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Incentivizing the adoption of nuclear and renewable energy in Southeast Asia

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Abstract

The deployment of low carbon electricity generation technology is driven by the twin objectives of addressing energy security and climate change. Despite the significant reduction in the cost of renewable technology, especially solar photovoltaic (PV) and wind, fossil fueled electricity generation technology remains more cost competitive especially under the low gas price. In the context of Singapore, there are two layers of cost disparity between the fossil and low carbon technologies to be addressed, namely overnight capital cost and electricity generation cost. In this study, we attempt to alleviate the gaps in the overnight capital cost and electricity generation cost by means of financial assistance from policy measures. This paper presents our preliminary findings from this study.

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1. Introduction

In the fifth assessment report, the IPCC [1] outlined its ambition of zero emissions by 2100 in which nuclear and renewable energy would play a major role. In Southeast Asia, the regional energy supplies are barely keeping up with the soaring demand driven by the fast economic development. Both the IEA [2] and the ADB [3] are projecting a dire situation of the Southeast Asian region becoming a net-energy importer by 2030. With accessibility and affordability being of top consideration, coal is projected to enter the region's fuel mix to address diversification, which will introduce additional burdens to the environment.

Under the urgency to reduce carbon emission and to address energy security, renewables are gaining momentum but there are physical and economic considerations such as overnight capital costs,

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intermittency, geographical dependency, conversion efficiency, and others. With the current state of technologies, the IEA [4] estimated that the technical potential for renewable deployment in Southeast Asia is approximately 150 GW of hydropower, 90 GW of bioenergy, tens of gigawatts of wind, and minimum grid connected PV and solar thermal. With limited access to advanced technologies, the region might only achieve a small fraction of the technical potential. Despite a seemingly well distributed portfolio of technologies as a region, access to each renewable energy technology varies significantly across countries. In the case of Singapore, only solar PV appears a more suitable option among all renewable energy technologies. As such, many countries in Southeast Asia has shown increasing interest in nuclear energy since it is the only economically competitive low carbon option for diversifying the base-load electricity supply [5].

Nomenclature

ADB	Asian Development Bank
CCGT	Combined cycle gas turbine
CCS	Carbon capture and storage
EIA	Energy Information Administration (USA)
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
LCOE	Levelized cost of electricity
SMR	Small modular reactor

Due to the challenge of evaluating the merits of energy systems over its lifetime, policymakers use metrics to measure competitiveness and economic efficiency. Levelized cost of electricity (LCOE) and its most recent iterations, system LCOE and System Value are alternative approaches to evaluate competing energy system solutions [6, 7]. The integrated bottom-up energy system modeling approach such as the MARKET ALlocation model has been widely used for evaluating economy-wide energy mix in the least-cost approach [8].

An evaluation of nuclear and renewable electricity in Asia was conducted by Sovacool [9]. The study criticized nuclear energy as high costs, high life cycle CO₂ emissions, environmental degradation due to spent fuel storage, spotty safety records and security of fuel supply for nuclear energy, and high LCOE values. However, recent LCOE calculations by IEA [6] show the cost effectiveness of nuclear when compared to host of other technologies. Due to concern over safety, there is a renewed interest in the development of Small Modular Reactors (SMR), which has been alluded to as a “game changer” for Southeast Asia [10].

Over the decades, the cost of renewable energy technology, especially solar PV and wind has also been experiencing a fast decreasing trend [7]. When viewed in terms of LCOE, the cost of electricity generation from large scale nuclear energy also appears to be on par with fossil fuels in Asia [11]. High energy commodity prices in first decade of the 21st century further have improved the economic attractiveness of renewables and nuclear power. However, the cost of renewable and nuclear power technologies remains higher than fossil fueled technology, especially under the low oil and gas prices since 2014.

With an estimated investment of \$ 36-42 trillion till 2030, the public funds may only be able to invest half of the funding requirement annually. Thus, innovative financial solutions are needed to spur private investment in green energy infrastructure [12]. A number of policy measures are also being studied or

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