EU-SCORES
European Scalable Offshore Renewable Energy Sources

European Scalable Offshore Renewable Energy Source (EU-SCORES)

D7.10 Analysis of Financial KPIs for a future system and scenarios

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Executive Summary

This deliverable D7.10 provides an overview of the main key performance indicators best suited to describe the EU-SCORES business cases.

The key performance indicators discussed in this deliverable are:

- Levelised cost of electricity
- Internal rate of return
- Net present value
- Return on Investment
- Payback period

Each of these key performance indicators provides a different measure of project viability. Combining them provides a comprehensive picture of the financial health of a project.

The deliverable discusses each of the key performance indicators in turn as well as their interactions with each other. A summary table of the definitions of each metric is also provided, along with why they are important and how they interact.

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Abbreviations

CAPEX	Capital Expenditure
DECEX	Decommissioning Expenditure
DEVEX	Development Expenditure
IRR	Internal Rate of Return
LCOE	Levelised Cost of Electricity
OPEX	Operational Expenditure
NPV	Net Present Value
ROI	Return on Investment
WACC	Weighted Average Cost of Capital

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Contents

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1. What are Financial Key Performance Indicators

This deliverable D7.10 provides an overview of the main key performance indicators (KPIs) best suited to describe the EU-SCORES business cases.

As part of EU-SCORES a number of different business cases with different locations and technology combinations have been conducted. As part of a business case, KPIs provide metrics that support the evaluation of financial performance, profitability, and the viability of a renewable energy project. The KPIs are quantifiable measurements that are used by investors, project developers, and stakeholders to assess the potential success and risk of a renewable energy investment.

To assess the financial performance of a renewable energy project it is recommended to not view them in isolation, as each KPI provides a different insight on the financial health.

The next sections will define each of the five selected KPIs that are best suited to describe a renewable energy project along with the relevant interactions between KPIs: Levelised cost of electricity (LCOE), Internal Rate of Return (IRR), Net Present Value (NPV), Return on Investment (ROI) and Payback period.

The summary of the KPIs and the key interaction between them are detailed in Chapter 2.

1.1 Levelised Cost of Electricity

The Levelised Cost of Electricity (LCOE) is a a comparative metric used in the energy industry to assess the relative merits of generation types. The LCOE attempts to compare the overall cost of different methods of electricity generation on a similar basis per kWh or per MWh. It is the key measure used in comparing different energy projects and is defined as the ratio of total lifetime expenses of the generation facility under analysis, versus the total expected production, and is expressed in terms of the present value equivalent. The 'costs' include all costs such as DEVEX (development expenditure), CAPEX (capital expenditure), OPEX (operational expenditure), commissioning and decommissioning costs, etc.

The LCOE equation is:

$$LCOE = \frac{\sum_{t=1}^{n}\left(\frac{I_t + M_t}{(1+r)^t}\right)}{\sum_{t=1}^{n}\left(\frac{E_t}{(1+r)^t}\right)}$$

where I_t is the initial cost at year t, M_t is the maintenance or operational cost at year t, r is the discount rate or weighted average cost of capital (WACC), and E_t is the electricity or yield generated at year t.

For renewable energy projects, LCOE combines a lot of information into one indicator, including the:

- availability (e.g. reliability, operability, maintainability, etc);

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- performance (e.g. efficiency, capacity factor, resource, etc);
- survivability (e.g. load cycles, lifetime, corrosion, etc);
- affordability (e.g. DEVEX, CAPEX, OPEX, DECEX, scalability, cost of finance, insurability, installability, etc)

Each of these categories impact LCOE either positively or negatively. There are also correlations between categories. One example is the close association between the OPEX and Reliability and Maintainability. Another example is that renewable power sources, such as wave, and wind, are sensitive to their location which will affect the capacity factor and thus the performance.

In general, a lower LCOE means the project is more cost-efficient in generating electricity, making it more competitive in the energy market. A lower LCOE means that the project will have more competitive pricing, potentially increasing revenue and thus IRR, and may also raise profitability (i.e. higher NPV).

However, a project with a higher LCOE may still have a reasonable IRR and NPV, due to favourable feed in tariffs or grant support. Furthermore, the LCOE does not provide information on the quality of the electricity, nor the time value of that electricity source. For example, there are real concerns that regardless of the LCOE reduction trajectory seen in offshore wind, the market value of the energy supplied to the grid is under pressure due to possible oversupply[1].

1.2 Internal Rate of Return

The Internal Rate of Return (IRR) is the annual rate of growth that an investment is expected to generate. In other words, the metric is used to estimate the profitability of potential investments over a project lifetime. IRR is in fact the discount rate that makes the Net Present Value (NPV) of all cash flows of a project equal to zero and is represented by a percentage.

The IRR equation is:

$$0 = NPV = \sum_{t=1}^{n} \frac{C_t}{(1+IRR)^t} - C_0$$

where C_t is the net cash inflow at time t, C_0 is the total initial investment cost, IRR is the internal rate of return, and n is the number of time periods.

Distinction can be made between unleveraged IRR (also known as Project IRR) and leveraged IRR (also known as Equity IRR). The main difference is whether the calculation accounts for debt financing. The unleveraged IRR reflects the pure return generated by the project itself. The leveraged IRR includes loan repayments, interest, and tax benefits of debt. If debt financing is cheap, then the leveraged IRR is typically higher than unleveraged, which in turn increases returns to equity holders.

[1] Pennock. S. et al., 2022. Temporal Complementarity of Marine Renewables with Wind and Solar Generation: Implications for GB System Benefits. Applied Energy 319 (2022) 119276.

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In general, the higher the IRR the more desirable a project investment may be.

A higher IRR leads to a higher NPV and indicates that the electricity generated is relatively more valuable. A lower LCOE would help increase IRR by improving the cash flow generated by the project.

1.3 Net Present Value

The Net Present Value (NPV) is used to measure the current value of a future stream of payments from a project. In other words, it is the difference between the present value of cash inflows and outflows over a given time period. This calculation requires a minimum acceptable rate of return (discount rate or IRR).

The NPV equation is:

$$NPV = \sum_{t=0}^{n} \frac{C_t}{(1+r)^t}$$

where C_t is the Net cash inflow at time t, C_0 is the total initial investment cost, r is the discount rate, and n is the number of time periods.

In general, a positive NPV indicates a worthwhile investment whereas a negative NPV does not.

The NPV depends on the cashflows generated by a project and is influenced by IRR. The bigger the IRR, the more likely NPV will also be positive.

1.4 Return on Investment

The Return on Investment (ROI) is a metric used to evaluate the performance of an investment. Similar to IRR it also measures how much return an initial investment will generate, however, ROI does not take into account the time value of money.

The ROI equation is:

$$ROI = \frac{Current\ Value\ of\ Investment - Co\quad of\ Investment}{Cost\ of\ Investment} * 100$$

Where the 'Cost of Investment' is the initial outlay, and the 'Current Value of Investment' is the current evaluation of that same investment. Due to its versatility and simplicity, ROI is favoured as a fundamental gauge of an investment's profitability. Furthermore, the similarities between ROI and IRR means that as IRR increases so does ROI.

1.5 Payback Period

The Payback period is a measure of the time it will take to recover the costs of an investment or to break even on the investment.

The equation for Payback period is:

$$Payback\ period = \frac{Cost\ of\ Investment}{Average\ Annual\ Cash\ Flow}$$

In general, shorter Payback periods are more desirable. Shorter Payback periods typically result in higher ROI and IRR.

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2. The interaction between KPIs

The KPIs described in Chapter 1, (LCOE, IRR, NPV, ROI and payback period) are interconnected. Optimising them together gives a comprehensive picture of the financial health of a renewable project. This chapter briefly describes the interactions between each of the metrics. A summary of each KPI, it's importance in assessing project viability, and their interactions is found in Table 1.

LCOE

LCOE impacts IRR, NPV, ROI, and payback period by affecting the cost of energy production.

Typically, a lower LCOE will reduce the cost of producing electricity, making it easier to generate higher cash flows. This in turn leads to an increase in IRR and higher NPV. However, a high LCOE may still have a reasonable IRR due to a high level of tariff or grant support and may therefore still be worthy of investment.

IRR

IRR reflects the return rate; higher IRR typically leads to a better ROI, a shorter payback period.

A higher IRR means that the project's revenues will exceed costs faster, creating positive cash flows and increasing profitability. This also is more likely to result in a positive NPV.

NPV

NPV measures profitability over time. In general, a higher IRR and lower LCOE both contribute to higher NPV. A shorter payback period can also positively contribute to NPV, as a faster recovery of costs results in a more profitable project.

ROI

ROI reflects total profitability and is enhanced by higher IRR and lower LCOE. A shorter payback period also has a positive impact on ROI in the same way as with NPV, where costs are recovered more quickly, thus providing higher profitability.

Payback period

The Payback period shows the time to recover investment and is typically shorter with higher IRR and lower LCOE.

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Table 1: Summary definitions of the financial KPIs, their importance, and their interactions with each other

	Definition	Why it's important	Interaction
LCOE	The Levelised cost of electricity is a per-unit cost, usually cost/MWh or cost/kWh. It is the sum of all discounted costs divided by the discounted total energy produced over the lifetime of the project and represents the price at which electricity must be sold for a project to break even.	LCOE is a key metric used to determine the competitiveness of renewable energy projects. It is used to compare the cost-effectiveness of different energy technologies (e.g., solar, wind, wave).	LCOE is a cost-focused metric, where a lower LCOE suggests more cost-efficient energy production. If LCOE is high, it may negatively impact both IRR and NPV. However, with favourable revenue and grant support, a reasonable IRR and NPV can still be achieved.
IRR	The Internal Rate of Return represents the rate of return at which the present value of all costs equals the present value of revenues. In other words, it is the discount rate at which Net Present Value of all future cash flows from an investment equals zero (represented as a percentage).	IRR is a key metric used to determine project profitability. A higher IRR generally indicates a more profitable project. It is also compared to the required rate of return or cost of capital to evaluate if the project is worthwhile.	A high IRR means a more attractive investment opportunity. IRR and NPV are often used together to assess project viability: a project is typically considered viable if it has a positive NPV and an IRR greater than the required rate of return.
NPV	NPV is the difference between the present value of cash inflows (revenues) and outflows (costs) over the project's lifetime, discounted at a chosen rate (usually the weighted average cost of capital or discount rate).	NPV is used to assess the financial viability of the project. If the NPV is positive, it means that the project is expected to generate more value than it costs (i.e. more value for investors). A negative NPV is unlikely to be profitable.	NPV is sensitive to both the LCOE and IRR. Higher costs (reflected in a higher LCOE) can result in a negative NPV. Higher cash flows, as a result of higher revenues or lower costs (also reflected in IRR) can improve the NPV.
ROI	ROI measures the profitability of an investment relative to its cost. It is calculated as the net profit divided by the total investment, expressed as a percentage. It is similar to IRR, but does not reflect the time value of money.	ROI is a straightforward metric to understand the profitability of a renewable energy project. A higher ROI means that the project has generated more profit relative to its cost.	A higher ROI typically correlates with a lower LCOE, which would increase the profitability of the project and thus improve both NPV and IRR.
Payback period	The payback period is the time it takes for an investment to recover its initial cost from the net cash flows generated by the project. In other words, it is the time required for the project to reach breakeven point.	A shorter payback period is generally more attractive because it means that the project will start generating positive cash flows sooner. It's particularly important for assessing the liquidity and risk of a project.	The payback period is inversely related to both IRR and NPV. A shorter payback period typically means a higher IRR and a higher NPV.