Attaining Grid Parity: LCOE Analysis for Grid-Connected PV Systems of Utility Scale across Selected ASEAN Countries

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Overview

Historically, ASEAN countries are dependent on conventional energy resources due to their abundance which explains renewable energy's competition with its counterparts for flourishment. With the existing government plans, various reports predict that only 17% renewable energy share can be achieved by 2025. Geothermal, Hydro and Bioenergy being limited to regional availability and with the declining cost of Solar PV, it is important to predict future Levelized Cost of Electricity (LCOE) for Solar PV systems in this region. Hence, unlike earlier research articles this paper focuses on evaluating Levelized Cost of Electricity (LCOE) for PV (equal 1 MW) technology across selected five ASEAN member states, i.e. Indonesia, Malaysia, Thailand, Vietnam and Philippines till 2040 while considering capital cost of sub-system components within a typical PV system, i.e. PV module, Inverter, Mounting Structure and Balance of System (BoS) distinctly to generate unique Learning Curves (LCs) for individual countries. Sensitivity analysis was conducted with regard to discount rate, solar irradiation and CAPEX to identify impact on LCOE values and attainment of grid parity.

Methods

LCOE methodoly has been adapted for comparing generation cost of electricity. LCOE calculation requires cost parameters as input to model. Hence; it is essential to derive cost data with regard to Capital Cost (C), Land Cost (L) and OPEX. Deriving future costs (2020-2040) associated with solar PV system requires estimation of Capital Cost (C) that an investor would encounter while installing a solar PV project in future. This research work has segregated PV system Capital Costs into four segments namely, Solar PV, Inverter, Mounting Structure and BoS (Balance of System). Future evolution of these costs were derived through Learning Curves (LC), generated from country-wise local data instead of global data.

Results

Research outcome i.e future projections infer that Philippines will have the highest LCOE of 0.16 $/kWh in 2020 followed by Vietnam, Malaysia, Thailand and Indonesia. LCOE evolves as lowest in Thailand as 0.074 $/kWh in 2040 followed by Indonesia, Malaysia, Vietnam and Philippines. It also predicts that utility PV systems have already
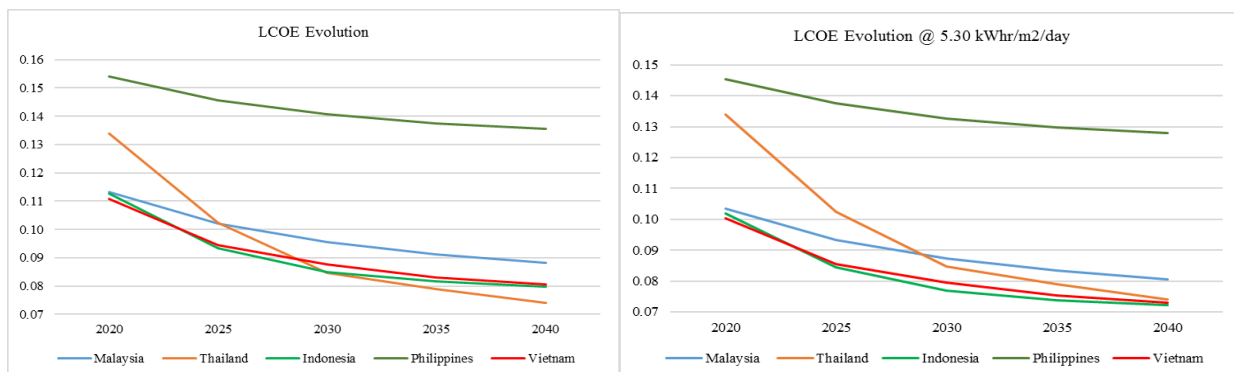

Fig. 1 LCOE Evolution

attained Grid Parity in Indonesia & will be achieved in Philippines, Thailand & Malaysia in 2021, 2023 & 2026 consecutively. LCOE varies mentionably due to variation in solar irradiation persistant within island countries like Indonesia and Philippines due to their geographical dispersion. Discount rate also plays a vital role in acceleration or decelaration of attainment of Grid Parity.
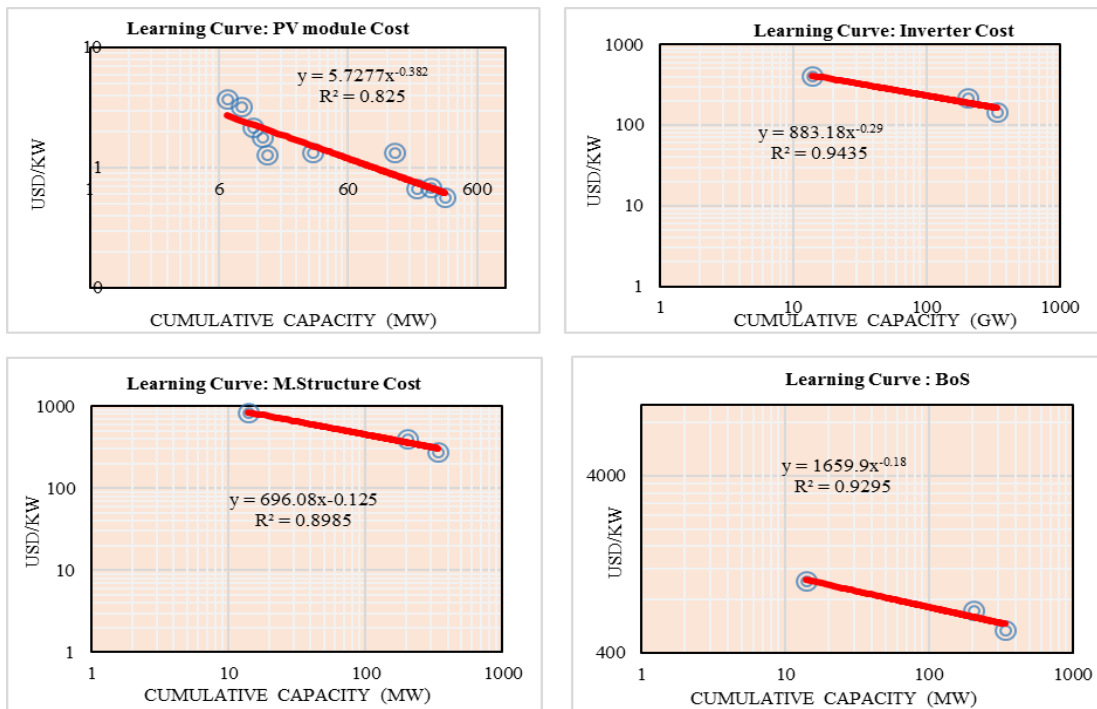

Fig. 2 Learning Curves (Malaysia)

Conclusions

The results emphasies on the fact that Grid Parity of Solar PV systems has already been relized in Indonesia and further policy reformations are required in withdrawing electricity subsidies which will drive accelerated realization of Grid Parity in remaining ASEAN countries.
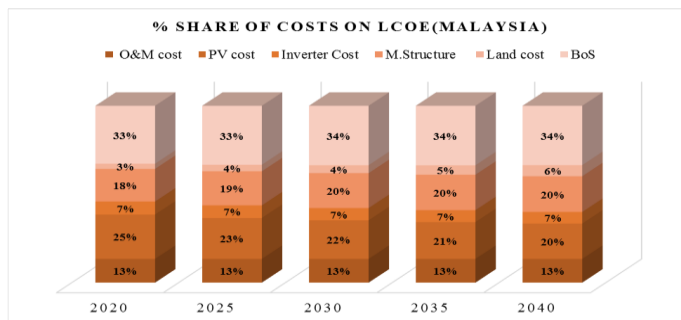

Fig. 3 % Share of Costs on LCOE

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