MOVING BEYOND LEVELISED COST OF ELECTRICITY: IMPACT OF VARIOUS FINANCING METHODS ON PV PROFITABILITY FOR SINGAPORE

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Overview

Over the past decade, renewable energy (RE) has gradually gained more prominence as a potential source to replace conventional forms of power generation. This is partly due to decreasing costs of renewable energy sources, especially of solar photovoltaic (PV) and wind, extended period of high oil prices that affected costs of fossil power generation as well as various mandated government policies and subsidies. In this context, the term "grid parity" has largely been used to describe the cost competitiveness of renewable energy compared to conventional power generation sources. When speaking about "grid parity", a commonly utilized metric is to compare the levelized cost of electricity (LCOE) of a certain energy source vis-à-vis the prevailing electricity tariff. The LCOE is calculated as the average lifetime generation cost of electricity generated and is a handy tool due to its intuitive and straightforward nature. Although renewable energy has been increasingly associated with a LCOE on par or even below prevailing electricity tariffs in countries without energy subsidies, it remains a largely underinvested sector. This paper seeks to uncover the reasons behind the under-investment in renewable energy compared to conventional power generation technologies and highlights the limitations of the LCOE methodology when using it as an investment decision criterion. In particular, the LCOE does not translate into the commercial decision-making matrix, and thus is not representative of the commercial viability (i.e. bankability) of projects.

Methodology

In this paper we adopt a commonly established discounted cash flow (DCF) model to assess the viability of a rooftop PV project under different financing terms. DCF takes into account the project cash flows over its lifetime and discounts them by using the cost of capital to give their present values. Factors such as corporate tax rates and depreciation are also taken into account in the model. Values of project financing such as cost of debt, cost of equity and leverage ratio are estimated via industry consultations. The discount rate utilized in the DCF model is based on the Weighted Average Cost of Capital (WACC), based on the financing conditions mentioned above. Profitability indices, such as Net Present Value (NPV), Internal Rate of Returns (IRR) and the Payback Period (PP) are used as project evaluation criteria,in addition to LCOE. The IRR matrix is further differentiated to account for the returns to equity investors and the project returns, with project IRR representing project returns and equity IRR directly representing returns to equity investors. Both the discounted payback and simple payback are considered. An added indicator of breakeven tariff is also introduced. The breakeven tariff is the tariff at which NPV is zero and represents the minimum electricity tariff offered that ensures that the project is feasible. We also distinguish between three different scales of PV project present in Singapore, namely residential, commercial and industrial installations and apply the relevant costs and cashflow assumptions for each project type.

Results

The results of our study illustrate that under current conditions of low oil prices, most solar PV projects are economically unfeasible. Of the three project types, only the commercial scale PV projects are able to gain a positive NPV, therefore illustrating the fact that it is difficult to achieve business case for PV in the current price environment Even though commercial projects are able to gain financial feasibility, low returns and long payback periods may deter investment in these projects.

	Residential PV Installation	Commercial PV Installation	Industrial PV Installation
LCOE	SG$0.186/kWh	SG$0.178/kWh	SG$0.169/kWh
Breakeven Tariff (Corporate Loan)	SG$0.247/kWh	SG$0.169/kWh	SG$0.161 /kWh
Breakeven Tariff (Project Loan)	SG$0.411/kWh	SG$0.248/kWh	SG$0.235/kWh
NPV	SG$ -327.52	SG$ 8.68	SG$ -147.15
Project IRR	3.10%	4.93%	4.03%
Equity IRR	4.09%	6.66%	5.37%
Simple Payback	Year 17	Year 15	Year 16
Discounted Payback	-	Year 24	-

Our study also illustrates the limitations of the LCOE metric compared to the conventional profitability metrics utilized by the private sector. We take a residential PV installation as an example and assume that the Singapore's residential electricity tariff is SG$0.23/kWh. In such a case the residential PV installation, with a LCOE of SG$0.186/kWh appears to be economically viable as it achieves grid parity. However, as the negative NPV result indicates, this project is unable to generate financial returns in excess of the explicit (accounting costs) and implicit (opportunity costs) investment costs. This is because LCOE highlights only the cost perspective of a PV project and does not account for revenues which are obtained through electricity sales. As such, projects with similar LCOEs may have largely varying profitability metrics depending on electricity price assumptions.

Our paper then explores the use of different financing structures to improve project bankability. Using the commercial-scale PV project as a case-study, we introduce the use of bond-financing as a way to improve project bankability. Our results illustrate that even without accounting for the potential reduction in cost of debt through bonds, the new cashflow structure is able to reduce the LCOE of the commercial-scale projects by SG$0.005/kWh while increasing project returns from SG$8.68/kWp to SG$89.02/kWp. Both the simple and the discounted payback periods are also reduced by one and three years respectively. This illustrates the suitability of fixed income financing for PV projects.

Conclusions

This paper has illustrated that the LCOE, though a preferred metric for policymakers, does not sufficiently represent the economic viability of RE projects. LCOE does not take into account the uncertainty of project revenues and also lacks uniform cost inclusion practices. Our results also validate the difficulty in attaining profitability for renewable energy in Singapore under low oil prices. In the absence of capital, one way to improve the financial viability for PV projects would be to open up the fixed income financing channel such as bonds. However, the use of fixed income instruments for financing PV projects has its own limitations. Firstly, the lump-sum principal repayment at the end of the bond tenure creates a large negative cashflow and could be a source of financial distress for companies. This may present problems if the bond maturity happens to be shorter than the project's discounted payback period. This risk could be managed through effective cash flow and project management. Otherwise, it is recommended to utilize bonds as a refinancing tool or to issue longer tenure bonds. Secondly, bond financing may face additional barriers when used for small distributed projects, as the latter would require capacity aggregation in order to reach the typical bond issuance sizes. The introduction of the retail-size bonds for smaller scale projects in addition to clear guidelines on project aggregation could be the way forward to unlock additional financing for small-scale PV.