Panama energy storage for resilience

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In 2024, El Niño has negatively impacted energy security across Latin America, resulting in disruptions to power systems and highlighting the significant vulnerability of the region’s energy sector to the effects of climate change.

This report identifies the risks to energy infrastructure in Panama and explores various ways to adapt existing and new infrastructure to meet the challenges of climate change. Considering national data and models of the occurrence of extreme climate hazards, the study identifies adaptation measures aimed at mitigating potential damage and enhancing the resilience of Panama"s energy infrastructure.

The report explores climate change adaptation measures that aim to reduce risks, mitigate impacts, decrease vulnerabilities and increase the resilience of Panama’s energy and related infrastructure. These measures include increasing water storage capacity at hydropower plants, building dams and coastal defenses, relocating infrastructure to lower-risk areas, and adopting more efficient and climate-resilient technologies.

Panama’s energy sector is facing significant challenges due to climate change, which is affecting its infrastructure and operations. The main issues revolve around the impact of extreme weather on the country"s hydroelectric infrastructure, transmission lines, and road systems.

Another important strategy is optimizing the efficiency of hydropower plants. When water availability is low, shifting from constant to variable-speed hydroelectric generation can help maximize energy production. This requires advanced turbines, control systems, and real-time monitoring equipment. Plants such as Goldisthal in Germany and Jirau in Brazil have successfully used variable-speed turbines to improve their efficiency.

Reducing evaporation from reservoirs is also crucial for conserving water. Techniques like using floating covers made of polyethylene sheets can cut evaporation by up to 95%. Other methods, including modular caps and plastic balls, also significantly reduce evaporation. Floating solar panels on water bodies have proven effective as well, with studies showing that covering 30% of a water surface can reduce evaporation by 49%, as seen in research on Lake Nasser in Egypt.

Flooding poses a major risk to Panama"s infrastructure. To control floods, cost-effective measures include building dikes, embankments, and retention ponds. Levees, like those along the Elbe River in Germany and the levee system upstream of China"s Three Gorges dam, protect areas and infrastructure from floods. Raising roads above water levels with embankments ensures safe travel during adverse weather, and retention ponds can temporarily hold rainwater to reduce flooding.

Underground transmission lines offer protection for the electrical grid from severe weather, reducing outages and the risks associated with fallen wires. This method helps maintain power for critical services like hospitals

and supports consistent electricity supply to underserved areas. In places like California, burying power lines could mitigate risks related to overhead wires, which have been linked to destructive wildfires.

Sea level rise threatens coastal energy infrastructure, including power plants and transmission lines, increasing the risk of flooding and storm surges. Inland, heavy rainfall and floods can damage roads and bridges critical for fuel transportation, impacting the distribution of energy resources.

Investing in climate-resilient infrastructure is not only necessary for mitigating these risks but also economically beneficial. For every dollar spent on resilience, up to six dollars can be saved in future costs. Therefore, integrating climate resilience into energy infrastructure planning is both a prudent and cost-effective strategy.

IRENA"s analysis of Panama"s energy sector includes evaluating how changes in temperature and precipitation impact different types of energy infrastructure, including hydroelectric, solar, and wind power plants. The report highlights a potential decrease in hydroelectric generation capacity due to reduced rainfall and a possible decline in the efficiency of solar and wind plants due to higher temperatures. Transmission infrastructure is also at risk from extreme heat.

To address these challenges, the report suggests upgrading existing infrastructure, applying robust design standards for new projects, and investing in advanced technologies to enhance efficiency and reliability. Coordinating efforts among national and local authorities and fostering international collaboration are also essential for managing climate risks and ensuring a sustainable energy future for Panama.

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