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Future Power Expo

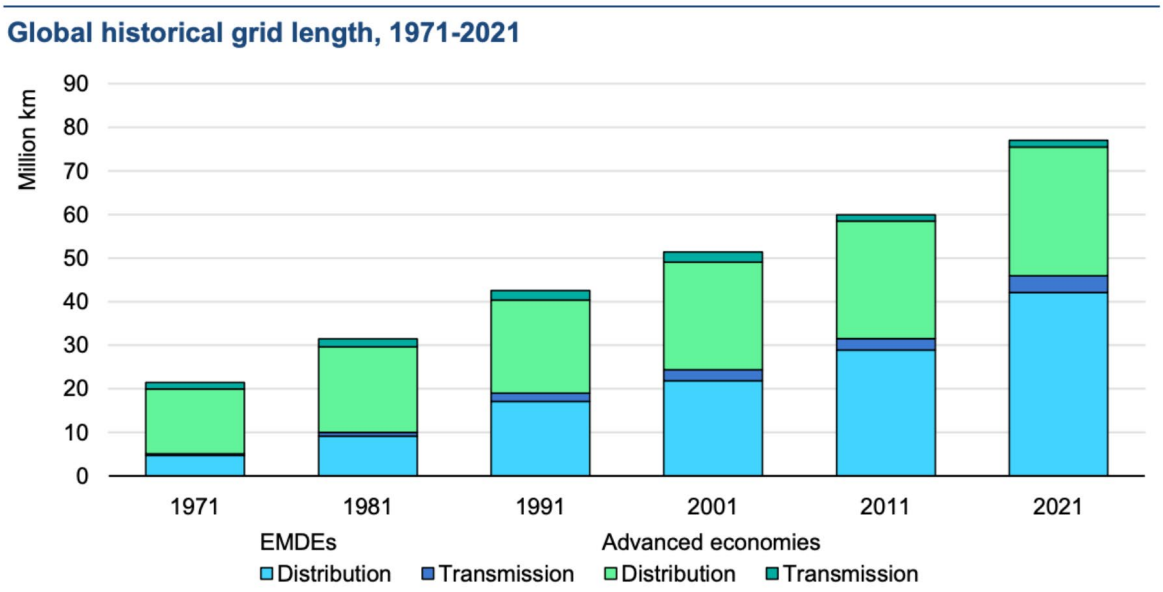
The Energy Landscape in Saudi Arabia

Modernizing the Grid to Power the Future

Grid Modernization

The International Energy Agency (IEA) describes power grids as a "backbone" of today's electricity systems. Over the years, the global historical grid length has substantially increased.

As of the latest available data, the world relies on nearly 80 million kilometers of grids to supply power to households, offices, and many other establishments across various sectors. While grids play a critical role in the modern era, two intertwined pressing concerns must be tackled: aging infrastructure and the integration of cleaner energy sources.



Note: Line route length of grids.
Sources: IEA analysis based on Global Transmission and NRG Expert.

Aging infrastructure and renewable integration

Indeed, the world's electricity grids are aging. Many were built over 50 years ago and are struggling to meet current demands. This aging infrastructure is prone to failures, leading to reliability issues that can hinder economic activities and pose challenges in integrating new and cleaner power generation sources.

According to a landmark 2023 report by the IEA, achieving all national climate and energy targets will necessitate the addition or refurbishment of 80 million kilometers of power lines by 2040. Moreover, to finance the changes that will be made to how grids operate, the report estimated that annual investments in grids must double to over $600 billion — per year by 2030.

The effect of insufficient and aging infrastructure is already being felt. In fact, the IEA revealed that there's a growing lineup of renewable projects waiting to be connected to the grid. Of this, 1,500 gigawatts worth of projects are already in the advanced stages. To put it in a broader perspective, these 1,500 GW projects are five times larger than the total amount of newly added solar PV and wind capacity globally in 2022.

In a press statement, IEA Executive Director Faith Birol noted, "The recent clean energy progress we have seen in many countries is unprecedented and cause for optimism, but it could be put in jeopardy if governments and businesses do not come together to ensure the world's electricity grids are ready for the new global energy economy that is rapidly emerging."

"This report shows what's at stake and needs to be done. We must invest in grids today or face gridlock tomorrow," he added.

The lack of adequate power grids, especially those that will accommodate renewable energy projects, also has a huge impact on the climate.

In the IEA report's Grid Delay Case, an analysis indicates that if the deployment of renewable energy sources continues at a sluggish pace, it could increase cumulative carbon dioxide (CO_2) emissions by almost 60 billion tonnes between 2030 and 2050.

Consequently, this scenario would significantly elevate the risk of surpassing the critical threshold set by the Paris Agreement, with a 40% likelihood that global temperatures could exceed 2°C — substantially above the target limit of 1.5°C.

The need for grid modernization

As the world transitions into a greener future powered by renewable energy sources, it entails one clear thing: a demand for a robust grid system. There's a need for innovative solutions to integrate and manage these environmentally friendly but variable energy sources effectively.

Experts point to electricity accumulation as a potential solution. Renewable energy sources are inherently intermittent — they produce energy depending on weather conditions, which are not constant. This variability can lead to challenges in maintaining a stable energy supply. Energy storage systems like batteries can mitigate this issue by storing excess energy generated during peak production times (e.g., sunny or windy periods) and releasing it during periods of low production. This helps maintain a consistent energy supply and enhances grid stability.

Advanced technologies like artificial intelligence (AI) should also complement it. AI is capable of predicting energy demand and production more accurately. This predictive capability allows utility companies to better manage energy distribution, reducing waste and improving efficiency.

Smart grids — or "electricity network that use digital technologies, sensors and software to better match the supply and demand of electricity in real time while minimizing costs and maintaining the stability and reliability of the grid" — can also help.

These grids can cut the power outage duration by half and lower energy consumption by up to 10%. As the IEA recommends, transmission and distribution system operators should keep supporting the use of new technologies. These include systems for managing distributed energy resources, devices for controlling network edges, advanced methods for managing voltage and power, digital replicas of networks, and artificial intelligence. They should also embrace the use of robots and drones to improve operations and management, implement closed-loop systems, and explore non-wire alternatives like flexibility services and independent distributed storage systems.

Concurrently, countries must undertake energy decentralization. Regulatory and bureaucratic delays can extend the timeline for new infrastructure projects from planning to completion to between 5 and 15 years. This too long a time will have several impacts. Promoting local energy production and consumption reduces the volume of electricity transmitted over long distances through the power grid. This decrease in long-haul transmission not only cuts energy losses but also alleviates stress on power lines, thereby extending their operational life.

Saudi Arabia's grid modernization efforts

According to National Grid SA, Saudi Arabia's national grid has a peak demand capacity of 70.66 GW, as of November 2023. The grid encompasses 1,233 substations and spans 95,132 circuit kilometers of transmission lines, supporting a massive infrastructure capable of transmitting 355,982 gigawatt-hours (GWh) of electricity. Additionally, the grid includes 3,940 transformers and utilizes 87,794 kilometers of fiber optic cables for efficient operation and communication.

This robust setup has been crucial for managing the country's rising energy needs. From 2008 to 2018, Saudi Arabia's electricity consumption nearly doubled from 169,000 GWh to 331,000 GWh. This highlights the critical role of ongoing investments and upgrades in the national grid to keep pace with escalating demand. A recent piece of research shows how smart grids can be beneficial for the country. According to a team of researchers at King Fahd University of Petroleum & Minerals (KFUPM), this smart transition "introduces the potential for revolutionary changes in the present energy management systems" in Saudi Arabia. Primarily, it would facilitate the integration of large-scale variable renewable energy sources and improve demand-side management.

The researchers stated that smart grids enhance the capability to integrate renewable energy sources into the electricity grid by improving energy transactions and ensuring a reliable supply. They argued that utilities would be more adept at managing the load-balancing challenges that come with incorporating renewable energy. Furthermore, the researchers noted that smart grids could contribute to reducing greenhouse gas emissions by optimizing the operational accessibility of grid assets.

With the potential of smart grids, the country has been keen on leveraging this technology. For instance, in April 2021, the Saudi Electric Company (SEC) has already completed the installation of more than 10 million smart electricity meters, replacing their mechanical counterparts.

Meanwhile, in October last year, the SEC inked a $3 billion deal with Dubai Islamic Bank PJSC, Kuwait Finance House, Mashreq Bank, and Saudi National Bank to boost the country's grid infrastructure.

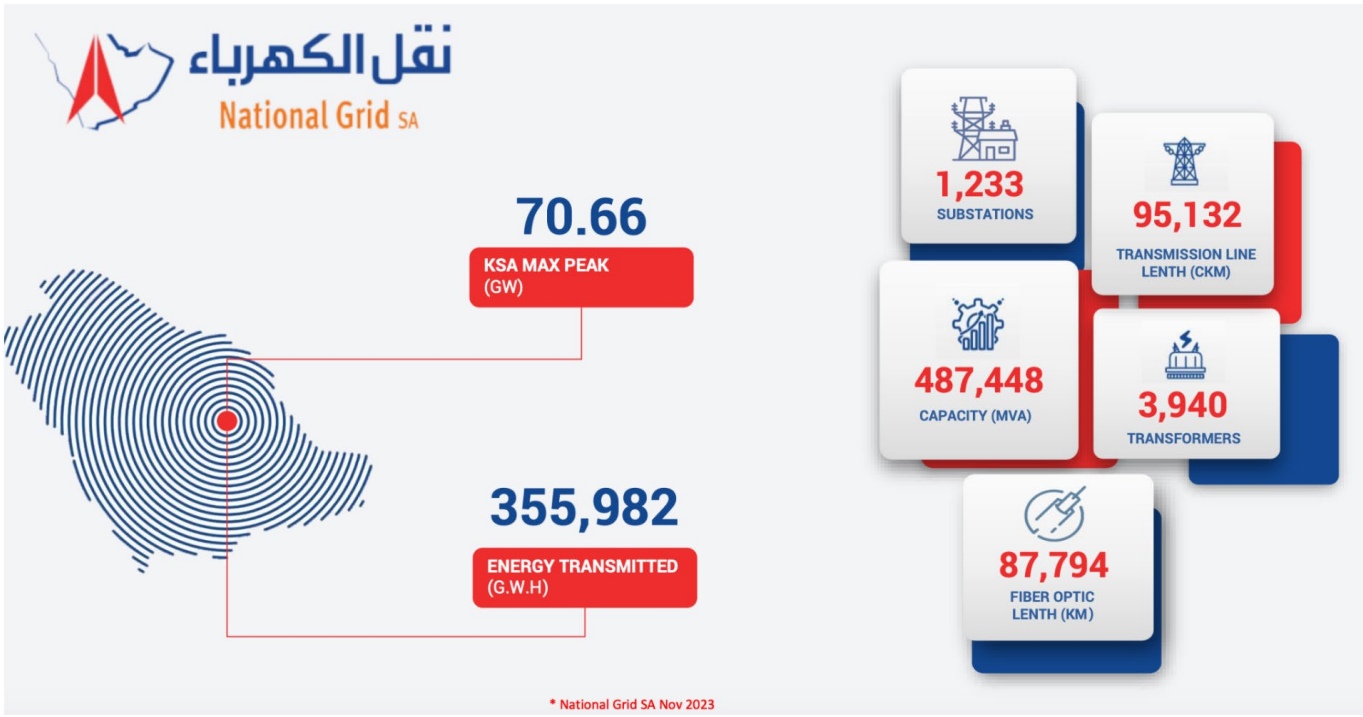
SEC CEO and President Engr. Khaled Al-Gnoon said, "The financing comes in line with our ambitious investment strategy aimed at injecting approximately SAR500 billion in our expansion plans in the electricity sector and CapEx spend by 2030 to provide exceptional electricity services to subscribers."

"Our investments primarily focus on building smart grids, integrating renewable energy projects, and improving the grid reliability. Altogether, these will provide the essential infrastructure for the transmission and distribution grids to further boost electricity generation efficiency levels and achieve optimal electricity production, in line with the goals of Vision 2030," he added.

A smart, greener future for Saudi Arabia also awaits as more significant projects are underway. In December, Saudi Arabian electric utility company and NEOM subsidiary ENOWA unveiled a blueprint for the world's first high-voltage smart grid.

"We call it the concept of a 'grid of microgrids' on a high-voltage level, and it allows us to reduce the footprint of the corridors by 50% and it allows us to bring the cost of undergrounding down by more than 50%," ENOWA's CEO Peter Terium explained on the sidelines of COP28.

To attain 100 percent renewable electricity in NEOM, Terium highlighted the importance of an efficient grid.


نقل الكهرباء
National Grid SA
70.66
KSA MAX PEAK
(GW)
355,982
ENERGY TRANSMITTED
(G.W.H)
1,233
SUBSTATIONS
95,132
TRANSMISSION LINE
LENTH (CKM)
487,448
CAPACITY (MVA)
3,940
TRANSFORMERS
87,794
FIBER OPTIC
LENTH (KM)
* National Grid SA Nov 2023

26 - 28 November 2024

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Future Power Expo, tailored to the needs of the power sector in Saudi Arabia, encompasses the entire power cycle, from innovation in electricity to clean energy, energy storage, batteries, critical and backup power, transmission and distribution, and electricity consumption management, as well as electric vehicle technology.

Aligned with **Vision 2030**, the expo propels Saudi Arabia's power projects forward, attracting attendees from various industries, including energy, engineering, construction, and infrastructure development, to government authorities and investors.

Explore business opportunities, network with industry leaders, and delve into key topics where energy transformation is topping agendas across the entire utilities supply chain. Join us at Future Power Expo, Saudi Arabia's leading power event, from **26-28 November 2024** at the **Riyadh Front Exhibition & Conference Center.**

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