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## Exploring the Future of India-Gulf Ties in the Power Sector

*Abdulla Alabbasi and Subha Haroon*

### **Introduction**

The Gulf Cooperation Council (GCC) countries and the Republic of India have an ambitious agenda of promoting renewable energy and reducing carbon emissions. These plans are based on their international commitment and their need to reduce dependence on finite resources. All GCC countries have announced mandatory targets for increasing the share of renewables by 2030. Similarly, India has also announced the initiative of ‘One Sun, One World, One Grid’, which envisions a globally interconnected electricity grid to complement the plans of the International Solar Alliance (ISA) for round-the-clock solar power production.<sup>1</sup> However, the integration of renewable energy technologies, particularly wind and solar, can affect the stability of the network, and they require a deep understanding of the electrical grid, consumption patterns, and operational aspects of electrical systems. For instance, renewable energy can increase the ramp in the load profile when the consumer demand is less than the renewables’ output. This effect of renewable production is often termed the “duck curve”, and it requires careful consideration through the planning stages and policy formulation.

One of the approaches for tackling the associated challenges of renewable energy is cross-border electricity interconnectors. The GCC countries have joined forces to develop an interconnected transmission grid, which will be

used mainly for supporting the GCC networks during blackouts and emergencies. Recently, the mandate of the GCC interconnector has been expanded to boost power trading in the region and increase cooperation with neighbouring countries.<sup>2</sup> India itself has a huge electrical grid which consists of five power grids: the Northern Region, Eastern Region, Western Region, North Eastern Region, and Southern Region grids. In addition to its local interconnection, India has cross-border interconnections with its neighbours, and it has a well-established mechanism for power trading called the Indian Energy Exchange (IEX), which aims to facilitate in-country and cross-border power trading.<sup>3</sup>

This chapter is an attempt to explore the possible cooperation between the GCC and India in the power sectors, particularly in developing an electrical interconnection between them. This interconnection can increase the deployment of renewable energy in GCC countries and India, and enhance the stability of the networks. It can also optimise the supply for dispatchable and non-dispatchable power plants in order to meet the growing demands in both regions. The chapter starts by explaining the energy mix for the electrical generation sector and renewable targets between the two regions, then highlights their electrical interconnection. Finally, it discusses the benefits of establishing an interconnection – a proposal that is realistic and achievable.

### **Electrical Profiles and Renewables Targets between GCC and India**

The formulation of any electrical grid is unique by its nature as it is developed over time, based on the evolution of the technologies and the distinctiveness of the country's natural resources. For example, the GCC countries' electricity generation depends on hydrocarbons, since this region has more than 30 per cent of the world's reserves of crude oil and 20 per cent of natural gas reserves.<sup>4</sup> In addition, the advancement of technologies has played a significant role in developing the electrical grid in every sector, including power generation, transmission, and distribution. This section will cover the energy mix for electrical generation in the GCC countries and India and their renewable targets.

### *GCC Electrical Profiles and Renewable Targets*

The GCC nations use natural gas as their primary source to generate their electricity, followed by crude oil, and the remaining fuel is made up of light oil, heavy fuel oil, diesel, and renewable energy sources.<sup>5</sup> However, the GCC countries set progressive targets and plans for integrating renewable energy sources into the total national energy mix, as shown in Table 1. Each country has set goals commensurate with its capabilities and vision for the future. At the end of 2020, the Gulf countries had installed an electric capacity equivalent to 146 gigawatts (GW), of which renewable energy constituted 3271 megawatts (MW). The investment in solar energy is considered the largest in the region as it represents 71 per cent of the projects, followed by concentrated solar energy (CSE) with 23 per cent; bioenergy and energy generated from waste represent four per cent while wind energy represents two per cent. The United Arab Emirates is one of the leading investors in renewable energy within the region, as the share of its investments constitutes 68 per cent of the total investments in the Gulf, followed by the Kingdom of Saudi Arabia with 16 per cent.

**Table 1: GCC Renewables Targets (IEA, 2022)**

| <i>Country</i> | <i>Installed Capacity<br/>in 2020[MW]</i> | <i>RE Share in 2020</i> | <i>RE Targets</i>        |
|----------------|-------------------------------------------|-------------------------|--------------------------|
| Bahrain        | 10                                        | 0.1%                    | 5% for 202520 for 2035   |
| Kuwait         | 106                                       | 0.5%                    | 15% for 2035             |
| Oman           | 159                                       | 1.3%                    | 10% for 202530% for 2030 |
| Qatar          | 43                                        | 0.3%                    | 20% for 2030             |
| Saudi          | 413                                       | 0.5%                    | 50% for 2030             |
| UAE            | 2540                                      | 7.2%                    | 50% for 2030             |

Looking closely at the UAE's power generation profile, we see that it has an installed capacity of 27 GW. In addition, the UAE is aiming to increase the production of electricity by interconnecting with other grids within the Emirates, including Etihad Water and Electricity, Department of Energy-Abu Dhabi, Dubai Electricity and Water Authority (DEWA), and Sharjah Electricity, Water and Gas Authority (SEWGA). DEWA declared in November 2013 that it planned to source 12 per cent of its electricity from nuclear sources by 2030. Leading the sector's organization is the State-owned Emirates Nuclear

Energy Corporation (ENEC), which in 2009, granted a US\$ 20 billion contract to a South Korean consortium to construct four nuclear facilities with a combined capacity of 5,600 MW. The UAE has also enacted a number of energy and climate change-related laws and made efforts to address the problem posed by carbon emissions. By using nuclear power, renewable energy, and energy-saving practices, the major goal is to lessen the UAE's overall reliance on fossil fuels. For instance, the Renewable Energy Development Strategy states that the deployment of renewable energy will increase to 25 per cent by 2030 and 75 per cent by 2050.<sup>6</sup>

Saudi Arabia is one of the few nations that directly burns crude oil to produce energy. Oil-fired generating units typically employ lower-priced fuel oil worldwide. With 58 gigawatts of total production capacity available, the State-owned Saudi Energy Company (SEC) is Saudi Arabia's largest electricity supplier in the region. The government invested over US\$ 53 billion in electricity generation between 2008 and 2015. This includes a US\$ 21 billion scheme for nine independent power projects that would increase capacity by 9,360 MW, and a US\$ one billion agreement to upgrade the Riyadh Power Plant with 30 gas turbines to generate an additional 2,000 MW. By 2032, when the anticipated growth in electricity demand will necessitate an increase in power-generation capacity to 120 GW, the King Abdullah City for Atomic and Renewable Energy (K.A. CARE) programme hopes to ensure that half of the electricity generated in Saudi Arabia comes from renewable sources.<sup>7</sup> In addition, the current trend of the Saudi leadership towards shifting to renewable energy, supporting sustainability projects and protecting the environment is a serious and strategic direction. This was clearly shown when Saudi Arabia chaired the G-20 and proposed the adoption of the Carbon Circular Economy (CCE), which was embraced by all G-20 countries. The adoption of a circular carbon economy will create a major change in the energy sector as well as the whole economy.

It is also essential to mention that Oman is a major exporter of oil and gas, and all its energy needs are met by domestically produced natural gas and oil products. To encourage private solar PV adoption, the government recently introduced the "Residential PV Initiative" (IEA, 2022). With a goal of generating at least 30 per cent of its electricity from renewable sources by 2030, Oman is seeking to increase the capacity of its electricity-generation

facilities through renewable independent power projects (IPP). The government-owned Petroleum Development Oman (PDO), an early innovator in large-scale solar power projects in Oman, seeks to reduce emissions by 50 per cent from 2019 levels by 2030. Ibri 2, Oman's largest utility-scale solar photovoltaic, independent power facility, commenced commercial operations in January 2022. By 2040, Oman wants to establish a hydrogen-based economy with annual green and blue hydrogen production of around 30 GW. Several gigawatt-scale green hydrogen projects have been announced by the government, including a 14 GW facility fuelled by 25 GW of wind and solar energy. According to the research firm MEED, Oman wants to invest over US\$ 45 billion in green hydrogen and green ammonia projects. To oversee hydrogen project management, Oman established an EDO subsidiary called Hydrogen Development Oman and a Directorate General for Clean Energy and Hydrogen under the Ministry of Energy and Minerals.<sup>8</sup>

Similarly, Kuwait's sole source of energy is fossil fuels, and by 2030, the nation's energy requirements will have tripled. The country wants to diversify its energy mix by increasing the proportion of renewable generation to 15 per cent by 2030 (IEA, 2022). In 2015, Kuwait possessed five thermal power plants: Doha East, Doha West, Al-Subiya, Shuaiba South, and Al-Zour South, with a combined installed generation capacity of 15.7 GW. The Kuwait Electric Power System (KEPS) produces, transmits, and distributes electricity under the supervision of the Ministry of Power and Water. The only facility that is not connected to desalination plants is Al-Subiya. In northern Kuwait, Al-Subiya II produces 2000 MW. The Ministry of Electricity and Water, set a target of 15 per cent of total energy production from renewable sources by 2030 as part of the country's National Energy Strategy 2035. The strategy also aims to generate two GW of electricity from renewable sources by 2030 with the goal of reducing dependence on fossil fuels and increasing the use of renewable energy for power generation. Sidra is the country's first solar power plant with a 10 MW output capacity, but so far not much progress has been made in this area. There has been a rise in power demand, partly because of significant energy subsidies. Rolling blackouts are common throughout the busy summer months. Plans to cut subsidies, which made up 6.5 per cent of the GDP in 2015, have encountered resistance in the legislature.<sup>9</sup>

Gas generates nearly all of Qatar's electricity, and according to State reports, the country had an electricity generation capacity of about 8,800 MW in 2017. The Qatar General Electricity and Water Corporation (QEWCo), enjoys a monopoly in government transmission and distribution. Although currently there are independent water and power providers, the majority of Qatar's generation capacity is owned by the QEWCo, a partially privatized enterprise. Additionally, the QEWCo works with private investors on energy projects.<sup>10</sup> The Qatari government has announced its goal to integrate renewable energy in order to meet 20 per cent of the electricity demand. Yet there is no dedicated entity responsible for following up on this mission, and there are several stakeholders involved in renewable projects including the Ministry of Energy, the Ministry of Industry and Trade, the Qatar Electricity and Water Company (Kahramaa) and the Qatar National Research Fund.<sup>11</sup>

The Kingdom of Bahrain's generation capacity is 3150 MW. Thermal, oil, or gas-fired power plants produce the vast majority of that. It has five power plants; two of them are public-private partnerships (PPPs): the Al Hidd IWPP (integrated water and power plant), which provides the grid with around 1,006 MW, and the Al Ezzel IPP (independent power producer), which has a capacity of 946 MW. Currently, Bahrain's government has taken several steps to incorporate renewable energy in its energy mix. A significant milestone was achieved in January 2017, when the Sustainable Energy Unit (SEU) launched the National Renewable Energy Action Plan (NREAP). This plan is a roadmap for identifying the most appropriate renewable resources and their best technologies, which reconcile with Bahrain's privacy. The action plan set a target of 255 MW of renewable energy by 2025, with a generation of 480 GWh per year. It also sets another goal for 2035, which is to produce 700 MW, with 1460 GWh per year (Bélaïd et al., 2019). In 2019, the largest tender to produce 100 megawatts of renewable energy through solar panels was awarded to a group of companies led by ACWA Power (SEA 2021). A tender was also recently announced for a capacity of not less than 72 MW of solar energy systems, linked to the national grid on the roofs of buildings, parking lots and electric car charging stations.<sup>12</sup>

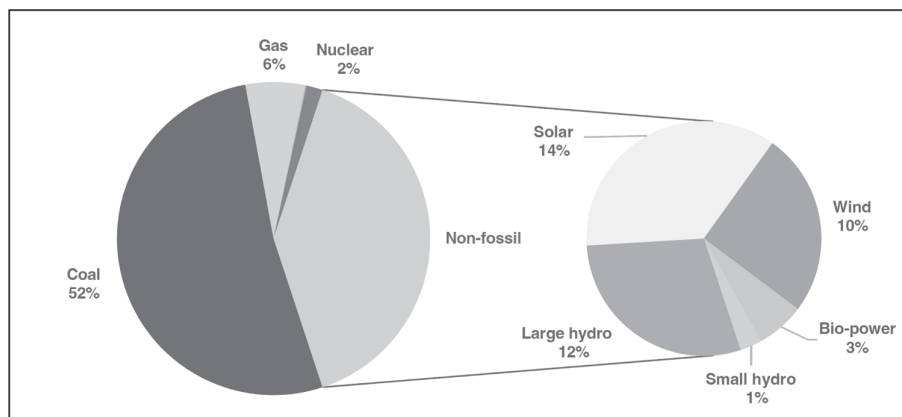
At the end of this section, it is important to highlight that even though the GCC countries have similar drivers to invest in renewable energy and diversify their energy mix, the progress of each country differs based on

individual availability of natural resources and having various economic challenges. Thus, it is not appropriate to put all GCC countries in one basket without understanding the indigenous difficulties of each nation. Despite these differences among GCC countries, the GCC interconnection that was completed in 2011, has provided the region with a solid base structure for formulating a holistic strategy for renewable energy investments and increasing the cooperation among both the member states and other neighbouring countries. For instance, the GCC interconnection is planned to be linked to the Iraq electrical grids and to connect to several more electrical grids in the future including Egypt, India, and Jordan.

### *India's Electrical Grids and Renewable Targets*

The majority of India's electricity is produced from coal-fired power plants. Coal continues to be the country's principal source of electricity, despite efforts to diversify. Electricity's proportion has increased since 2000, reaching 73 per cent in 2013. Except for renewables, the percentage shares of all other energy sources have fallen over that period. India produced 1078 TWh in total in 2015 from sources like coal, natural gas, oil, nuclear electricity, and hydropower.<sup>13</sup> As depicted in Figure 1, India has a total electrical installed production capacity of about 404 GW with 52 per cent based on coal-fired power plants and 40 per cent from renewables.<sup>14</sup>

Figure 1: India's Electric Power Installed Capacity as of June 2022



The development of alternative and renewable electricity sources like solar, wind, biomass and small hydropower (less than 25 MW) facilities are also advancing significantly. India's target is for 50 per cent of its installed generation capacity to come from renewables by 2030. This achievement will be based on the current development and potential in the country. It was anticipated in 2015 that non-utilities or independent power producers would produce about 185 TWh. Their growth rate over time has also been nine per cent. In order to meet its needs, India additionally bought five TWh of power from Bhutan in 2015.<sup>15</sup> The country can also produce up to 84,000 MW from hydro. Thus, the government intends to expedite a hydro development plan in which it seeks to construct 50,000 MW of additional capacity by 2026, with the majority of the capacity centred in the southern region. At the 2015 Climate Summit in Paris, a "Solar Alliance" was also proposed, with the objective of increasing its renewable generating capacity to 175 GW by 2022. According to the Ministry of New and Renewable Energy, India had achieved until now an installed renewable energy capacity of 137 GW, which includes 85 GW of solar power, 38 GW of wind power, 10 GW of bio-power, and 4 GW of small hydropower. In order to achieve the 175 GW target, the has taken several steps, including reducing tariffs for wind and solar power, providing financial incentives and subsidies, and implementing various policies and schemes to promote the use of renewable energy. India has also set a target of achieving 40 per cent of its total installed power capacity from non-fossil fuel-based energy resources by 2030 as a part of its National Action Plan on Climate Change. Despite the challenges of the COVID-19 pandemic, India continues to make progress towards its renewable energy targets.<sup>16</sup>

The Indian grid is connected with those of Nepal, Bhutan and Bangladesh already, and there are ongoing plans to be connected with Sri Lanka through undersea cables. There is also a plan for the interconnection of ten ASEAN countries and Southeast Asia that would eventually result in improving the accessibility of electricity and the economy of the countries involved. In such a huge interconnection plan, all parties will benefit from efficiency, dependability, and resilience by connecting smaller power systems to create a larger power pool or regional grid. The interconnected grids will ensure that resources are used efficiently and that the unexpected electrical demand is met without disturbing the networks. The excess capacity that must be set aside

for demand during peak hours can, in general, be drawn from another area where the peak may occur at other times in an interconnected system due to peak and non-peak hours in every power system. If two power systems are integrated, the capacity needed in the event of a power plant or transmission line failure, can be immediately supplied. In a large power pool, the likelihood of a grid collapse is far lower in the event of disasters, both natural and man-made.

Looking at the Indian and GCC interconnection, we can observe some similarities. Both regions have rapid growth potential in electrical demands and are planning to integrate more renewable energy into their energy mix. They also have electrical interconnections and are eager to expand them with other regions to maximise their benefits, which include reducing the cost and stabilising their electrical networks. In the following section, attention is drawn to the electrical interconnection between India and GCC in order to explore the possibility of future cooperation through cross-border connections between the two regions.

### **Future Perspectives for GCC and India Interconnections**

The development of an electrical interconnection is a strategic project that requires a deep understanding of electrical profiles of the parties involved. As for the GCC countries, the main reason behind their electrical interconnection is to support their electrical grids during emergencies and blackouts. The success of their cooperation boosts the mandate of its interconnection for further cooperation related to minimising the cost of spinning reserves and creating a power-trading platform between the member states. In the case of India, the cause of its rapid progress in establishing its interconnection with other countries is the need to increase the acceptability of electricity and to cover the growing electrical demands. This section will cover the electrical interconnection within the GCC and India, and attempt to shed some light on the benefits of a future interconnection between the two regions.

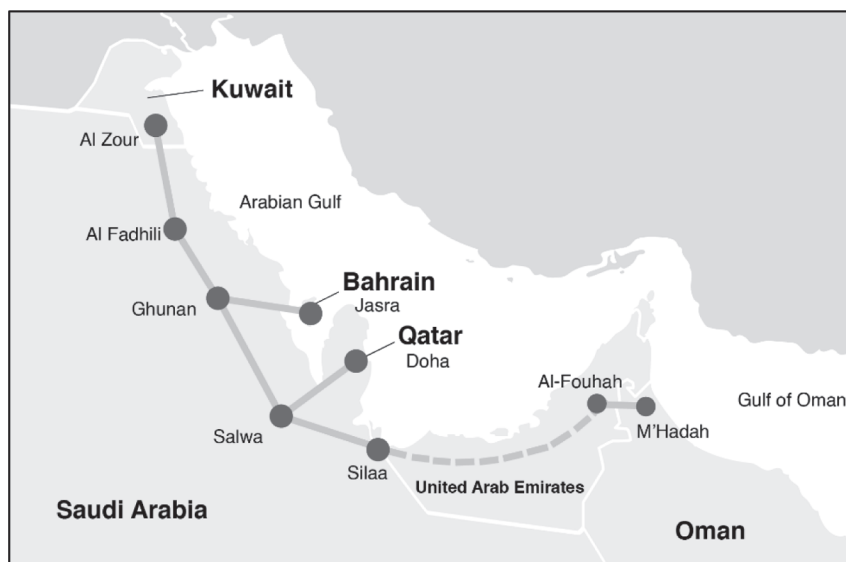
#### *GCC Electrical Interconnection*

The GCC nations had come up with GCC Interconnections to strengthen their local networks and reduce the possibilities of full or partial blackouts. Furthermore, the countries need to face the rising power demands brought on

by the rapid population, commercial, and industrial growth in their respective nations. In addition, the GCC governments have started to restructure their electrical market by encouraging the private sector to invest in this lucrative business. This is because they were aware of the financial burden of building utility projects to fulfil the growing demand. In order to maintain and operate the GCC power grid, the GCC Interconnection Authority (GCCIA), a power grid authority, was founded by the GCC nations in 2001. By lowering the quantity of reserves required in each nation, and by offering wheeling services and facilitating energy trading, the power grid will reduce the long-term investment costs of building generation plants.<sup>17</sup>

The GCC grid's interconnection architecture combines the "common link" which represents Phase I of the interconnection of Bahrain, Saudi Arabia, Qatar, Kuwait, and the UAE, and the "neighbour-to-neighbour" connection between Oman and the UAE to produce the "hybrid link." Except for Oman, which will require all transactions with the other five GCC nations to use the UAE power system, this "hybrid link" will give all countries direct access to any other system.<sup>18</sup>

Figure 2: The GCC electricity grid



The advantages of the GCC interconnection grid are extensive. Economic benefits include increased energy efficiency, greater supply security, and cost savings through sharing spinning reserves. For instance, the bilateral power trading between the member states exceeded 1.3 million MWh with a value of US\$ 161 million in 2016. Additionally, the link reduces the need for further expenditure on constructing a new power plant, as well as operational and maintenance costs. Saudi Arabia may be able to save more than US\$ 309 million by reducing its total installed capacity by two GW. It is also anticipated that the entire region will save US\$ 180 million in operating fuel expenditures.<sup>19</sup>

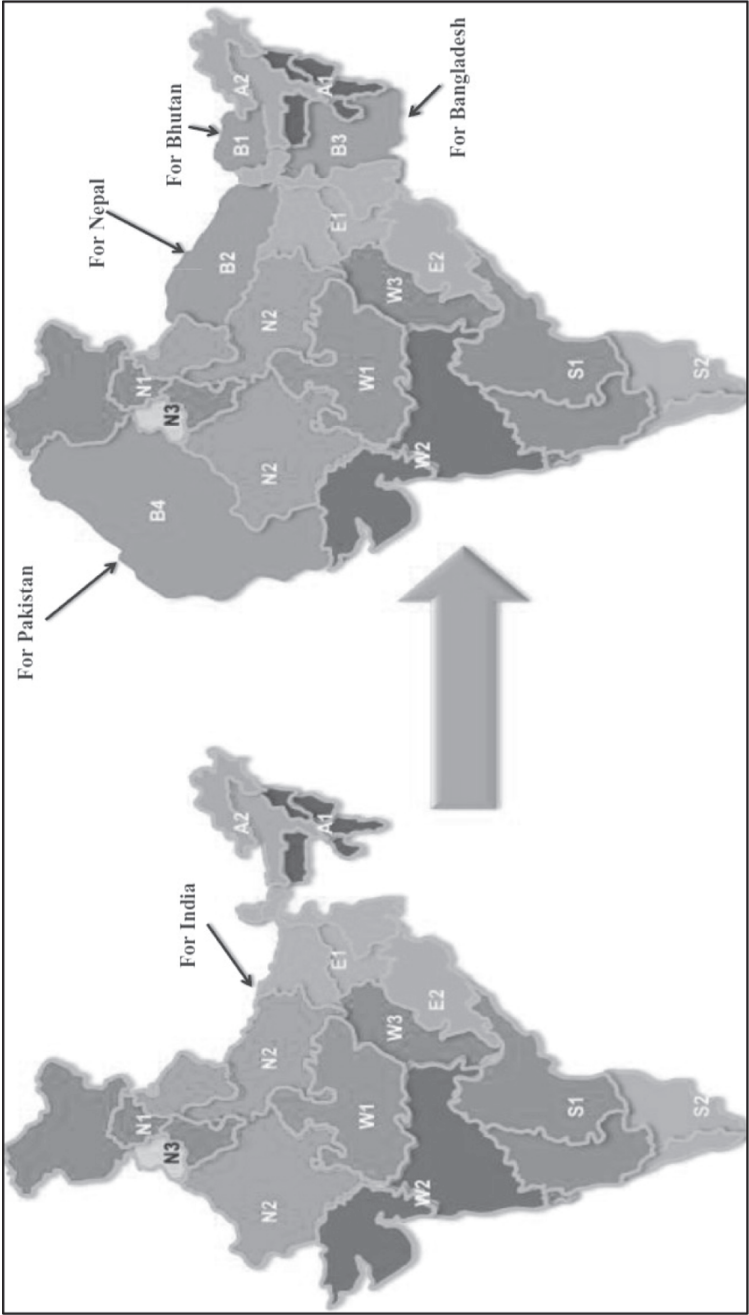
### *India Electrical Interconnection*

India occupies a pivotal position in the South Asian region and has cross-border linkages with its neighbours, which significantly contributes to the efficient use of the region's resources. Additionally, on 18 December 2018, the Indian Ministry of Power released "Guidelines for Import/Export (Cross Border) of Energy-2018" to enable the import and export of electricity between India and its neighbours. The Indian Energy Exchange (IEX) platform, which is an automated trading exchange, is responsible for facilitating country and cross-border power trading. The power producers and buyers can participate in live bidding through the IEX platform, regulated by the Central Electricity Regulatory (CERC). Currently, India is subdivided into 12 bidding areas in five major zones. In the coming years, several interconnections will be structured between India and neighbouring countries such as Pakistan as shown in Figure 3 (Ray and Ro, 2022).

Currently, the Indian grids are connected to Bangladesh, Myanmar, Nepal, and Bhutan. The details of the interconnection are as follows:<sup>20</sup>

1. **India-Nepal:** There are several locations where Nepal and India are connected by 11kV, 33kV, 132kV, and 220kV lines. A 400kV D/C transmission line from Dhalkebar (Nepal) to Muzaffarpur (India) has been built to connect India and Nepal for the transport of bulk power. Through these links, Nepal receives a total of 700 MW of electricity. Additionally, it has been decided to string the second circuit of the 132 kV lines from Kataiya (India) to Kushaha (Nepal), the 400 kV D/C Gorakhpur (India) to Butwal (Nepal), the 400 kV Dhalkebar

Figure 3: Indian Bidding Zones and Cross-Border Interconnection



(Nepal) to Sitamarhi (India), and the 132 kV Raxaul (India) to Parwanipur (Nepal).

2. **India-Bhutan:** Several 400kV, 220kV, and 132kV lines currently connect India and Bhutan, mostly for the import of roughly 2000 MW of power from Tala (1020 MW), Chukha (336 MW), Kurichu (60 MW), and Mangdechhu HEP (720 MW) in Bhutan to India. Additionally, the Punatsangchu-I (1200 MW) and Punatsangchu-II (1020 MW) HEPs in Bhutan are expected to be operational by 2024-2025. There is already a transmission system in place for the transport of power from these projects to India.
3. **India-Bangladesh:** The Baharampur (India) - Bheramara (Bangladesh) 400kV D/C lines and the 2 x 500 MW HVDC back-to-back terminal at Bheramara provide high-capacity connectivity between the two countries. Another 400kV (run at 132kV) interconnection exists between Surajmaninagar (Tripura), India, and Comilla, Bangladesh. Together, these links make it possible to send 1160 MW of power to Bangladesh. Additionally, during the official visit of the Prime Minister of Bangladesh to India, in October 2019, it was decided to build a 765kV double circuit cross-border electricity interconnection between Katihar (India), Parbotipur (Bangladesh), and Bornagar (India) in order to facilitate more intra-regional electricity trade, including competitively priced power produced from hydro-electric power projects in India, Nepal, and Bhutan.
4. **India-Myanmar:** Through an 11 kV transmission line, India is providing almost 3 MW of electricity from Moreh in Manipur to the town of Tamu in Myanmar. It is being jointly developed to strengthen more low-capacity links along the border in diverse locations. Additionally, a high-capacity link between the nations is being proposed.

#### *Future Cooperation between GCC and India*

India used 980 TWh of power in 2015, and its annual growth rate has been 8.84 per cent. When compared to the world's average, which is 2728 kWh, and the Middle East's average, which is 3378 kWh, the electricity use per person in all GCC countries is regarded as one of the highest rates of energy

consumption per person. In 2010, the electricity usage per person in these countries ranged from 5340 kWh to 17610 kWh.<sup>21</sup> The demand for electricity is increasing rapidly with the growing development in both regions. With such a rapid increase in demand, India and GCC countries should consider other available options such as linking the GCC and India through a power grid that will provide energy security, safety, and reliability. It will also save millions which can be spent on the construction of new power generation plants otherwise, and both regions could benefit from this interconnection.

From a technical perspective, the interconnection between two regions is feasible and there are several studies covering the modelling and potential for such a project. For instance, Ray and Ro (2022) in their study proposed two approaches to connect the GCC to India. The first option is through Oman by submarine cables and the second is through Iraq, to Iran, to Afghanistan, to Pakistan, as presented in Figure 4. In addition, the announced projects – particularly the ones related to solar power plants with cross-border interconnection – provide a promising role model to encourage this investment. This could be shown in Singapore’s solar cable that will provide the country with 14GW from a solar power plant in the Australian deserts. The submarine cables between the two countries will be 4300 km long (high voltage DC). Another project with 3800 km of submarine cables will be between Morocco and the UK to supply the former with solar and wind energy.

Figure 4: Options for the GCC Interconnection to India



No doubt that the power exchange, if planned extensively, could potentially provide involved stakeholders access to a very dependable, carbon-free power supply. At the same time, it can spur the transition to a low-carbon economy and open new markets for renewable energy.<sup>22</sup> There are three main benefits of the proposed interconnection of the GCC and India: cheaper electricity costs, lower emission levels, and increased supply reliability. Such interconnection is also justified in providing reliable electricity and security. For instance, the sun sets on average at 18:00 hours in India, where the evening peak lasts from 17:30 hours to 21:00 hours. The remaining three hours' worth of electricity must still be transported. These additional hours would be available through interconnection with the Gulf region. The time difference would be much more advantageous if transmission lines were to be extended even further, for example, between North Africa and South Asia. Additionally, India may have a great export opportunity in renewable energy. There would be a surplus during the monsoon season when there are plenty of hydroelectric resources, which could be traded to the Gulf as necessary. With the potential to become a hub for the trade of renewable energy, India is in a unique position to gain from this type of electrical interconnection. Cross-border interconnections comprise a crucial component of the infrastructure required to make the transition to a net-zero planet. Thus, they provide motivation to achieve the initiative: One Sun, One World, One Grid.<sup>22</sup>

Furthermore, this interconnection between the GCC and India could contribute positively to the deployment of renewables to neighbouring regions. As the proportion of variable renewable energy (VRE) resources on the grids has increased, interest has grown in the relevance of regional grid connectivity. If the Association of Southeast Asian Nations (ASEAN), the South Asian Association for Regional Cooperation (SAARC), and the Gulf Cooperation Council (GCC) interconnection have a common connection, then all regions will benefit by allowing for the sharing of electricity between them. This will provide demand flexibility and access to a variety of generation resources. In simple terms, it means that the interconnection will enable the two regions to better manage their electricity supply and demand by sharing resources, which will lead to more efficient use of energy and help to meet the varying electricity needs across the regions. Due to the diversity of demand profiles, opportunities for profitable energy exchange exist in both power shortage and surplus

circumstances. These variations are caused by seasonal variances, as well as varying weekend events and holidays in each connected country, in addition to the differing time zones.

There is a five-hour time zone difference between the western end of the GCC grid and the eastern portions of the ASEAN grid, which can be effectively utilised in the interconnected operations. Solar generation will be at its highest in the ASEAN and GCC regions as the evening peak begins in the ASEAN region. Later, the base load plants in the ASEAN grid might support it as the night-time peak load rises in the western part of India and the GCC region. Moreover, based load strategies in the SAARC area can support the morning peak in ASEAN. This system of interconnected operations aids in both the effective functioning of base load facilities throughout the world and the incorporation of renewable energy sources. When the GCC nations have tens of gigawatts of solar energy, the hydro generation in SAARC and ASEAN could also improve the quality of electricity in the GCC system. Through the supply of clean solar, wind, and hydro-electricity, the link may also have the ability to decrease the consumption of fossil fuels in these areas.

It is essential to mention here that there are several initiatives that could be suggested to increase the level of cooperation between the two regions in the power sector. At the moment, stakeholder engagement could initiate the project; stakeholders include transmission experts, politicians, public authorities, environmentalists, energy research institutes, regional/national NGOs and the public. Such engagement will not only allow doors to be opened for better innovative ideas but also reduce the gap between industries and the public. For instance, in some of the European countries, there are web links made for public consultations on power grid development plans.<sup>23</sup> It will also be beneficial to investigate the potential for more comprehensive and strategic cooperation, which will cover several sectors and strengthen the economic ties between the two nations.

## **Conclusion**

The GCC and India's electrical networks are on a long journey to develop their electrical grids and increase the share of renewables. The concept of cross-border interconnection between the two regions was discussed in this chapter with an emphasis on the potential benefits. The chapter also explored

electrical profiles and renewable targets, as well as the established interconnection in each area. Both cases are being developed with differing drives. They are heading to the future with similar visions for diversifying their energy mix and reducing their greenhouse emissions. Both regions are also facing rapid electrical demands, an increase in their populations and growing economies. The efforts should be directed towards increasing awareness about the benefits of the interconnection between the two regions and establishing a dialogue among the concerned stakeholders.

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