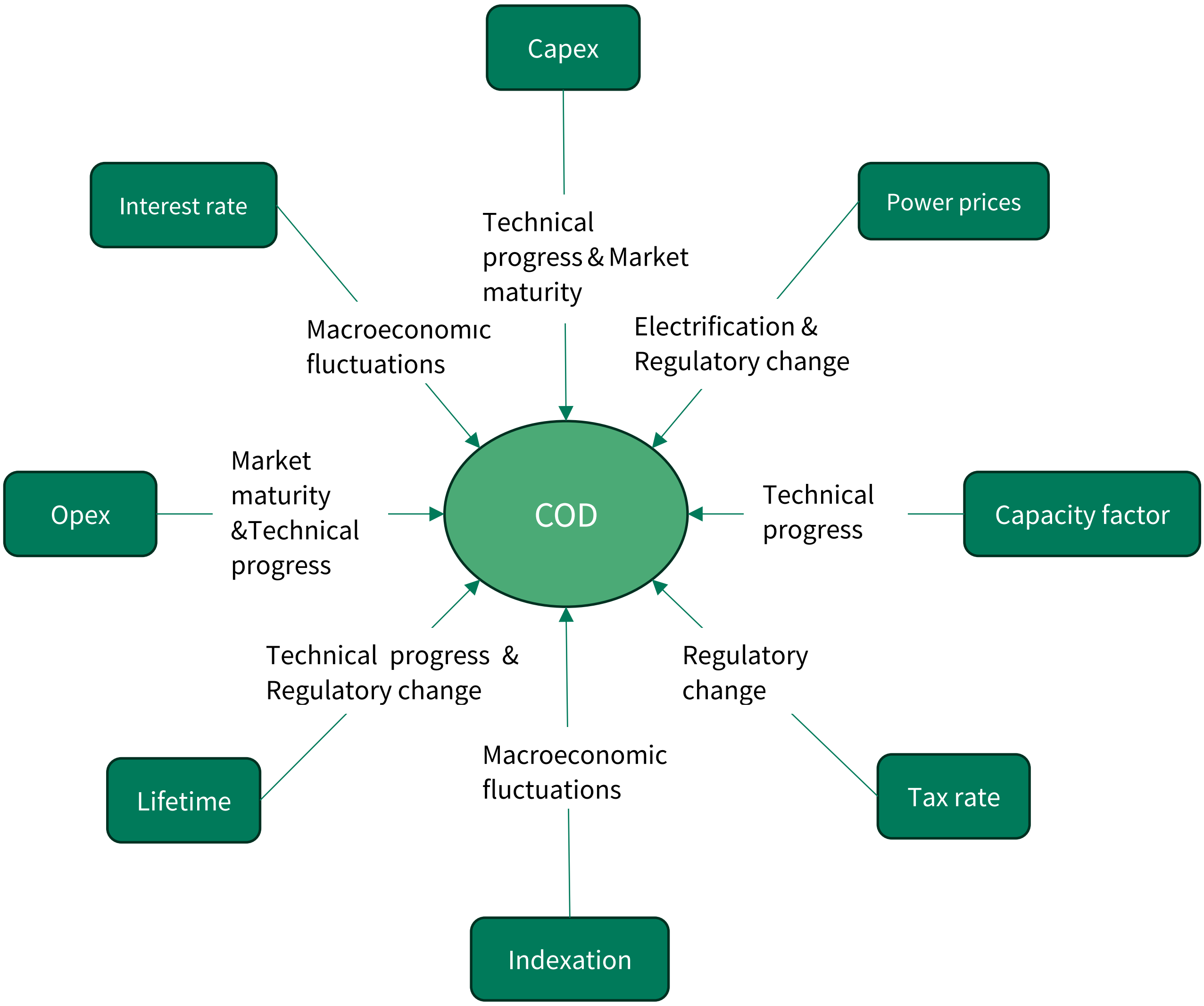
Estimate of Encavis portfolio EV in May 2024 vs Trading EV. Entreprise value: source CapitalIQ, Ticker: ECV, Metric: TEV, retrieved on 25/07/2024. Linear regression and exponential moving average (EMA): own algorithms applied to M&A transaction multiples from 2021-2024. Low 1std and High 1std: estimate from weighted linear regression (WLS) +/- one standard deviation, computed with error propagation methods. See Appendix C and D for details on methodology.

Our base case estimate, with both weighted linear regression (WLS) and exponential moving average (EMA), is close to the trading enterprise value of Encavis in May 2024. At this time, the share price closes in on the bid price made public by KKR. We also observe that the take-private was initiated when Encavis' trading enterprise value crossed the WLS estimate minus one standard deviation.

This EV/MW valuation method produced a reasonably accurate estimate of a private market valuation of a renewable portfolio. The estimate carries significant uncertainty, which is quantified by the valuation band of +/- one standard deviation from the WLS estimate, an acceptable precision level given the minimalist model inputs. Further tests should be conducted to assess the relevance of this time-efficient valuation method. Of the two algorithms tested, EMA is straightforward and easy to apply, while WLS offers error quantification.

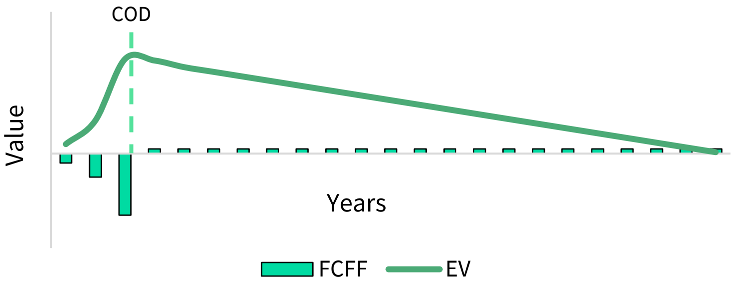
Missing factor: commercial operations date

Not available in our database of M&A transactions, the commercial operations date (COD) factor would likely further improve the results. As illustrated below, it would add information about the macroeconomic state at project construction, influencing interest rates and contract indexations, the regulatory framework in place, contract for difference (CfD) prices, or the technological advancement and market maturity, with higher efficiency at lower cost over time for newly built projects.



Rationale of COD Factor

With COD data, we could also improve the Project Status factor, making a distinction between projects in first years of operations and projects close to maturity. Indeed, renewable energy projects reach their maximum enterprise value at COD, when investment is complete, and all positive cash flows are yet to come. The EV then declines linearly as yearly cash flows are similar.



Schematic, Project EV over Project Life

Limitation: transaction premia

A key limitation of this valuation method is the assumption that M&A transaction prices accurately reflect the project value determined by the project developer, implying that transaction premia are low enough to substitute EV/MW multiples from M&A for those used in internal valuation. Should this assumption fail, there is a risk of overestimating the portfolio's EV.

Transaction premia in renewable energy typically do not arise from traditional synergies such as economies of scale or scope, since renewable energy projects are stand-alone generation assets, unlike energy networks.

Risk reassessment is likely the main driver of transaction premia in renewable energy assets. Rising trends in power prices, increasing political support for renewables, and shifting market expectations create opportunities for renegotiating PPAs or refinancing. This may result in varying internal rate of return (IRR) hurdles across the industry, and ultimately in optimistic M&A EV/MW multiples as projects are acquired by those with the lowest IRR hurdles.

Another likely source of premia is repowering and revamping opportunities. Repowering involves replacing turbines at wind farms nearing the end of their project life, while revamping involves replacing solar panels. With regulatory changes simplifying re-permitting procedures and old projects being located on the windiest or sunniest locations, repowering is increasingly viewed as a real option. Variations in assumptions on this real option to repower can lead to differences in valuations.

Additionally, some investors can hold overly optimistic views. They may value portfolios based on aggressive power price assumptions, or underestimate pipeline risks, such as permitting and grid connections. For short-term investors (e.g., five-year horizon), this overestimation may be rational, as they are not penalised by the market for assumptions that would only be disproved after they exit.

Finally, a potential source of transaction premia is a lag in accounting for rising interest rates. Private actors, for instance, may base their valuations on lower capital costs secured earlier, which could lead them to overpay for a portfolio.

Conclusion

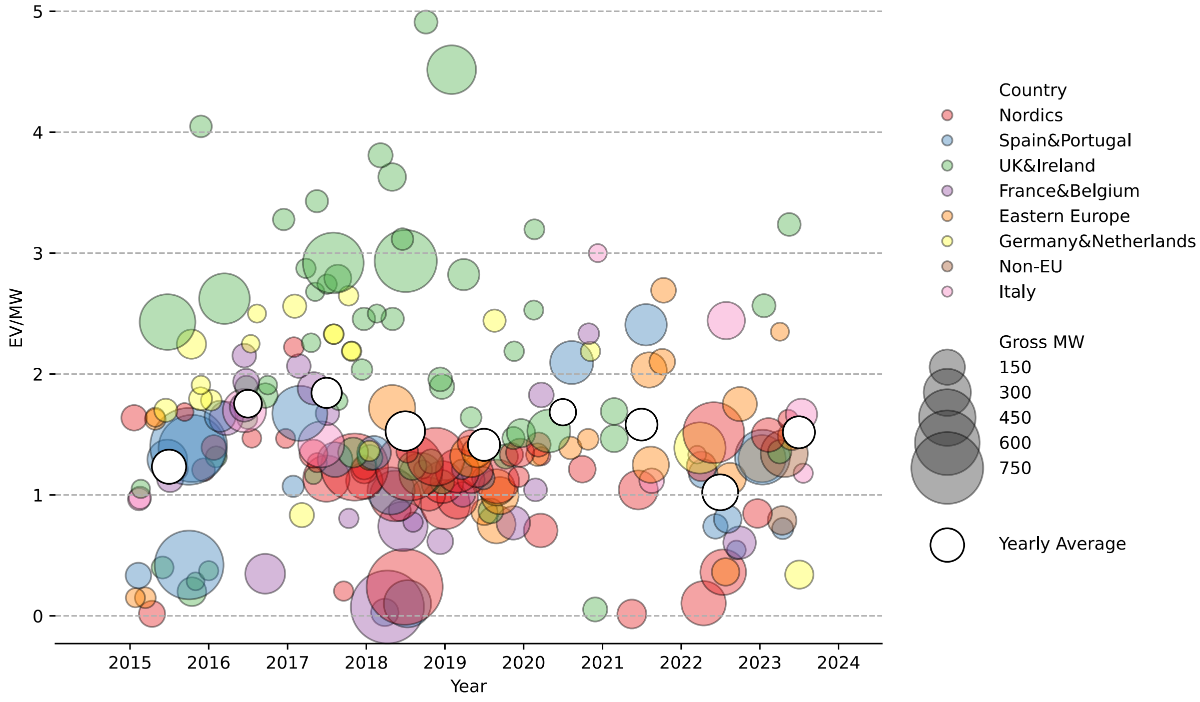
Valuation of renewable energy portfolios with EV/MW multiples is a time-efficient method relying on asset fundamentals. Regressing past transaction multiples on three externally available project factors — project status, technology and location — yielded a reasonable estimate of the bid price for the Encavis take-private, with minimalist inputs.

This method could be a complement to a capex-based valuation approach, which would estimate the EV calculated by project developers through project costs, avoiding the potential upward bias of transaction premium [4].

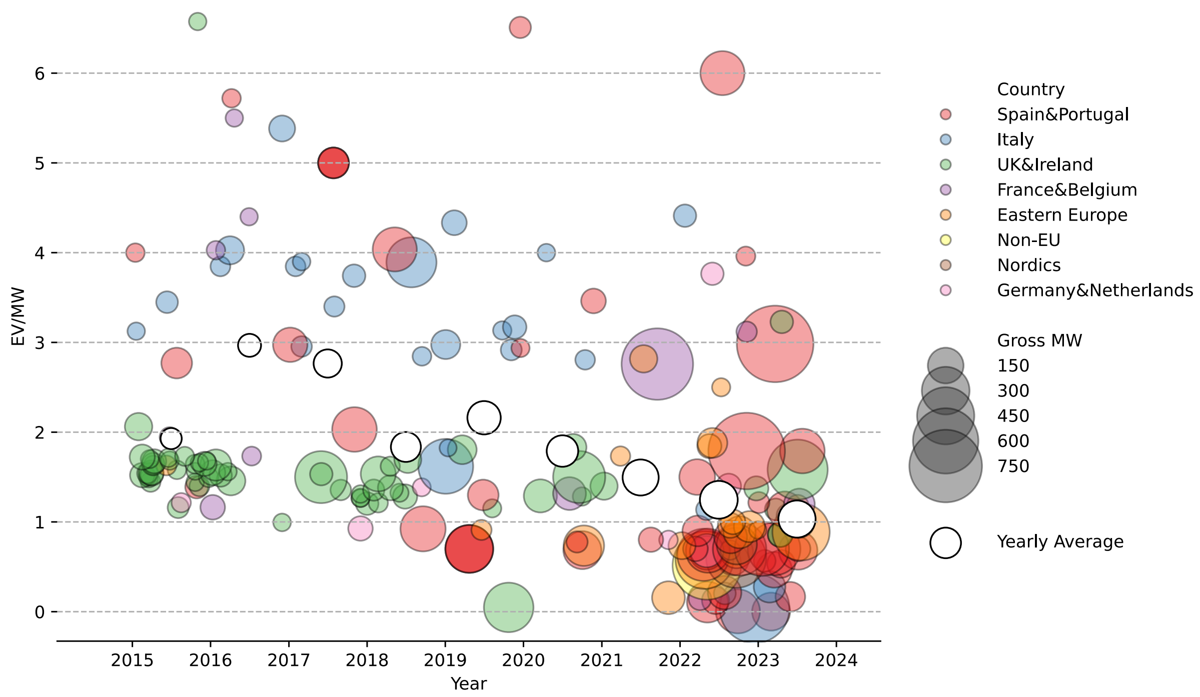
Appendix

A. Dataset of M&A transactions

The dataset includes 762 transactions from 2001 to 2023, with disclosed price, in Europe, for wind (onshore and offshore), and solar PV. We were able to reproduce Deloitte 2017 [5] with this dataset.



Database Transactions, Onshore Wind, All Development Stages, >2015



Database Transactions, Solar PV, All Development Stages, >2015

B. Linear regression, EV/MW multiples

Computed with Python, *statsmodels*, cross-validated OLS, 2001-2024, European projects, several technologies (onshore wind, solar PV, offshore wind), all development stages.

Variable	*Coeff*	*Std Err*	*t*	*P>|t|*	*[0.025*	*0.975]*
Gross MW	1.94	0.08	23.18	3.24e-82	1.77	2.10
Constant	-4.56	17.60	-0.26	0.80	-39.13	30.01

Linear Regression, EV vs Gross MW

Variable	*Coeff*	*Std Err*	*t*	*P>|t|*	*[0.025*	*0.975]*
Gross MW	6.97e-05	3.21e-04	0.22	0.70	-5.61e-04	7.01e-04
Constant	1.87	0.07	27.68	2.87e-110	1.74	2.01

Linear Regression, EV/MW vs MW

C. WLS and EMA: methodology

Computed with Python, *statsmodels/pandas*.

The dataset is filtered for available and unambiguous Project Status, Technology and Location, e.g. combined wind and solar projects are excluded as ambiguous.

First EV/MW estimates are obtained with a multivariate weighted linear regression (WLS) of EV/MW over dummy variables for Project Status, Technology and Location. No intercept fitted. Linear penalisation based on time distance between datapoint and valuation date. The resulting coefficients are used as EV/MW estimates per combination of Project Status-Technology-Location.

Second EV/MW estimates are obtained with an exponential moving average (EMA), applied to EV/MW transaction multiples grouped by combination of Project Status-Technology-Location, with an alpha of 0.02.

After pre-processing a target portfolio (summing gross MW of assets with >50% ownership by Project Status-Technology-Location combination), MW are multiplied by the corresponding EV/MW multiple, to get the valuation of the parts. Summing up the parts gives a portfolio enterprise value estimate.

For the linear regression method, upper and lower bounds at one standard deviation are computed, using standard error propagation calculations.

D. Encavis portfolio EV estimate

Encavis portfolio was modelled based on the versions of the factbook provided by the company on its investor relations page, retrieved via *archive.org*. Among the available versions, those of 27/06/2023, 25/10/2023 and 27/02/2024 (identical to 23/05/2024) were used to perform the valuation, as there were sufficient differences in the portfolio.

References

[1] Green Investment Partners, Cleantech Cycles - The Tide Is Out, 23/10/2020

[2] Valuation Multiples, What They Miss, Why They Differ, and the Link to Fundamentals, M. Mauboussin, D. Callahan, MS Investment Management, 23/04/2024

[3] Encavis take private offer from KKR, 4-Jun-24

[4] Green Investment Partners, Renewable Energy Asset Valuation: Public Versus Private Markets, 09/2024

[5] A market approach for valuing onshore wind farm assets, Deloitte, 2017