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Climate Change and Renewable Energy: Mitigation or Vulnerability?

By Margareth Sembiring

Synopsis

Renewable energy is often seen to provide relief to climate change. However, renewable energy is at the same time vulnerable to climate change. As the region is set to meet its renewable energy targets in the coming years, it is important therefore to ensure that the development of renewable infrastructure is infused with climate change adaptation thinking.

Commentary

RENEWABLE ENERGY is set to grow in Southeast Asia as countries in the region are working towards closing the massive gaps between renewables current installed capacities and targets to be achieved within 10 to 15 years' time. While renewable energy is often regarded as an important element in climate change mitigation measures, its vulnerability to climate impacts itself seems to have received less attention.

The effects of climate change in Southeast Asia have been observed, among others, in the rise of heavy precipitation events in the Mekong River Basin region between 1900 and 2005, the Mekong floods in 2000, and droughts in Laos and Vietnam in 1997 and 1998. The concern over renewable energy's susceptibility to climate change is not unfounded as the sources of some types of renewable energy, notably hydropower, solar photovoltaic (PV) power, and wind power, are dependent and affected by climate conditions.

Solar PV Power and Haze

Changes in monsoon weather patterns are believed to affect the frequency and intensity of floods and droughts. Prolonged dry spell which aggravates the occurrence of land and forest fires, and resulting haze, is of particular importance as air pollution has direct impacts on the energy generation of solar PV systems.

Singapore's latest and newly-launched Climate Action Plan document lays out its SolarNova programme aimed at expanding solar PV systems to reach the target of 350MWp by 2020, from 60MWp in 2015. While such a plan is a positive development for climate mitigation, studies by Nobre et al. and Maghami et al. find out that air pollutants during the mid-2013 haze period directly reduced the energy yield although the output reductions vary across different types of solar panels.

A subsequent study by Nobre et al., published in April 2016 indicates that the reduced intensity of sunlight reaching the PV panels during the mid-2013 haze event has caused PV systems in Singapore to suffer about 15 to 25% drop in electric power generation. Additionally, some studies also show that dust particles sticking on solar panels, which would become thicker during heavily polluted hazy days, would also reduce the energy generated.

Indonesia, Thailand, and the Philippines are also developing their solar PV systems as they are catching up with their set targets. Since forest fires-driven transboundary haze is a recurring problem in the region, which hopefully will find its cure soon, the deployment of solar PV systems needs to take climate change impacts on solar PV energy yield into consideration.

Hydropower and floods and droughts

Considering hydropower as part of renewable energy, increased frequency and intensity of floods and droughts are also affecting its energy generation. Extreme volume of floods risks excess of reservoir design limitations and may lead to catastrophic structural failure. Some studies show that the effects of hydrology variability may differ from one hydropower facility to the other depending on, among others, the reservoir size, the locations, and the ratio of reservoir surface area to volume.

The effects of droughts on hydropower generation are easier to understand as the lack of water is tantamount to lesser 'fuel' to produce energy. Droughts in parts of Africa have at times reduced hydropower generating capacity by half, and some separate studies based on future drought scenarios show that current hydropower projects would unlikely be able to cope with reduced amount of water to produce desired energy output. Blackouts in areas exclusively dependent on hydropower and reduction of hydroelectric generation by 30 percent in the western United States have also been studied based on future drought projections.

Hydropower designers are not ignorant of such climate impacts. Difficulties in predicting future climate phenomena, however, pose a major hurdle. Common design practice draws from climate history and assumes that future hydrology scenarios would follow the historical patterns. Such practice, however, runs the risk

of either dam over-design under extreme drought events or under-design under extreme flood events.

In many countries in Southeast Asia including Vietnam, Indonesia, Thailand and the Philippines, hydropower would contribute the biggest share in the renewable-powered energy pie. As dams are being built and the impacts of climate change are becoming more real, therefore, the different flood and drought scenarios of various magnitudes need to be incorporated in the reservoir designs and safety measures to ensure robust, resilient, and efficient hydropower infrastructure in the face of climate change.

Wind power and tropical typhoons

Wind turbines are designed with certain durability against external conditions including, among others, wind speeds, turbulence intensities, extreme changes of wind directions and severe disturbances to the electrical grid. Despite such design, a number of damages on wind power facilities due to tropical typhoons, such as typhoon Maemi on Japan's Miyakojima Island in 2003, several typhoons across southeastern China between 2003 and 2014, typhoon Jangmi in Taiwan in 2008, and super typhoon Usagi in China's Shanwei city in 2013, have been recorded.

Investigations into failed turbines, fractured blades and collapsed towers revealed that there were some aspects of the design that were inadequate to anticipate the massive forces generated by extreme wind conditions. The recommendations then point to better engineering design to account for stronger typhoons. While this may sound straightforward, just like in the case of hydropower, challenges in reliably predicting future climate variability means the chances for design failure in extreme weather situations remain there.

As Thailand, Vietnam, and Indonesia, and particularly the Philippines whose wind power will make the third largest share in its renewable energy sources, are setting targets for wind power share in electricity generation, climate change impacts on typhoons intensity, frequency, and tracks need to be taken into consideration while designing and doing wind project siting.

Renewable Energy in Southeast Asia: Mitigation vs Vulnerability

Renewable energy developments are spurred by commitments to climate change mitigation and the need to strengthen national energy security. While countries in Southeast Asia are setting ambitious targets for renewables, their vulnerability to climate change impacts suggests that there is an urgent need to mainstream climate change adaptation measures and risk management practices in the establishment and operations of renewable energy infrastructures.

Designs incorporating different future climate change scenarios with various intensity and severity are necessary to anticipate extreme weather events that would affect renewables' energy yields. Moreover, it is also equally important to ensure that the constructions of such renewable energy facilities would not contribute to higher carbon emissions through massive land clearings and environmental damages.

After all, what we want to see is renewable energy that truly mitigates climate change, and not renewable energy that stands vulnerable in the face of climate change.

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