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# Transforming Regional Electricity Markets in South and Southeast Asia for a Greener and More Sustainable Future

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Electricity grids were an important technological invention. They marked an advance that helped humanity think beyond its self-drawn boundaries of community and enabled countries to partner together to develop integrated electricity grids. Today, in the various regions around the globe, approximately twenty regional electricity grid integration initiatives are at various stages of development and market integration. In any region, the development of regional electricity markets (REMs) reflects the level of integration, which is strongly influenced and shaped by prevailing political, economic, social, and cultural factors. Countries have gradually overcome various challenges and have deepened grid integration through cross-border electricity trade (CBET) and come up with REMs.

A large, interconnected grid across a subregion, region, or continent can bring far-away resources to the load center and exploit diversity of peak hours and time zones, among other factors. Such an interconnected grid facilitates large-scale integration of renewable energy with a larger balancing area and contributes to efforts to fulfill clean energy transition priorities. With looming climate change threats and the urgent need to tap renewable energy at scale, the role of electricity grid integration has resurfaced as a mechanism to contribute to climate change mitigation and facilitate large-scale decarbonization in a sustainable and economical manner. While physical infrastructure like power generation and transmission facilities is the basic requirement, translating the potential benefits of grid integration into reality depends on the regional power market design and associated political and regulatory governance. This essay explores electricity grid integration in South and Southeast Asian countries and provides realistic perspectives on the development of REMs.

## Efforts to Integrate Electricity Grids in South and Southeast Asia

*South Asia.* South Asia is the least integrated region in Asia. It comprises Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka and is home to nearly one-fourth of the world's population. While South Asia used to be an electricity-starved region, governments have prioritized electricity sector expansion, and most of the countries (except Afghanistan) now have close to 100% electricity access.

- South Asia's total power installed capacity has increased from only 190 gigawatts (GW) in 2010 to 449 GW by 2020.<sup>1</sup> Almost 85% of this total capacity is in India.
- Total capacity of South Asia includes coal (49%), renewable energy (21%), and large hydro (14%).<sup>2</sup>
- Bhutan and Nepal are almost 100% dependent on hydropower.
- Bangladesh relies on natural gas (57%), and dependence on coal is highest in India (55%).<sup>3</sup>
- Pakistan relies on coal (27%) and oil (31%), whereas Maldives is almost entirely dependent on oil-based power generation.<sup>4</sup>

Interestingly, South Asia is blessed with abundant renewable energy resources. In terms of hydropower,

it has around 350 GW of potential, of which only 18% is tapped.<sup>5</sup> The region also has around 939 GW of solar power potential, of which only 3.8% is developed, and around 1,289 GW of wind power potential, of which only around 3% is developed.<sup>6</sup> South Asian countries have prioritized the expansion of renewables and announced net-zero targets.<sup>7</sup> India has come up with what is arguably the world's most ambitious expansion target—500 GW of non-fossil energy capacity by 2030.<sup>8</sup> As of 2020, total installed capacity of renewable energy in the region was 155 GW including hydro and 94 GW excluding it.<sup>9</sup>

South Asian countries have a long history of electricity cooperation and integration of their power systems, with the 1954 India-Nepal Kosi agreement and the 1961 India-Bhutan Jal Dhaka agreement. Currently around 27 cross-border interconnections at various voltages exist among Bhutan, Bangladesh, India, and Nepal. Peak CBET increased from around 1,400 megawatts (MW) in 2012 to 3,760 MW in 2020. Around 1,160 MW is exported from India to Bangladesh, whereas CBET between India and Bhutan and India and Nepal is around 2,100 MW and 500 MW, respectively.<sup>10</sup> The total CBET in South Asia was 296 gigawatt-hours (GWh) in 2000, which increased to 7,705 GWh in 2014 and 18,740 GWh in

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2021. Currently there is no physical interconnection between India and Sri Lanka and India and Pakistan due to various geographic, political, and economic factors. Rapid expansion in cross-border transmission interconnection (CBTI) is envisioned. CBET is the amount of electricity traded, while CBTI is the cross-border transmission capacity. By 2040, CBTI capacity could be nearly 40 GW, which would be a tenfold increase from the current level of around 4 GW.<sup>11</sup>

The South Asian Association for Regional Cooperation (SAARC) has been the regional intergovernmental platform for deepening electricity grid integration since the signing of the SAARC Framework Agreement on Energy Cooperation (Electricity) in 2014. Yet the Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC) is emerging as an attractive platform with the signing of the Memorandum of Understanding (MOU) for Establishment of the BIMSTEC Grid Interconnection in 2018. As BIMSTEC has members from both South and Southeast Asia, it could play an active and constructive role in the integration of the two regions' power systems and electricity markets.

*The ASEAN power grid.* The Association of Southeast Asian Nations is a strong and active regional cooperation organization consisting of Brunei Darussalam, Cambodia, Indonesia, Myanmar, Lao PDR, Malaysia, the Philippines, Singapore, Thailand, and Vietnam. Electricity is an important area of cooperation. As of 2020, the ASEAN region had 282 GW of power installed capacity.<sup>12</sup> The three dominant economies (Indonesia, Vietnam, and Thailand) accounted for much of the total coal (31.4%), gas (30.9%), and hydro (20.9%) and contributed more than 80% of the total power installed capacity of all ASEAN countries. The ASEAN region also has substantial renewable energy potential: 37.7 GW of

biomass, 240 GW of hydro, 33.3 GW of geo-thermal, 8,119 GW of solar, and 342 GW of wind sources.<sup>13</sup>

ASEAN has been pursuing CBTI for sustainable optimization of diverse energy resources and has a long history of CBET. Imports by Thailand from Lao PDR started in 1971, and imports by Lao PDR from Thailand date back to the 1990s. An MOU between Thailand and Lao PDR was signed in 1993 to export hydropower from Lao PDR to Thailand for up to 1,500 MW.<sup>14</sup> Cambodia has imported from Lao PDR since 2010, Thailand since 2009, and Vietnam since 2008.<sup>15</sup> The MOU on the ASEAN Power Grid was signed by ASEAN members on August 23, 2007.<sup>16</sup>

There has been significant progress in cross-border electricity grid interconnection as part of the ASEAN Power Grid. Grid interconnection exists between Lao PDR and Thailand, Lao PDR and Vietnam, Lao PDR and Cambodia, Thailand and Cambodia, Vietnam and Cambodia, Peninsular Malaysia and Singapore, Thailand and Peninsular Malaysia, and Sarawak (Malaysia) and West Kalimantan (Indonesia).<sup>17</sup> Myanmar, Lao PDR, and Vietnam all have grid interconnection with China, which is a part of the Greater Mekong Subregion. As of April 2020, the ASEAN Power Grid had 7.7 GW of CBTI capacity, and in the future its capacity is expected to increase to around 26–30 GW.<sup>18</sup>

## Motivation and Challenges of Grid Integration and REM Development

Broadly speaking, the key motivations for integration in South and Southeast Asian countries are regional cohesion, optimal development of diverse and distributed energy resources, energy availability and affordable electricity, access to resources and markets beyond borders, integration of increasing shares of renewable energy sources,

and competitive electricity price discovery through market platforms. This in turn provides various benefits such as economic and financial gains, technical and system operational benefits, a better economic environment and social development, new investment avenues, and geopolitical and strategic dividends, all of which collectively lead to sustainable development, regional peace, prosperity, and stability. With a focus on renewable energy, cross-border interconnection can also act as a major source of flexibility, an enabler of renewable energy development and integration for a greener and more sustainable future.

Yet, while there are benefits, grid and market integration face challenges. The scale of challenge is very complex in developing regions like South and Southeast Asia. Unlike in the developed world, grid integration is taking place in an extraordinarily complex political and economic environment where industrialization, decarbonization, infrastructure building, domestic power market reform, and deployment of renewable energy are happening simultaneously along with poverty reduction and enhancement in economic and social wellbeing. Negotiations on any integration are politically complicated by tension between regional and national interests, which has limited the level of integration among South and Southeast Asian countries. Different levels of policy, regulatory, market, technical, and commercial frameworks also pose obstacles, and calls for harmonization often see resistance.

For REM development, policymakers encounter concerns over sector restructuring, desire to trade after self-sufficiency, market domination by large countries, and “market for me” syndrome (designing markets only for national rather than regional benefit). It often revolves and evolves around

issues of energy security, energy interdependence, and geopolitical and strategic realities. Concerns over related grid security, especially cybersecurity threats, are further constraining integration. Despite these challenges, because of the larger strategic, economic, and geopolitical implications, various global visions, concepts, and initiatives have evolved over the years. A recent example is the One Sun, One World, One Grid initiative to tap renewable energy resources through grid integration.

### **Models of Cross-Border Electricity and Regional Market Development Integration**

Subregional CBET initiatives in South and Southeast Asia are at an early stage of development and vary significantly from each other. During the early stage, simple interconnection (unidirectional or bidirectional) with a bilateral nonmarket mechanism (negotiated price) is preferred by the participating countries. It is often noted that interconnections are extensions from a generation facility in one country to a load center in another country. For example, in the Greater Mekong Subregion, cross-border transmission lines have been primarily developed with the intention to facilitate CBET from individual plants to significant load centers, and in most cases these load centers are not fully interconnected with an integrated national grid system.<sup>19</sup> It is also often noted that this limited form of integration (i.e., a bilateral and nonmarket form of CBET) evolves into a multilateral form with varied market integration.

One example of a project with some momentum toward a deeper form of integration is the Lao PDR-Thailand-Malaysia-Singapore Power Integration Project. The project is the first CBET scheme in the ASEAN region that has enabled trilateral and



eventually multilateral CBET. Malaysia purchases electricity up to 100 MW from Lao PDR via the transit/wheeling country (Thailand) by using its existing transmission grid. In terms of the legal and contractual framework, a tripartite agreement known as an energy purchase and wheeling agreement (EPWA) was signed by EDL (Lao PDR), EGAT (Thailand), and TNB (Malaysia) on September 27, 2017, at the 35th ASEAN Ministers on Energy Meeting. The EPWA governs the sale, transit, and purchase of electrical energy. During a subsequent meeting in October 2018, all parties agreed to increase the capacity up to 300 MW.<sup>20</sup> More recently, Keppel Electric and EDL signed a two-year power purchase agreement that allowed Singapore to begin importing renewable energy from Laos through Thailand and Malaysia in June 2022.<sup>21</sup>

In South Asia, bilateral CBET dominates through medium- and long-term contracts. Over the years, however, some commercial and market avenues for trade have evolved. The India-Bhutan model is dominated by government-to-government hydropower project development through grants or concessional lending and pricing through negotiation and guaranteed offtake of surplus power by India. While this model continues, a new

model has evolved to develop hydropower projects in Bhutan through joint ventures of public-sector undertakings. It is also hoped that some portion of the power produced from these projects will be sold in a competitive power market. A concession agreement for the first Indo-Bhutan joint venture was signed on June 29, 2020.<sup>22</sup> Similarly, India's power exports to Bangladesh were initially based on government-to-government negotiations. However, Bangladesh has also bought a portion of CBET through a competitive tendering process to select the seller from India.

India's role in CBET and grid integration is crucial due to the country's central geographic location. India has promulgated forward-looking guidelines, regulations, and procedures for facilitating CBET.<sup>23</sup> The "Guidelines for Import/Export (Cross Border) of Electricity" have allowed CBET through Indian power exchanges and trilateral CBET through tripartite agreements. As a first step, Bangladesh plans to import 500 MW of electricity from a hydropower project in Nepal through India. The 1,125 MW Dorjilung hydropower project in Bhutan is also envisioned to be a trilateral project with exports to Bangladesh via India.



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In a major change, Nepal has taken the lead on market-based CBET by importing electricity from the power exchange in India starting in April 2021.<sup>24</sup> Such imports of electricity by a country from a neighboring country's power exchange are not only unique in South Asia but possibly a first of their kind across various subregions of Asia. With the success of imports, Nepal is exporting electricity in the Indian power exchange. Bhutan bought around 240 GWh of electricity from the Indian power exchange in the year 2022. Bangladesh is also expected to trade through India's power exchange platform soon.

This offers a model for South and Southeast Asian countries to take a first step in transitioning to market-based CBET across subregions of Asia with minimal harmonization. However, only a few countries have made advances in power market reform and established competitive national power exchange platforms. Limited market-based CBET is a reflection of the low level of power market reform, sector reform, and competition in the electricity sector in South and Southeast Asian countries. While domestic market reform is not a precondition for market-based CBET, it is highly desirable in developing REMs to reap their full potential.

In the ASEAN region, competitive power market structures only exist in Singapore (wholesale competition) and the Philippines (wholesale competition and partial retail competition). Vietnam is working to create a market platform for electricity.<sup>25</sup> All other ASEAN countries continue to be dominated by the single-buyer model. In South Asia, only India has a power exchange platform in place that allows for wholesale competition. A pilot project to explore CBET through market platforms may be considered among ASEAN countries.

## Policy Options for Developing Regional Electricity Markets

As South and Southeast Asian countries are at an early stage of grid integration and REM development, evolution is expected to be gradual but robust. Bilateral integration will likely be supplemented with trilateral integration, which in turn will give rise to subregional markets and eventually to REMs with market products closer to the time of delivery as the market matures. The following measures would facilitate this process.

*Democratize dialogue and intensify regional institutionalization.* Regional countries can build and maintain political trust and consensus by engaging in continuous dialogue on regional electricity integration and market development across all levels of stakeholders. They can further democratize and institutionalize the process by creating function-specific regional institutions, such as forums and associations of policymakers, parliamentarians, electricity regulators, system operators, transmission planners, consumer organizations, investors and industry bodies, and market entities, to provide long-term sustainability with a strong advisory mandate.

*Harmonize through building consensus.* It is important to recognize and respect varying levels of policy, regulatory, legal, technical, and market frameworks and adopt a gradualist and minimalist approach to harmonizing power markets with an open mind to leapfrog on certain aspects as feasible. To build regional consensus, governments should put in place the basic ingredients for competitive power markets (i.e., transparent scheduling and dispatch, congestion management, ancillary services, and an imbalance management mechanism).

Harmonization and development can be focused on goals such as grid connectivity, regional transmission and pricing, license trading, and regional power market design.

*Promote bilateralism with market features.* Bilateralism will remain a dominant choice for CBET in the immediate future, and existing bilateral agreements can be used to build adequate infrastructure and encourage market-based CBET.

*Foster multilateral trade.* Development of two to three trilateral and multilateral electricity trade projects that share transmission costs in a fair and equitable manner can be prioritized and pursued as “regional pride projects” in order to build confidence and trust.

*Strike a balance between idealism and realism.* Countries should prioritize developing mutual understanding, shared interests, and realistic expectations to navigate from “what should be done” to “what can be done.” The combination of reasonable realism and long-term vision is key to deepening CBET, REM development, and the eventual integration of electricity markets. To this end, countries need to treat and prioritize REM development as a tool for fostering regional approaches to meet climate and decarbonization goals in their policy design and planning.

*Reform and develop domestic power markets.* Taking into account country-specific priorities, countries need to accelerate their power market reforms. Specifically, they must develop wholesale power markets and power exchange platforms gradually alongside reforms focused on renewable energy deployment and grid integration.

*Create a regional electricity grid integration fund.* Countries could create a regional electricity grid

integration fund facility by mobilizing the resources from government, the private sector, multilateral development banks, and climate funds, among other sources, to finance regional projects. In addition to financing large projects, a regional electricity grid integration fund would provide grant-in-aid financing, viability-gap funding for reducing the risk of CBET projects, and blend financing.

*Promote regional power exchange.* Countries should integrate their national power exchange platforms either through market coupling or through the creation of a separate regional power exchange for CBET. Moreover, South Asian and Southeast Asian markets should gradually be integrated.

*Leverage competitive national power markets for CBET.* Countries should allow CBET in national power exchange platforms and offer CBET either as a separate market product or as part of national market products of power exchange across market products.

*Invest more and refocus strategies on power market reform.* Development financial institutions and aid agencies should design regional programs with a focus on power market reform, REM development and integration, and regional institution building and strengthening. ∞

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## Endnotes

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