Energy storage for renewable energy egypt

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Between 1901 and 2013 temperatures in Egypt increased by an average of 0.1?C per decade. The rate accelerated between 2000 and 2020 with a temperature increase averaging 0.38?C per decade, which was higher than the world average (0.31?C per decade). As a result, the number of cooling degree days (CDDs) increased dramatically - by around 300 during 2000-2020 - while winter heating needs declined by over 50 heating degree days (HDDs) in the same period. UNEP"s recent study shows that 50% of all electricity is already being consumed for air conditioning during the peak summer months in Cairo.

Climate projections show that Egypt will continue to experience a higher level of warming than the world average.1 Compared with the pre-industrial period, temperatures in 2081-2100 could be around 2.5?C higher in a low-emissions scenario2 and around 6?C in a high-emissions scenario.3 The warming, coupled with urbanisation and population growth, is expected to trigger a significant increase in extreme heat events and electricity demand for cooling.

Rising temperatures could add stress to Egypt"s power generation. Natural gas power plants, which account for around three-quarters of the country"s electricity supply, can be negatively affected by a warmer climate. Climate projections show that two-thirds of Egypt"s natural gas power plants are projected to see an increase of over 2?C in 2080-2100 compared with 1850-1900 under a low-emissions scenario (Below 2?C)2 and an increase of over 5?C in a high-emissions scenario (Above 4?C).3 Studies show that increased ambient temperatures could lead to a decrease in air mass flow entering the gas turbine compressor and consequently lower the performance of natural gas power plants.

Wind power plants" level of exposure to a maximum temperature above 35?C is even higher: almost 100% of existing capacity would see an increase of over 20days under a low-emissions scenario, and over 80days under a high-emissions scenario. The exposure level of wind power plants to warming is particularly notable given that only 7% of wind power capacity around the world would reach that exposure level (i.e.an increase of more than 80 days with a maximum temperature above 35?C), even under a high-emissions scenario.

The combination of increasing electricity consumption for cooling and decreasing generation efficiency from gas, solar and wind power plants could add strain to Egypt"s electricity systems. Climate resilience measures could help its electricity systems cope better with the adverse impacts of rising temperatures and heatwaves; possible examples include incorporating climate impact assessment into energy planning, additional cooling systems for thermal power plants, innovative design to cope with higher temperatures, improved energy efficiency and behavioural change.

Climate projections show a potential decrease in mean precipitation in northern Egypt while the trend is still uncertain in the rest of the country. Despite the uncertainty, most climate models show that a higher level of global warming would lead to a higher level of variability in precipitation and water flow, bringing higher risk of floods.

Regional variability in future precipitation would have different impacts on two power generation technologies: natural gas power and hydropower, which accounted for 84% and 8% of total electricity generation respectively in 2020. While most natural gas power plants in Egypt are projected to see a slightly or moderately drier climate in the future, hydropower power plants are expected to experience a slightly wetter climate by 2100.

Climate projections show that around one-third of existing natural gas power plants would be exposed to an increase in consecutive dry days of over 10 in 2080-2100 compared with 1850-1900 in a low-emissions scenario (Below 2?C)2 and over 20 in a high-emissions scenario (Above 4?C).3 This level of exposure is notably higher than the global average: only 5% of gas power plants globally would be exposed to an increase of over 10 in 2080-2100 in a low-emissions scenario (Below 2?C), and 8% would see an increase of over 20 in a high-emissions scenario (Above 4?C).

While natural gas power plants are projected to see a slightly or moderately drier climate, most hydropower plants in Egypt are likely to experience a wetter climate with increasing precipitation and water flow. As a result, Egypt is projected to see a higher hydropower generation capacity factor. Compared with the hydropower generation capacity factor of 2010-2019, that of 2060-2099 is projected to increase by 2.4% under a low greenhouse gas concentration scenario4 and by 7.5% under a higher emissions scenario.5

However, a wetter climate in areas with hydropower plants does not always bring positive impacts. The projected increase in heavy rainfall and pluvial floods could physically damage hydropower plants with sediment and floating debris. In a high-emissions scenario, the majority of Egypt''s hydropower plants are likely to be exposed to at least a 40% increase in their one-day maximum precipitation in 2080-2100 compared with 1850-1900. This level of exposure in Egypt is significantly higher than the world average, where only around 10% of hydropower plants would experience such level of increase in their one-day maximum precipitation.

More than 30% of the Nile delta is a lowland area (less than 2metres above sea level) and faces severe risk of hazards such as coastal erosion, storm surge and flooding. Climate projections show that the sea level around the Mediterranean could rise by 0.4metres in a low-emissions scenario2 and 0.7metres in a high-emissions scenario3 in 2081-2100 compared with the 1995-2014 period. Estimates in Egypt''s first updated NDC show that sea level rise may reach 1metre in some coastal areas of Egypt. In this case, several places in the Nile Delta, the northern coast and Sinai could be submerged by 2100.

This is particularly alarming since 95% of Egypt''s population lives in the Nile Valley and Delta and many energy infrastructure assets are located along the coast and in the Nile Delta. Respectively, 39% and 7% of installed gas and oil power plant capacity is located in areas below 10metres above sea level. Most gas-fired power plants located in low-elevation areas (below 10metres above sea level) are projected to be exposed to over 0.4metres of sea level rise in a low-emissions scenario, and over 0.6metres of sea level rise in a high-emissions scenario in 2081-2100.

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