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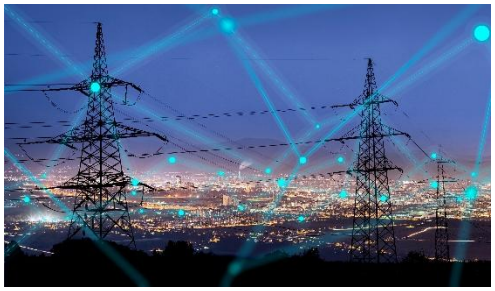
The promise and limits of electricity interconnections: Lessons from Morocco



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Renewable energy as a tool for climate action

Although many countries have set ambitious decarbonisation and net-zero targets, the global energy system is still heavily reliant on carbon-intensive sources accelerating global warming. Today, 60% of global electricity generation comes from fossil fuels, underscoring the scale of the challenge.

The global exploitation of renewable energy represents one of the most effective pathways to achieve a net-zero future. Renewable sources such as solar, wind, and hydropower energy emerge as clean, reliable, but also more affordable alternatives to fossil fuels. Their potential extends beyond the shift from fossil to renewable electricity production as renewables can also transform heating, transport, and industrial processes, helping to decarbonise sectors that remain heavily dependent on coal, oil and gas. The falling cost of renewable technologies has made them a more accessible alternative. This brings new opportunities for energy independence and economic diversification. The International Renewable Energy Agency (IRENA) estimated that 90% of global electricity could be generated from renewable sources by 2050.

Within this context, Africa holds immense unexploited potential of renewable energy, with the United Nations estimating it could generate ten times more electricity from renewables than needed by 2040. Morocco stands out as one of the frontrunners, turning its geographical and natural advantages into a strategic energy action plan.

Morocco's role in the energy transition

With some of the most competitive renewable generation costs in the region, and proximity to European markets, Morocco is well placed to become both a clean electricity and green hydrogen producer and exporter.

The country is a key player in the regional energy transition, with abundant winds and solar resources, combined with its strategic location at the crossroads between Europe and Africa. The Kingdom invested broadly in renewable production. The current strategies significantly raised Morocco's ambitions, aiming for at least 52% of renewable energy in its installed capacity. In its newly updated Nationally Determined Contribution (NDC 3.0) published this year, the Kingdom aims to triple its current installed renewable energy capacity by 2030, reaching more than 15 gigawatts (GW), enough to supply around 10 million households.

To reach these targets, Morocco invested massively in renewable energy infrastructures, building on the country 's significant renewable resource potential. The development of solar power plants, such as the Noor Ouarzazate complex, the largest concentrated solar complex in the world, and the expansion of photovoltaic projects across the country, has made Morocco a regional leader in solar electricity production. Morocco also has strong wind energy potential, supported by several large-scale onshore and

offshore wind farms that are already operating or under development. Finally, leveraging on the potential of green hydrogen production and its derivatives, the Kingdom invested important resources to develop the national sector. According to the Moroccan Agency for Sustainable Energy (MASEN), it presents the potential to meet more than 4% of global demand by 2030.

Realising Morocco's renewable energy ambitions, and those of its partners, depends on coordinated planning, infrastructure investment, and cross-border cooperation. In this context, one important viable solution is the so-called interconnectors.

Interconnectors and their potential as a building block for energy transition

Interconnectors are high-voltage cables that connect countries, regions, or even continents cross-border, across land or under the sea and are a way to enable renewable electricity trade to contribute to the renewable energy transition. This cross-border integration allows countries to exchange electricity, balance supply and demand, and optimise the use of renewable resources across regions. By sharing excess power from one region with another facing a deficit, interconnectors can help reduce waste, prevent curtailment (intentionally reducing electricity output), and make electricity systems more flexible and secure. This is even more relevant given the difficulty of storing electricity, as interconnectors help ensure that electricity is used where it is most needed, improving overall efficiency.

They can also lower production costs, foster competitive energy markets, and support the shift away from fossil fuels. Additionally, the access to diverse electricity sources also strengthens energy security. Interconnectors enable neighbouring countries to support each other during shortages or technical failures, as illustrated by the April 2025 blackout on the Iberian Peninsula. After a major power cut, the existing interconnections between Spain and Morocco allowed the Kingdoms to cooperate in restoring the power. Recent research shows that a globally interconnected renewable power system could produce more than three times the projected 2050 global electricity demand. However, this also comes with technical, economic, regulatory and environmental challenges.

Electricity interconnection infrastructure at Fardioua, Morocco, linking Morocco and Spain.
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Morocco's push for energy interconnections

Morocco is strengthening its position within regional and global energy systems through an ambitious expansion of electricity interconnections. Integration of electricity networks through interconnections has been one of the main pillars of the country's Energy Strategy since 2009. Morocco is currently the only African country directly connected to Europe through two high-voltage cables linking its grid to Spain since 1997. In addition to the two existing interconnections with Spain, a third is currently being developed to increase exchange capacity, while Morocco is also evaluating an interconnection project with Portugal that would further increase its integration into the Iberian electricity system and reinforce its access to European renewable markets.

On an African scale, a new interconnection with Mauritania is being studied to promote regional energy cooperation in West Africa. Together, these initiatives illustrate Morocco's growing ambition to position itself as a regional and transcontinental hub for clean energy exchange.

These infrastructure developments are complemented by collaborative policy initiatives. In parallel, the Sustainable Electricity Trade (SET) Roadmap, a strategic initiative involving Morocco, Spain, Portugal, France, and Germany, seeks to promote and facilitate renewable electricity trade between the participating countries in line with the objectives of the Paris Agreement. It is managed by MASEN and supported by the German-Moroccan Energy Partnership. The roadmap focuses on integrating renewable energy into regional markets, enhancing cross-border trade mechanisms, and improving overall energy security.

Behind the challenges of building cross-border power links

Despite their potential, interconnectors face significant global challenges. Building and

maintaining such infrastructure requires international actors to coordinate closely, massive investment, and lengthy timelines. Globally, only a few specialised companies possess the facilities and expertise to manufacture High Voltage Direct Current (HVDC) cables and converter stations required for interconnector projects. Because of this, production stays limited, and companies struggle to keep up with orders. These constraints can delay project delivery and significantly raise costs, even more when repair operations are impacted by bad weather or distance. Technical complexities, such as maintaining grid stability and ensuring that systems synchronise in real-time efficiently, can pose serious obstacles.

On the regulatory side, countries often differ in market design, tariff structures, and energy governance. These factors introduce additional considerations for harmonisation efforts. In Morocco, the electricity market continues to operate under a centralised framework led by the National Office of Electricity and Drinking Water (ONEE), which differs from Europe's more liberalised system. Interconnections also demand a strong national grid to ensure optimal use of cross-border capacity. Ongoing work to strengthen the national network will further enhance the effective use of these interconnections, particularly between renewable production sites and demand centers.

The other side of interconnected power systems

While interconnectors bring significant benefits in terms of security of supply, market efficiency, and renewable integration, they also introduce several risks that must be carefully managed. By physically linking national grids, interconnectors make electricity systems mutually supportive. Thus, when one country experiences shortages, the other can supply additional power. However, this same interdependence can transmit disturbances from one system to another. A power failure or technical fault in one network can quickly propagate across borders, amplifying its impact. For example, when a fault happened on the electricity cable between France and the UK, the UK suddenly lost a large amount of power. This made the grid frequency drop below its normal level, similar to a heartbeat suddenly slowing down, which is a sign that the whole system is under stress. Batteries and reserve power acted right away to prevent a blackout in the UK, keeping the lights on and the system stable.

The economic dimension introduces another layer of uncertainty. Some countries view interconnections as a potential source of price volatility or as a threat to domestic energy production. They argue that prices would be influenced by supply and demand from other countries. Moreover, cheaper imported electricity could weaken the capacity of national power producers. Some countries have become more cautious toward new projects, perceiving them as increasing electricity prices and as a threat to energy independence. While able to play a key role in reaching net-zero, interconnectors also create new vulnerabilities that require careful governance, better regulation, and international coordination to make sure that the benefits of connection do not come at the expense of system stability or sustainability.

In the end, connection isn't enough

Interconnectors hold great promises for accelerating the global energy transition by linking regions, optimising renewable resources, and enhancing energy security. Yet, their use represents only one of many tools to global energy transition and cannot stand alone against climate change. For Morocco, interconnections represent not only a technical asset but also a strategic opportunity to strengthen its role as a regional energy hub between Africa and Europe. If developed sustainably and supported by robust domestic infrastructure, interconnectors have the potential of transforming Morocco's renewable potential into a driving force for regional cooperation and global climate resilience.

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