

Technoeconomic Analysis of Hydrogen Storage and Battery Energy Storage System (BESS) for Energy Storage of Excess Solar PV Generation

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Keywords: *energy storage, BESS, solar PV, hydrogen storage, electrolyser*

Abstract

The global aspirations for low-carbon economy and ecosystems have led many countries to increase the share of renewable energy in their electricity generation and capacity mix. With insignificant wind potential and limited hydro resources in Peninsular Malaysia, increasing solar PV installations seems to be the low hanging fruit to increase the share of renewable energy in the power generation mix. Many incentives were introduced to accelerate investments in solar PV technologies. These initiatives have attracted many new entrants in electricity supply industry including participations from residential consumers through installations of rooftop solar.

As solar PV generation depends on the prevalent weather condition and non-dispatchable, too much energy from solar can be detrimental to the grid. Few studies were carried out to determine the critical limits of solar PV generation that could impact the system stability and operation of other power plants in the system. The limits indicated in the studies are broken into few categories, whereby the most critical limit will require curtailing some energy from the solar PV generation.

Curtailment of solar PV energy is a lost opportunity for solar power producers in terms of lost revenue. To address the issue, these solar power producers may consider storing the excess energy for export at later times when energy price is most desirable. As such, the analysis to be presented assumed the case where there are too much solar PV generation in the grid system which necessitates the curtailment of excess and undesirable solar PV energy in order to preserve system reliability. The analysis will consider technical and economical parameters of two different storage options i.e. using battery energy storage system and using hydrogen storage system utilizing electrolyser to convert electrical energy from solar PV to hydrogen. Different types of electrolyser will be briefly explored in terms of announced efficiency and cost. Similarly, the analysis will discuss on different types of battery energy storage system to be considered based on current trend and expected cost projection. The analysis will elaborate on quantitative and qualitative comparison between chosen battery energy storage system and electrolyser technology. Finally, the analysis will conclude with recommended solutions among the options being considered.