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Forging a Unified Path: Energy Security and the Drive for Collaborative Consensus

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"Energy" tries to meet all the demands of the society. Consequently, "Energy" is a prerequisite for the development in different fields, whether cultural, economic, political, or social. Bearing in mind that traditional energy resources are used currently for satisfying needs related to everyday life, the existing energy resource reality falls short of supporting humans' energy needs, which are growing rapidly. Afghanistan, Bangladesh, Bhutan, the Maldives, Nepal, India, Pakistan, and Sri Lanka are today considered to be a part of South Asia. Many South Asian countries are included in the global level of the list of rapidly emerging and developing countries. These are also considered to be the centers of an emerging middle-class population, and the consumption of primary energy has increased to a substantial level due to better economic status and higher per capita income. According to the SAARC, more than 1.5 billion people, or about 24% of the people worldwide, live in these countries.

However, the consumption of the primary energy of South Asian countries varies a lot in both amount and structure. Each country in the region uses energy differently based on various factors, namely access to energy, economic and commercial viability, the region's fundamental geopolitical position, the volume of trade in the energy sector, and the tools available for energy analysis. The trade in diesel-powered automobiles has also seen to boost in the recent period, jumping from 4% to 11%. Energy reserves in developing countries are fast getting depleted (Rahman & Velayutham, 2020). The emissions and effluents generated by combusting fuel obtained from petroleum harm the atmosphere as well as human health (Koçar & Civaş, 2013; Mekhilef et al., 2011). South Asia is blessed with a range of abundant natural energy resources, including coal, wind, thermal, water, gas, solar, and geothermal energy (Abas et al., 2017). The country has abundant natural resources, with proven coal reserves of 133,237 million tonnes, hydropower potential of 296,431 MW, natural gas reserves of 85 Tcf, and high renewable potential from solar (365,639 MW) and wind (378,594 MW) sources (Abas et al., 2017; Gulagi et al., 2017). However, the region is rich in energy resources, yet some South Asian countries are facing severe electricity shortages and frequent blackouts (Rehman & Rashid, 2017). Because of the presence of energy resources in the region, governments in South Asian countries are incentivized to increase their usage of renewable energy sources (Gulagi et al., 2017; Mansoor et al., 2019). To ensure a sustainable energy mix, the countries have initiated a lot of programs and measures, and at last, some of these programs have met with success. To reach the stated goals, however, constant progress is needed.

Bangladesh consumes less energy on a per-person basis (Islam & Khan, 2017). The growth of the country's energy policies, the deepening energy crisis, and the quest for alternative energy sources are all affected by India's rapid economic growth and expansion. India uses 6% of the world's primary energy utilization with coal being the major source of fuel according to Sahoo (2016) and Manju & Sagar (2017). The Jawaharlal Nehru National Solar Mission (2010) estimates approximately 22 GW of

grid-connected solar electricity to be in place by the year 2022 through the implementation of numerous solar power projects. India has been aggressive enough to commit itself to making the Nationally Determined Contributions (INDCs) of 100 GW of solar power capacity over the next few years to make the necessary contributions in combating the menace of climate change. An energy strategy is a prerequisite for a developing country like the Islamic Republic of Pakistan, considering its population growth. It has had specific programs within the rounds of the country's energy policy that included the owner policy, energy conservation and efficiency policy, environment policy, petroleum policy, and renewable energy policy (Irfan et al., 2019). There are also plans for the optimal utilization of renewable energy in Pakistan under the Alternative and Renewable Energy Policy 2019 (ARE Policy 2019) that goes further to enhance aggressive electricity pricing in the industry. According to the Alternative and Renewable Energy Policy 2019, the year 2019, the Government of Pakistan (GOP) plans to develop renewable energy by a capacity-driven by approximately 20% by the year 2025 and by at least 30% by the year 2030.

Fig. South Asian countries' electricity consumption and uses

Country	Energy consumed (million tons of oil equivalent)	Fossil fuels (% of total use)	Combustible renewable and waste (% of total use)	Alternative and nuclear energy (% of total use)	Energy produce (million tons of oil equivalent)	Energy Use − Energy production (Mtoe)
India	749.4	72.3	24.7	3	540.9	208
Sri Lanka	10.4	48.7	47.4	3.9	5.3	5.1
Pakistan	84.8	60.9	34.6	4.5	65.1	19.7
Afghanistan	–	–	–	–	–	–
Bangladesh	31.3	71.5	28.2	0.2	26.1	5.2
Nepal	10.4	12.5	84.1	2.7	9	1.4

Fig. Electricity Generation in South Asian Countries

Country	Electricity production (kWh billion)	Coal (% of total)	Natural gas (% of total)	Oil (% of total)	Hydropower (% of total)	Renewable energy (% of total)	Nuclear power (% of total)
India	1052.3	67.9	10.3	1.2	12.4	5	3.2
Sri Lanka	11.6	8.9	0	50.2	39.7	1.2	0
Pakistan	95.3	0.1	29	35.4	29.9	0	5.5
Afghanistan	–	–	–	–	–	–	–
Bangladesh	44.1	1.8	91.5	4.8	2	0	0
Nepal	3.3	0	0	0.1	99.9	0	0

South Asia is the most densely populated place in the world. For example, the region houses approximately one-quarter of the world's people while its area is less than 3.4% of the world's area. Thus, over 1.7 billion people are therefore unable to subsist due to the environmental degradation that is being experienced. The rapid growth of population, industrialization, and urbanization continue degrading the already existing conditions and are seen as the disaster zones of climate change disaster (Intriligator, 2015). South Asia will, therefore, find itself in the deadly effects of climate change. It will come along with the concerns of the scarcity of water, the unpredictability of the monsoons, the failure of the crops, and the rise of temperature. Such changes, which the environment undergoes are a threat to human life, in that the groundwater levels will go down, while land degradation will increase. Such changes, while threatening the environment, also pose risks to the safety of our food, water, and energy security, foster the emergence of new diseases, and endanger the security of all three. The climate changes affect the various ecosystems. It will result in much competition over dwindling resources and intensification of rural-urban migration due to the strain that climate change is exerting on traditional lifestyles.

Over the last decade, South Asia has seen an escalation in the detrimental impacts of climate change-related disasters. These disasters could worsen in the future (Mohsin, Rasheed, et al., 2019). In 2010,

Pakistan experienced an unprecedented flood. Unexpected monsoon rains caused the displacement of tens of millions of people in India, Bangladesh, and Nepal, resulting in 1,200 deaths. In 2015, heatwaves—a recurrent climate calamity in South Asia—resulted in the deaths of 1,250 people in Pakistan and 4,620 in India. Environmental scientists agree that these disasters are all driven by climate change. For example, the region is facing severe consequences from climate change: over the next 40 years, rising sea levels are expected to submerge 17% of Bangladesh and the Maldives, displacing 18 million people. Additionally, 1.7 mm of monsoon-related erosion is predicted, which will significantly affect the agricultural capabilities in Pakistan and Nepal (Rahman & Velayutham, 2020).

Currently, only 5.9% of the world's energy is consumed in South Asia. The International Energy Agency projects that the energy needs of South Asian countries will triple in the coming decades. According to predictions by Mohsin, Zhang, et al. (2019), India alone is expected to see a 140% increase in energy demand, compared to a 55% global increase. Oil consumption in South Asian countries is expected to rise by 6%. The largest crude oil reserves in South Asia are located in India.
In comparison with Pakistan's 324 million barrels, Sri Lanka has 150 million. India will deplete its oil reserves in less than 30 years if it continues consuming oil at the current rate. India's natural gas reserves total 39 trillion cubic meters, Pakistan's 33 trillion, and Afghanistan's 15 trillion. Tragically, Bangladesh has depleted a substantial portion of its oil reserves, as noted by Abbas et al. (2018). Bangladesh, Pakistan, and India are the only nations in the region producing natural gas, with reserves-to-production ratios of 16, 21, and 35, respectively. Of the 223 million tonnes of biomass produced throughout South Asia, India contributes the largest share (Khan, 2020).

Per-person energy consumption varies from 119.8 kWh in Afghanistan to 635 kWh in India and Sri Lanka (Ahmed et al., 2017). Over a third of South Asia's 1.3 billion population, or 417 million people, live without power, reflecting an average regional electrification rate of 74%. Thirty-eight percent of the population has access to non-solid fuels. Bangladesh, the Maldives, and Bhutan have access rates of 9%, 92%, and 60% respectively, surpassing the global average of 59% (Mohsin et al., 2018). Except for Pakistan and Sri Lanka, nearly all South Asian countries rely on a single source for over 50% of their electricity: the Maldives generates 99% of its electricity from oil, Nepal 99% from hydropower, Bangladesh 82% from natural gas, and India 57% from coal (Timilsina & Toman, 2018). Despite having significant local coal reserves, India also imported 28 million tons of coal in 2015 due to insufficient domestic supplies (Nepal & Paija, 2019).

Power Partnership in South Asia

Access to electricity improved in the new millennium in South Asia, from 57 percent in 2000 to 80 percent of the population in 2014. Nevertheless, despite the noted improvement, in 2014, 343 million people in South Asia (including 270 million in India) were living without electricity. World Bank estimates suggest that South Asia is likely to achieve universal electricity access by 2030. Strengthening cross-border electricity cooperation in South Asia can be part of the solution for providing adequate and reliable electricity to a population that remains outside the electricity grid because there are complementarities in electricity demand and resource endowments and differences in seasonal patterns of supply and demand. In addition, increased electricity cooperation and trade among countries can bring economies of scale in investments, strengthen electricity sector financing capability, enhance competition, improve sector efficiency, and enable more cost-effective renewable energy cooperation (Singh et al., 2015).

The size of India's domestic electricity demand, and its geographic as well as economic centrality in the region, makes it an indispensable player in driving (and blocking) trans-border electricity cooperation. No other South Asian states share borders except with Afghanistan and Pakistan, and they

are connected to India. Thus, bilateral cooperation between India and other states contributes to creating a regional grid and promotes regional cooperation. Thus, keeping India at the center of this section, we attempt to take a synoptic view of energy cooperation efforts between South Asian states.
Nepal and Bhutan are well-known for their abundant hydropower resources, making India's involvement in generating and importing electricity from these countries a logical step. The history of India-Nepal trans-border electricity cooperation dates back to the 1920s, with significant projects like the Kataiya powerhouse and the Trishuli, Devighat, and Phewa hydropower projects, all supported by India both financially and technically. In 1971, Nepal and India solidified their partnership through a Power Purchase Agreement that facilitated electricity supply across their borders. In 1996, both nations further committed to an integrated development of the Mahakali River basin, which included projects like the Sarada Barrage, Tanakpur Barrage, and Pancheshwar.

In 2014, India and Nepal expanded their collaboration with a new power trade agreement, recently completing significant projects like the double-circuit transmission corridors between Dhalkebar-Muzaffarnagar and Hetauda-Duhabi. Over 20 interconnections now facilitate robust power exchange and trade. Seasonal power shortages in Nepal and rising demand have led to significant electricity imports from India, with India supplying 350–370 MW of power to Nepal. Both countries are also exploring ambitious plans to construct 20,000 MW of hydropower projects in Western Nepal, a move expected to substantially increase electricity trade between the two countries.

India-Bhutan electricity trade has a more recent history compared to Nepal. The Indian government sees the India-Bhutan electricity partnership as a win-win situation that provides a reliable, adequate, and inexpensive source of clean electricity to fuel India's economy, while giving Bhutan the export revenue it needs to sustain and increase social sector expenditures, thereby promoting economic integration between the two countries. The cooperation officially began in 1961 with the signing of the Jaldhaka Agreement. The first hydropower project under Indian assistance in Bhutan was commissioned in 1967. In the 1970s and 1980s, India constructed electricity connections from the states of Assam and West Bengal to Bhutan's bordering regions to extend electrification.

India has constructed three hydropower projects in Bhutan, generating 1,416 MW of electricity. A significant agreement in 2006 outlined further cooperation in hydropower, committing India to develop at least 10,000 MW of hydropower by 2020 in Bhutan and to purchase any surplus electricity. Currently, India is developing three additional hydropower projects under an inter-governmental model, expected to produce 2,920 MW. In 2014, the two countries also agreed to implement four more projects under a Joint Venture model, which would collectively produce 2,120 MW of electricity.

India engages with both Nepal and Bhutan in electricity cooperation, yet the dynamics of these relationships differ significantly. Bhutan has been a substantial electricity exporter since 1995, exporting about 75% of its electricity, mainly to India, where trade has increased over the years. In contrast, electricity exchanges with Nepal have not shown significant growth due to a lack of commercial initiatives and Nepal's inability to fully harness its hydropower resources. As a result, Bhutan exported 5,556 Gigawatt-hours to India in 2013–2014, while Nepal imported 793 GWh from India.

Besides Nepal and Bhutan, India also has electricity trade ties with Bangladesh, which faces a significant power deficit due to increasing demand and insufficient generation capacity. In 2010, Bangladesh and India agreed to establish a 400 kV, 30 km double-circuit transmission line and a 500 MW substation in Bangladesh. In 2012, Bangladesh signed a 25-year agreement with India, securing an initial supply of 250 MW, which was later expanded to include an additional 500 MW starting in 2018. Furthermore, the two nations are collaborating on a 1,320 MW coal-fired power plant. The close

geographic and economic interdependence of India's eastern regions with Nepal, Bhutan, and Bangladesh creates potential for subregional cooperation across various sectors including energy, trade, and connectivity, supported by the Asian Development Bank's South Asian Subregional Economic Cooperation (SASEC) program.

Like India's eastern neighbors, Pakistan and Sri Lanka are potential partners for electricity cooperation with India. Pakistan shares a border with India, making it geographically contiguous, whereas Sri Lanka, though separated by the sea, is relatively close to the Indian mainland. This geographical proximity suggests the potential for exploring electricity supplies from India to both nations. In the past, there have been discussions about electricity trade between these countries: in 1998–99, the discussion was about supplying surplus power from Pakistan to India, and more recently in 2012–13, the dialogue shifted to a proposal for India to supply 500 MW to Pakistan. However, neither of these proposals was brought to fruition.

For Sri Lanka, a report by the Asian Development Bank highlights that an electrical interconnection with India could provide a long-term solution to meeting peak electricity demands, enhance system reliability, and better utilize Sri Lanka's hydropower resources. Despite this potential, actual electricity cooperation between India and Sri Lanka has yet to materialize.

Afghanistan faces a severe electricity shortage, with only 270 MW of installed capacity. The country's northern regions primarily receive their electricity from Central Asian states such as Turkmenistan, Uzbekistan, and Tajikistan, while parts of western Afghanistan are supplied by Iran. Additionally, there is a proposal to build a Central Asia-South Asia (CASA)-1000 electricity link project, which could further integrate Afghanistan into regional energy markets.

The CASA-1000 project aims to link Tajikistan, the Kyrgyz Republic, Afghanistan, and Pakistan to form a regional electricity market. Tajikistan and the Kyrgyz Republic, with their surplus hydropower potential, are poised to supply power to Afghanistan and Pakistan. Initiated in 2016, this project is slated for completion by 2018. It is recognized as economically viable and has received strong support from the World Bank and the Asian Development Bank (ADB). There are also expectations to bring India into the project, expanding its regional impact.

However, the progress on regional electricity cooperation has been less than satisfactory. The scope and depth of such cooperation vary significantly across regions, making South Asia's situation unique and not directly comparable to other regional electricity grid and market integrations. It is generally observed that regional electricity cooperation for market integration often follows bilateral cross-border electricity trade arrangements. More advanced frameworks may involve shared generation of assets and multi-country trading through integrated competitive markets, suggesting potential for deeper integration and cooperation in the future.

Despite various efforts, South Asian regional electricity cooperation still falls short of its potential due to three main obstacles. Firstly, the unstable regional political climate significantly hinders broader electricity trade. Domestic politics and historical tensions, particularly exemplified by the lack of electricity trade between India and Pakistan, inhibit cooperation. Secondly, there is an absence of a cross-border regulatory framework, which complicates the seamless and stable operation of transmission systems. As regional electricity trade expands, there is a critical need to synchronize technical, legal, and commercial regulatory aspects across the region. Lastly, the presence of tariff and non-tariff market barriers imposed by participating countries increases the costs of electricity exchange and negatively impacts the overall growth of regional electricity trade. These three factors collectively slow down the progress in expanding regional electricity cooperation.

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