ASIA-PACIFIC
SOLAR RESEARCH CONFERENCE

Impact of Imposing Carbon Price on Transition Rate to Renewable Sources in Australia

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Australian National Electricity Market (NEM) is experiencing a rapid transformation toward renewable electricity generation. To ensure the energy adequacy, reliability, and security, the possible future electricity generation portfolios should be comprehensively investigated. Over the past few years the significant decline in the cost of renewable energy generation has led to huge increase in the share of these technologies in the electricity market and therefore the need for supporting mechanisms such as carbon cost has shrunk. However, the share of carbon intensive fossil fuel generation technologies such as coal is still significant in the Australian generation mix. And even for the future scenarios over the next two decades, despite huge increase in the share of renewable energy generation, the fossil fuel generation technologies are still present in different generation mix scenarios. Therefore, recognising the environmental impact of different generation technologies in one way or another could be of interest to the electricity industry stakeholders. One such mechanism, as mentioned, is the to impose carbon cost on the generation technologies to promote cleaner electricity production.

In this paper, the impact of imposing different values of carbon cost on the optimal generation portfolio has been investigated. The study is based on the Integrated System Plan (ISP) model and dataset provided by Australian Energy Market Operator (AEMO). The power system planning tool, Plexos, was utilised to find the least cost generation mix under different carbon cost scenarios. The base case scenario is simulated using the published model and data of “neutral ISP” scenario, followed by simulation of the same scenario with the introduction of carbon cost. Different carbon cost values from $10/TCo2 to $100/TCo2 have been considered. The results show imposing higher carbon cost is not leading to reduction of fossil fuel capacity, but significantly decrease their participation rate (capacity factors). It is also evident in the simulation results that imposing the carbon price leads to building higher capacity for renewable energy technologies as well battery storage. The need for higher capacity of battery is a direct result of the higher share of intermittent renewable generation. The storage fleet mainly comprises of pumped hydro technology which in fact is due to considerably lower cost of this technology compared to utility battery storage. To investigate the implications of utility battery storage, in this study, a hypothetical scenario of very high build cost of pumped hydro is also investigated. This unrealistically high cost of pumped hydro, unsurprisingly, resulted in increasing the capacity of utility storage battery. The results also show the increase in the share of gas-based technology in the generation fleet, as well as increasing the total industry cost by more than 1.9 billion dollars in final year of simulation compared to AEMO’s estimation. Figure 1 shows the share of different technologies cost in the total industry cost for the AEMO’s neutral case (top) and the same case study without pumped hydro (bottom).

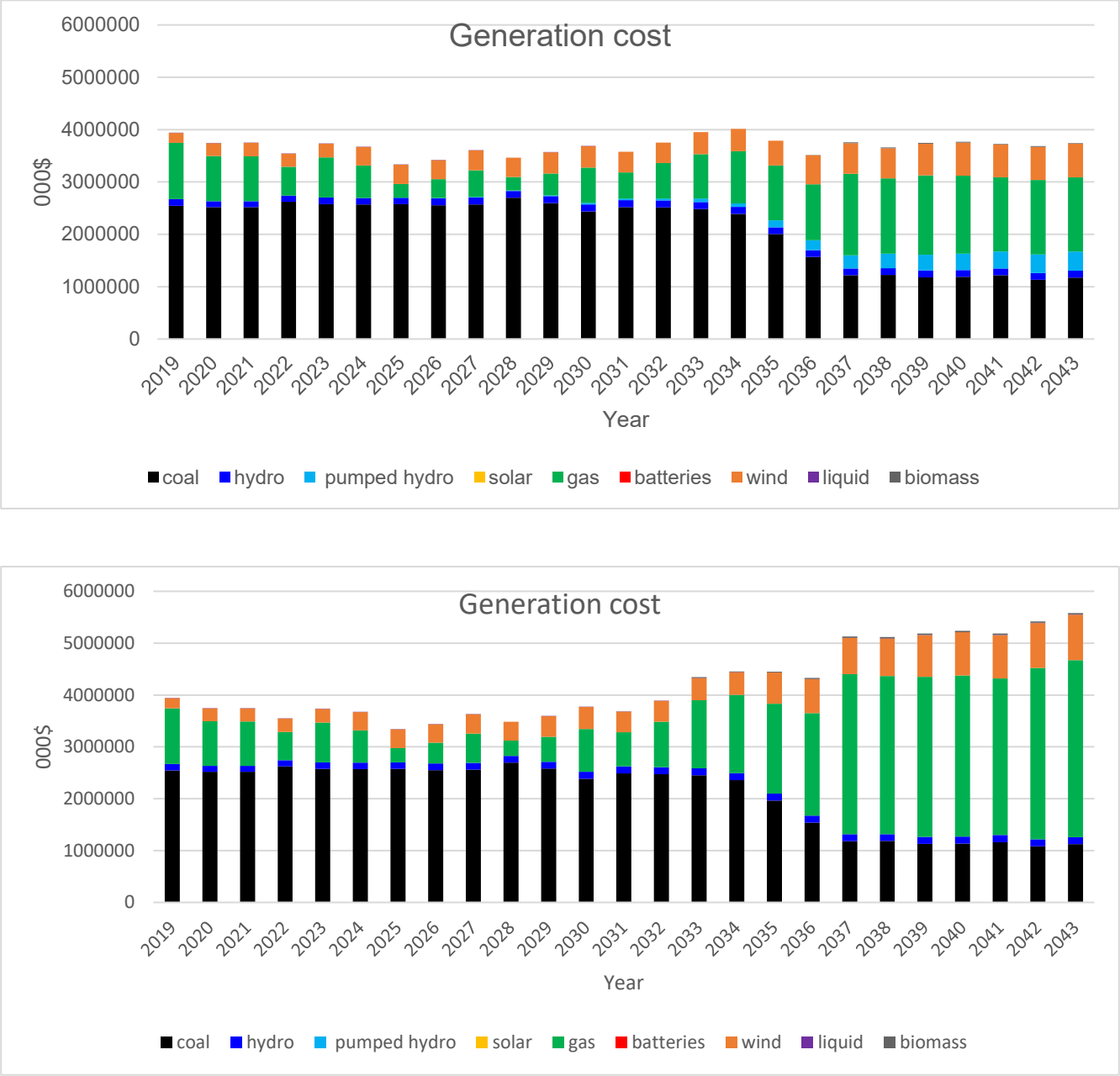

Figure 1 AEOM ISP scenario with (top) and without (bottom) pumped hydro