How droughts are impacting the global energy mix and energy security

By Irene Lauro

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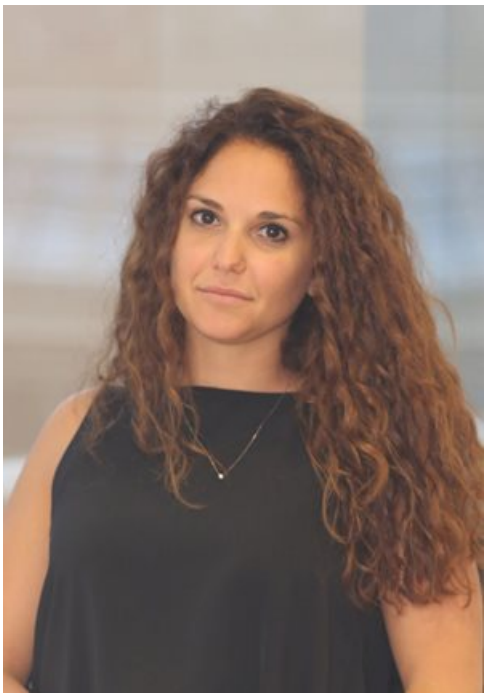
When thinking about the impact of droughts on economic activity, the agricultural sector is the first that comes to mind. This sector is highly sensitive to weather variability, with the fall in crop production being the first direct damage of water shortage.



Irene Lauro, environmental economist at Schroders

But agricultural activity is not the only area that is impacted; the energy and transport sectors are also affected by droughts.

In South Africa, parts of Johannesburg were facing water shortages last month because of increased demand and a decaying infrastructure, encompassing water storage, supply and treatment. These issues were further exacerbated after power outages curbed supplies by the main distributor, in the midst of a heat wave. This led to the region's authority, Rand Water, imposing 30% water restrictions. South Africa's economic hub is now facing a water crisis – in addition to its ongoing electricity woes.

Looking abroad, in northern Italy higher temperatures have triggered the worst drought in 70 years. The Po, Italy's longest river, has hit record low water levels after months without heavy rainfall and little snow in the mountains. The river is a vital source of water for drinking, agriculture and energy production, and the ongoing water crisis is heavily impacting the energy storage of its hydropower system.

More than 85% of the 4,000 hydroelectric power plants in Italy are located in the northern regions. Hydro is the oldest source of renewable energy, accounting for around 35% of total green energy production and usually meets over 15% of Italy's energy demand. The ongoing water shortage is exacerbating the energy crisis as the drought is hitting the economy at a time in which gas supply is being squeezed by the Russia-Ukraine war.

Spanish hydropower generation, which accounts for more than 11% of total energy produced in the country, is also running at very low levels. This summer, hydro was more than 30% below its past seven-year average.

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Other countries are being hit

Droughts are causing significant disruptions in hydropower generation in China. In particular, Sichuan, a province that gets more than 80% of its energy from hydropower, is witnessing its worst drought in more than 50 years. Restrictions on power supply have been implemented due to low water levels, with some key automakers, like Toyota, reporting that they have been forced to halt production for several days at their factories in the region.

The western states of the US have also been hit by droughts. The United Nations Environment Programme (Unep) has

recently highlighted that, due to more than 10 years of dry weather, the two largest hydroelectric reservoirs in the US are currently at their lowest levels ever. Lake Mead and Lake Powell provide water and electricity to tens of millions of people in the states of Nevada, Arizona, California, Wyoming, Colorado, New Mexico, and in Mexico.

UNEP has also warned that if drought conditions persist, these reservoirs could eventually reach “dead pool status”. This occurs when the water level in the dams falls so low it can no longer flow downstream and power the hydroelectric power stations.

Effects of drought in California

Natural gas generators are being used to offset the reduction in low-cost hydroelectric power. The US Energy Information Agency (EIA) has analysed the effects of drought in California. The analysis forecasts wholesale electricity prices in the state would increase by 5-7% relative to the median case in a drought scenario. The median case is defined as median water supply between 1980 and 2020.

The EIA analysis highlights how physical climate risks can add pressures on prices, at a time in which many economies are battling with already elevated inflation. Switching to gas to replace the loss of hydroelectric output also threatens to worsen the climate crisis as it leads to higher carbon emissions, with the EIA expecting CO2 emissions in California to be 6% higher than in the median case.

Nuclear power production in France affected

In order to avoid this rise in carbon emissions, countries could turn to other zero-carbon sources of energy. France, for example, meets 70% of its electricity needs with nuclear power. However, France too is struggling as nuclear power production is also being restricted by droughts.

French nuclear reactors rely on rivers for cooling, and output must be reduced when river temperatures reach certain thresholds. This is to ensure the water used to cool the plants will not harm the environment when put back into the waterways. This is happening at a time in which EDF, the French energy supplier, is already reducing output as some of its nuclear reactors are under maintenance for corrosion issues. So far this year, 15% of the 56 nuclear units in France have been forced to curb output due to environmental issues, according to the filings reported by EDF.

Further curbs to nuclear power production have been implemented during the summer, leading to a reduction of more than 5% of total nuclear capacity in some days in July. This has added further pressure to Europe’s energy crunch.

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Droughts impact shipping too

Transport is another sector of the economy that can be impacted by droughts, in particular inland waterways. Low water levels can reduce the navigability of vessels, as ships must be operated at limited capacity with restrictions to the cargo they transport.

Inland waterways play a critical role in freight transportation in many countries around the world, but this has become an acute issue in Germany in recent years. According to the Federal Ministry of Transport, approximately 240 million tonnes of bulk goods are transported per year via the German Federal waterways, which equals almost 75% of the goods transported by railway in the country. Almost 70% of transport of industrial goods such as coal, crude oil, coke oven products, and chemical products takes place on the Rhine, one of the longest rivers in Europe.

It is also important to highlight that reduced freight transportation also impacts the energy sector, as the Rhine is used to transport hard-coal from the ports of Amsterdam, Rotterdam and Antwerp by barges. The Rhine is drying up due to higher temperatures and low rainfall, and its critically low water levels are causing difficulties for coal to be delivered to German coal-fired plants. Some German power producers have recently warned that they will be able to generate less electricity at their coal-fired power plants due to reduced fuel supplies.

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Wind and solar can come to the rescue

Physical risks are already having a significant impact on the global economy, but their importance is likely to increase. As global warming intensifies, we are likely to see more frequent droughts over the next decade. These droughts are limiting activity in the energy sector, highlighting the need for diversification in power supply.

Speaking to delegates at the 2022 Windaba in Cape Town earlier this month, South Africa’s mineral resources and energy minister said the country should shift to an energy mix of "renewables coupled with nuclear" until wind and solar can provide affordable energy at scale.

According to a report by the National Business Initiative (NBI), as much as 150GW of solar and wind capacity must be installed by 2050, and at least 30GW of battery storage in order for South Africa's ideal power system to achieve net-zero emissions by 2050.

Renewables improve energy security

Wind and solar are not only the winners from the energy transition, but they can also improve energy security, insulating economies from geopolitical risks by reducing their reliance on imported fossil fuels. In addition, an increased use of zero-carbon power sources like wind and solar will help limit global warming and, therefore, the impact of physical risks on economic activity in the long term.

They will also be able to provide an infinite source of energy once the necessary technology has been developed, unlike fossil fuel energy. However, they present some limitations due to their variable output, with the ability of meeting electricity demands with wind and solar energy generation relying on factors such as location and weather.

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Importance of a diversified energy mix

This highlights the importance of a well-diversified energy mix: multi-technology solutions, with different sources of energy that tend to be uncorrelated, can help guarantee the stability of the system.

In addition, enhancing flexibility in the grid and investing in energy storage technologies also need to be part of the solution. In particular, storage mechanisms and back-up power stations are likely to play a critical role in periods of prolonged low wind speeds and low sun exposure. These can address the seasonality problem of renewables.

Finally, demand-side management mechanisms are also important, reducing energy consumption via investments to improve energy efficiency.

ABOUT THE AUTHOR

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