



RELIABLE AND SUSTAINABLE ENERGY: CHALLENGES AND OPPORTUNITIES

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The world's population, economy and energy demand are expected to grow substantially by 2040. Global gross domestic product (GDP) is likely to double from its current level, the world's population is expected to rise from 7.2 billion currently to 9 billion, and total global power generation, currently around 25,000 terawatt-hours (TWh), is forecast to grow to around 40,000 TWh. Most forecasts anticipate the need for more oil and gas to satisfy consumer demand. However, it is important to meet this energy demand in a way that minimises emissions. This remains one of the most difficult challenges of the twenty-first century.

Renewable generation technologies could play a significant role in satisfying energy demand while achieving environmental goals. Renewables are now mainstream in most countries, with national policies and investments supporting their expeditious deployment. Since 2012, global capacity additions of renewables have exceeded those of their conventional fuel counterparts. By the end of 2018, total global renewable generation capacity stood at 2.4 terawatts (TW), nearly half of which is hydropower. In 2015, about 30 countries produced over 5 per cent of their energy from renewables. By 2018, this had risen to nearly 50 countries.

Solar photovoltaic (PV) generation and wind power are the most recognised renewable technologies. Every year since 2007 has been a record year for solar PV capacity additions. By the end of 2018, the total global cumulative capacity of PV was 505 gigawatts (GW), far ahead of concentrated solar power (CSP). The cumulative global installation of CSP is only 5.5 GW, about 1 per cent of the total global capacity of solar PV. Despite its ability to store energy, CSP has a relatively high capital cost, a major hindrance to widespread adoption.

According to the International Energy Agency (IEA), solar PV and bioenergy are the only technologies of those considered that are on track to meet the goal of the Paris Agreement to limit global temperatures to 2° C above pre-industrial levels. The IEA reports that three technologies need more effort to stay on track (wind, hydro, and bio), while three are not currently on track (geothermal, CSP, and wave power).

Renewable generation is only one part of the solution to meeting the growing demand for energy sustainably. Clean technologies used in transport, building, industry, fuel supply, and energy integration processes can contribute significantly to reduced emissions. In the transportation sector, for example, electric vehicles (EV) can supply the

grid with energy during times of peak demand. This turns EVs into virtual power plants.

The potential to electrify aircraft has received relatively little attention compared to the electrification of automobiles. Some aviation industry experts see electric 180-passenger aircraft as a viable alternative for short routes of around 600 nautical miles. This option is, of course, contingent on further progress in developing the necessary battery technologies. Other technologies that fall under the clean technologies umbrella include utility-scale storage, hydrogen power, energy digitalisation, and controlling flare emissions.

The power sector has incorporated a small share of renewables without impacting its ability to function. However, as the share of utility-scale renewables rises, new modes of operation may be required to ensure the reliability of renewable generation and the flexibility of supply. The flexibility concern is further amplified by the increase in distributed, or on-site, generation. All power system technologies provide some form of supply adaptability. Natural gas in particular is expected to play a significant role in providing flexibility. Utility-scale storage will also provide flexibility and frequency correction within the power system, provided it becomes cost-competitive. Markets for ancillary services, reserve capacity, and ramping capabilities in the power generation sector are likely to be increasingly important.

Alongside technical flexibility, other important changes will be required to aid the global transition to cleaner fuel. This includes proactive policymaking, innovative regulatory structures, and supportive legal frameworks. Designing tariffs that generate high enough returns to attract investors but remain affordable for consumers, raising investment capital, dealing with stranded conventional generation assets, de-risking investments in transmission and distribution lines due to the trend toward decentralisation, and optimising regional interconnectivity are all critical to the continued health of the energy sector.

The IEF's role in facilitating this transition has never been more important. In the words of His Excellency Khalid Al-Falih, Saudi Arabia's Minister of Energy, Industry and Mineral Resources: *"For effective communication and cooperation to take place, there must be a venue where all participants are made welcome, and where all can be heard. The IEF provides just such a platform."* The transition to cleaner energy is likely to present numerous challenges and opportunities. The IEF is an ideal forum for stakeholders to address the technical and policy enablers of the transition. ■