How climate-related weather conditions disrupt power plants and affect people

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Severe weather conditions triggered by climate change can adversely affect the operation of power plants.

Heavy rainfall, heatwaves and lightning can disrupt electricity transmission and distribution networks and cause power outages.

A 2019 World Bank report showed natural shocks and climate change caused 44% of power outages in the US between 2000 and 2017 and 37% of outages in Europe between 2010 and 2017.

This cost electricity utilities, consumers and governments billions of dollars per year.

Similar cases also happen in Indonesia.

Our study found disruptive weather and climate change disrupt the electricity supply chain, including electricity generation, transmission and distribution, affecting Indonesia's state-owned electricity company (PLN) and its consumers.

Based on extensive field work in February and March 2018, the study involved interviews and focus group discussion supplemented by published reports and PLN's internal reports.

At least three categories of severe weather events may disrupt the operation of power plants in Indonesia.

1. Heavy wind and rainfall

Heavy wind and rainfall are by far the most significant threats to the power distribution networks.

In the Java-Bali region alone, these events accounted for more than 95% of weather-related power outages during 2014–2015.

Strong winds knocked down trees and billboards onto power distribution

lines.

Heavy rainfall also led to widespread power cuts as soaked, heavy tree branches touched distribution wires.

Heavy rainfall also made coastal power plants and transmission substations more vulnerable to floods. This could lead to emergency power shutdowns.

A notable example is a severe flood on the northern coast of Jakarta in January 2013 that forced the gas-fueled Muara Karang power plant to shut down for 12 days.

Furthermore, more than 500 units of inundated distribution substations in the Central Jakarta region were turned off for safety reasons. The incident cost the state US$15 million.

Coal and gas power plants are also at risk from heavy rainfall and rising seawater temperature. Excessive river flow due to heavy rainfall could also transport waste into power plants. This would disrupt the cooling water system and, in a worst-case scenario, force the plants to shut down.

In addition, excessive water will turn coal into sticky sludge and reduce power plants' efficiency.

In another example, in March-April 2010, excessive water entered the reservoirs of three Citarum hydro power plants in West Java, leading to lasting downstream flooding.

2. Rising seawater temperature and heatwaves

Rising seawater temperatures and heatwaves can also affect the operation of power plants.

For coal power plants, seawater temperature affects their cooling systems. This system circulates seawater through pipes to absorb heat from steam and discharges the warmer water back to the sea. Warmer seawater reduces the energy efficiency of the power plants.

Higher seawater temperature also triggers jellyfish blooms. In April 2016, an inflow of jellyfish forced Paiton coal power plant in East Java to shut down for 20 days. This caused an estimated loss of $21.7 million for PLN.

Indonesia's Meteorology, Climatology and Geophysics Agency has explained that an extremely cold temperature in Australian seas triggered the jellyfish outbreak. The change in temperature forced jellyfish to migrate to the warmer North Java Sea.

Heatwaves are a particular concern for natural gas power plants. These plants need ambient air to produce electricity. The higher the air temperature, the lower the efficiency of a gas power plant, which then reduces its power outputs.

3. Severe drought and lightning

Extreme dry seasons affect hydro power plant operations.

Drought reduced generating capacity in Saguling and Cirata hydroelectric power plants, both located in West Java, in 2011, resulting in estimated financial losses of $51.5 million for the utilities.

Power plants' transmission networks are prone to lightning strikes.

A lightning strike can damage power transmission equipment and result in power failures.

PLN recorded 107 incidents of lightning strike-related power outages in the Java-Bali transmission network from 2011-2017.

Climate-related weather extremes affect consumers

Floods in 2014 and 2015 forced PLN to shut down the inundated distribution substations for safety reasons. It affected 89,000 consumers. They could not get electricity for an average of 16 hours in 2014 and 1.7 hours in 2015.

Floods earlier this month forced PLN to turn off nearly 2,500 distribution substations in Greater Jakarta.

Power interruptions are inconvenient and lead to economic losses for consumers and electric power utilities.

For households, power outages make it impossible to turn on air conditioners, causing inconvenience and discomfort, especially in cities with warmer temperatures. Power failures also affect household tasks, children's educational outcomes, and other social activities (like transportation, hospitals, food deliveries).

Weather-related power outages affected PLN financially due to the reductions in electricity sales and damaged infrastructure. Unfortunately, the total loss has not been estimated to date.

In some cases, PLN had to generate electricity from diesel power plants, which are costly compared to coal or natural gas, to compensate for the power plants hit by extreme weather.

Climate-resilient infrastructure is a necessity

Amid the constant threats of weather-related power outages, analysis of the vulnerability of Indonesia's electricity sector to climate change is still lacking.

Given the sector's vital role in meeting the target of 99% of the population having access to electricity as well as the national target of reducing CO_2 emissions by 29% by 2030, the country must improve the sector's resilience to climate crisis.

To do that, the government first needs to acknowledge that electricity infrastructure in our country is vulnerable to the threats of climatic changes.

The government should then find strategies to achieve a low-carbon, climate-resilient electricity sector. These strategies should be part of Indonesia's National Action Plan for Climate Change Adaptation published in 2012.

Second, the government needs to increase awareness of the electricity sector's stakeholders, like PLN and independent power producers, on climate change consequences for their business operation sustainability.

It is crucial for electric power companies to include climate change risks in their long-term business strategies and capacity building.

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