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Barriers to regional cooperation for grid integration
of large-scale renewable energy in Eastern South
Asia

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1 Introduction

This paper provides suggestions for a new regional research project focused on regional electricity cooperation in Eastern South Asia, to be sponsored by the UK Department for International Development's Applied Research Programme on Energy and Economic Growth (EEG).

South Asian countries are seriously constrained by a lack of adequate and reliable power supply. Rapid growth in demand is outpacing additions to supply. Power shortages are rampant.

Insufficient supply is not due to a lack of resources. Hydropower and sunshine are plentiful in South Asia, and the price of utility-scale solar and wind is rapidly falling (International Renewable Energy Agency (IRENA), 2018).

Huge coal reserves are also available in India. If hydropower and other renewable energy sources are not exploited at a large scale, there is a danger that countries will move to coal (owing to diesel and natural gas being expensive), further increasing local air pollution and jeopardising the Paris Agreement commitment on climate change mitigation. In India, almost all new electricity connections since 2000 were from grid connections: coal fuelled about 75% of the new electricity access and renewables just 20% (International Energy Agency (IEA), 2017).

Several studies have found that the region would benefit from regional electricity integration (South Asia Regional Initiative (SARI), 2016b; Singh *et al.*, 2015; Singh *et al.*, 2018; Timilsina *et al.*, 2015; Wijayatunga *et al.*, 2015). As outlined in Figure 1, Nepal and Bhutan, both rich in hydro resources, are in close proximity to northern and eastern India and Bangladesh – two large markets with significant prevailing and projected power shortages. Myanmar, which also has large hydropower potential and projected growth in demand, could potentially be part of this market too.

Recent studies have also shown that the load patterns in the region are complementary (e.g. Timilsina *et al.*, 2015). There is diversity in energy demand across countries, due to seasonal variations (wet and dry seasons), different holidays and festival seasons, time differences, etc.

Increased regional trade can help to match supply and demand, improving utilisation (both peak and off-peak) of hydropower. Studies highlight numerous potential benefits of regional cooperation for grid integration of large-scale renewable energy in South Asia, including more affordable electricity, improved reliability, reduced air pollution and greenhouse gas emissions, regional electricity security, and the championing of regional cooperation that would serve as a model for other sectors to bring about regional prosperity.

Despite these potential benefits, regional power trade is minimal. To date, there has only been small-scale and bilateral power trade between countries, notably Nepal–India, Bhutan–India, and lately India–Bangladesh.

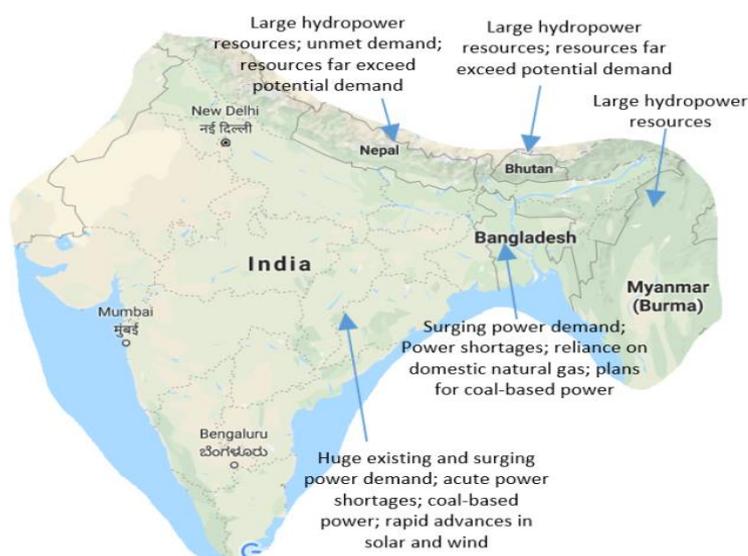


Figure 1: Peculiarities of Eastern South Asia

A wide spectrum of barriers to regional power trade exists, relating to knowledge, planning, financial, investment, political, and technical aspects. These barriers include a lack of evidence-based information on, and knowledge of the benefits and operational aspects of power trade; the nature of changing power markets in the region; the investment climate across countries; unsupportive national electricity regulation; a lack of regional institutional arrangements for trade; geopolitical disputes between countries; and national political opposition. Understanding these barriers in depth is crucial to unlocking the existing potential for regional electricity cooperation.

This study provides detailed insights into these barriers to set out where research must be focused to complement ongoing efforts. The following section outlines our methodological approach. This is followed by Section 3, on current trends in Eastern South Asia's electricity sectors; Section 4, on the benefits of electricity cooperation; Section 5, on the state of power trade in Eastern South Asia; Section 6, on electricity market structures and cross-border transmission capacity; and Section 7, on barriers for regional cooperation on power trade. Section 8 concludes with recommendations for EEG to help unlock regional power trade.

2 Methodological approach

This is largely a desk-based study, which involved collecting existing literature in the region on the topic and carrying out synthetic analysis on what is known and not known, and on what the crucial barriers are to addressing the promotion of grid integration in the region. We have closely tracked not only formal research reports from the United State Agency for International Development's (USAID's) South Asian Regional Initiative for Energy Integration (SARI/RI), but also the recent outcomes and deliberations of SARI/USAID forums. We also reviewed the recent work conducted by the National Renewable Energy Laboratory (NREL) on Greening Grids in India (NREL, 2017), since India sits at the centre of this regional electricity cooperation.

Apart from the desk review of published academic papers, research reports, and the broader literature, this study has closely tracked the deliberations that took place in the following forums:

- the World Bank-convened Power Secretaries Forum (Bangkok, April 2018);
- the International Centre for Integrated Mountain Development (ICIMOD) and National University of Singapore's workshop (Kathmandu, November 2017), which brought together former ambassadors, former power secretaries, current heads of power utilities, government officials, and independent power producers (IPPs), the World Bank, and other independent experts;
- the Nepal Power Investment Summit (2017 and 2018); and
- the South Asia Power Summit (New Delhi, December 2017).

The knowledge gained from the Asian Institute of Technology's 2017 study on the barriers and opportunities for power trade for Nepal, in which we interviewed about 25 people from government, academia and research, the private sector, and donor communities in Nepal, is also reflected in this analysis.

3 Current trends in Eastern South Asia's electricity sectors

Eastern South Asia has made great strides in the rate of electrification in the last two decades, but the region is still host to 29% of the global population who lack access to electricity. In South Asia, 343 million do not have access to electricity.

As more households gain access to electricity, residential demand is rising. India, which currently has an 82% electrification rate, and 239 million people without access to electricity in 2016, is expected to reach full electricity access well before 2025, possibly even by 2020 if the current rate persists. Other countries are also making important progress (IEA 2017). Nonetheless, the level of electricity consumption *per capita* in the region, ranging from 139 KWh to 806 KWh in 2014, is far below the world average of 3,126 KWh (Table 1).

Meeting the demand for productive use of electricity for economic growth remains a further challenge. The region is experiencing steady economic growth of 5% to 7% annually.

Table 1: Key indicators

Country	Electrification rate, %						Population without access Millions	Electricity consumption <i>per capita</i> ** KWh	Installed capacity** * GW
	National				Urban	Rural			
	2000	2005	2010	2016	2016	2016	2016	2015	2015
India	43	58	66	82	97	74	239	859	298 ¹
Nepal	15	35	76	77	97	72	7	138	0.8
Bangladesh	20	34	47	75	90	67	41	326	8.6
Bhutan*	35	60	73.3	100	100	100	0	2,572 ³	1.5
Myanmar	5	12	49	59	79	43	22	249	5.39 ²
Developing Asia	67	74	83	89	97	81	439	-	
World	73%	76%	82%	86%	96%	73%	1,060	3,052	

IEA (2017)

*World Development Indicator (2018)

** IEA (2017b)

*** SARI (2017)

¹ India: 344 GW installed capacity by 30 March 2018 (197.17 GW coal, 24.9 GW gas, 0.84 GW diesel, 6.78 GW nuclear, 45.29 GW hydro, and 69 GW renewables (of which: 4.48 GW small hydro, 34 GW wind, 8.84 GW biomass, 21.7 GW solar)). See www.cea.nic.in/reports/monthly/installedcapacity/2018/installed_capacity-03.pdf

² Figures for 2016; hydro 60.4%, gas 35.6%, coal and diesel 4% (Ministry of Electricity and Energy (MOEE), 2017)

³ Figures for 2012 based on SARI (2016)

3.1 Demand growth is outpacing supply in India, Bangladesh, and Myanmar:

- In India, power demand has constantly outpaced supply (SARI, 2017, Figures 32–33). However, the level of deficit has been declining in recent years, from over 12% before 2010 to about 4%–5% in 2015 (in energy as well as power terms), a figure that is still significant. The recent projection

from the Central Electricity Authority (CEA) in its 19th Power Survey (2017) suggests that power demand in India is expected to increase on average by 5.8% annually over the next decade (2017–2027).

- Myanmar's electricity demand is expected to grow between three- and five-fold from 2017 to 2030 under the low and high scenarios.
- Bangladesh's peak power demand is expected to grow by 8.6% in the period 2010–2030, reaching about 33.7 GW, while installed capacity is expected to grow at 9.4% to 35.2 GW (SARI, 2017). Depleting gas reserves are adding pressure to the power sector in Bangladesh.

The installed capacity and electricity consumption in the region has been rising over the past decade, but electricity from oil, coal, and gas dominates the electricity mix in India and Bangladesh. Fossil fuels, primarily coal, represented 81% of installed capacity in India in 2016 (WDI, 2018). In Bangladesh, 62% of installed capacity was gas and 29% was oil in the same year (SARI, 2017). Bangladesh is now shifting to coal.

In contrast, Bhutan and Nepal's electricity mixes are virtually all hydropower. By 2018/19, Nepal is expected to have surplus electricity for export in the wet season while some import in peak hours might be needed from India. At this time, 2,310 MW of hydropower plants are under construction (1,300 MW from IPPs and 1,010 MW from Nepal Electricity Authority). Nepal has a further planned 5,521 MW, and this would result in a total capacity of about 10,000 MW by 2026 to meet domestic demand as well as for cross-border power export (SARI, 2017; ICIMOD, 2018). There is a local perception that Nepal could consume a large amount of electricity domestically and that current demand forecasts are conservative.

Bhutan has harnessed about 1,600 MW of hydropower out of its 24 GW economic potential. Currently, about 75% of the power produced in Bhutan is sold to India. Unlike in Nepal, in Bhutan domestic demand in the future is expected to be small.

Myanmar also has large hydro potential. Currently, 55% and 60% of electricity consumption and installed capacity, respectively, comes from hydropower (MOEE, 2017). Future hydro development is inhibited by environmental concerns and sub-national disputes.

If India and Bangladesh are not able to harness clean electricity from countries such as Nepal and Bhutan, they might be forced to rely on coal, raising environmental concerns and undermining their Paris Agreement commitments in their Nationally Determined Contributions. The absence of large-scale hydropower trade would also be a missed opportunity to reduce overall costs and would undermine energy security for the region (Tortajada and Saklani, 2018).

The falling cost of solar must also be considered in power trade discussions, since this may reduce the need for cross-border power trade to some extent. India, in particular, has been developing electricity from solar and wind at a rapid pace (about 55 GW installed capacity in total by March 2018; Table 1). Nevertheless, the intermittent nature of solar and expensive storage costs will attract cross-border power to balance loads.

4 The benefits of electricity cooperation

A range of benefits of electricity cooperation in South Asia has been articulated and demonstrated in recent studies. This sections summarises the main benefits cited in the literature.

On the economic front, seamless electricity trade will reduce the cost of electricity in terms of short-term energy and operation costs, as well as long-term capacity investment costs due to a shared reserve margin and avoided investment, especially in peaking plants (Timilsina *et al.*, 2015; UN-DESA, 2006; Wijayatunga *et al.*, 2015; Chattopadhaya and Fernando, 2011).

South Asian countries' load profiles have seasonal complementarity (i.e. monthly consumption varies between countries), which makes power trading attractive, because unused capacity in one country's low season can be used to meet peak load in another's high season (Timilsina *et al.*, 2015).

The reliability, stability, and quality of electricity supply could also be improved since the security of supply will be enhanced during contingencies (Lama, 2016; Economic Consulting Associates (ECA), 2009; UN-DESA, 2006).

Large hydropower and cross-border interconnections represent a development opportunity for both importing and exporting countries (Tortajada and Saklani, 2018). For resource-starved Bangladesh, a recent study has showed that importing electricity from a neighbouring country is more economical than any other local options, except coal, and would bring substantial socio-macroeconomic and environmental benefits (SARI, 2017b). An earlier study on Bhutan's annual tradable surplus of electricity found that country could export 52 billion units by 2030 and 90 billion by 2050. Should Bhutan sell its surplus electricity, *per capita* earnings from electricity export could rise 29 times from 2012 to 2035 (SARI, 2016). SARI (2017c) also identified large benefits to Nepal from power trade to India.

Electricity cooperation could also increase economies of scale, opening up larger markets for larger plants (ECA 2009; ECA, 2009b). In addition, it could also spur competition and help develop intra-country electricity markets.

On the environmental front, regional power trade could reduce local and regional pollutants and greenhouse gas emissions. Greater use of hydro plants in Nepal and Bhutan could reduce the use of thermal power plants in India and Bangladesh (Timilsina *et al.*, 2015; UN-DESA, 2006; Wijayatunga *et al.*, 2015).

In terms of political benefits, electricity cooperation could be a stepping stone for, and a model of, cooperation to strengthen mutual confidence and increased interdependence among the countries in South Asia, which could spill over into other sectors (Lama, 2016; UN-DESA, 2006). International grid interconnection has the potential to spur additional international cooperation, avoiding conflicts, encouraging democratisation, and promoting political stability (UN-DESA, 2006).

Important regulatory lessons can be learned from experiences of creating legal structures to support electricity trading (ECA, 2009; UN-DESA, 2006), which can provide models for greater economic integration in the region in other spheres, especially in regard to other energy commodities, such as gas and petroleum products (SARI/EI, 2005).

5 Current state of power trade in Eastern South Asia

Unlike other regions, the status of power cooperation in Eastern South Asia, both for power trade and transmission interconnections, is at an infant stage (Timilsina *et al.*, 2015). The Greater Mekong Sub-region (GMS), the Southern African Power Pool (SAPP), the Central American Electrical Interconnection System (SIEPAC), and the NordPool Market are a few examples from other parts of the world where regional power cooperation has progressed far ahead of the situation in Eastern South Asia. Despite the large opportunities outlined earlier in this document, Eastern South Asia has only just begun to trade power bilaterally, and in a limited fashion.

This section explores (1) existing bilateral power trade in Eastern South Asia, and (2) progress in developing regional power trade arrangements.

5.1 Existing bilateral power trade in Eastern South Asia

The power trade between Bhutan and India is often quoted and labelled as a successful example of such trade in the region. Bhutan has installed about 1,600 MW of electricity capacity and sells 70% of its produced electricity to India, which amounted to 5,044 million KWh in 2014 (SARI, 2016). In 2015, the value of this exported electricity was 10.14% of Bhutan's GDP (SARI, 2016b). The hydro plants selling electricity to India are all funded and developed by India. The Bhutan–India agreement assures a minimum of 5,000 MW electricity import commitment by 2020 by India (Singh *et al.*, 2015). The export price is relatively low, at Indian rupees (INR) 2.55/KWh (revised from 2.25 in 2017).

Despite Nepal's large potential to produce and sell power to India, it has recently been a net importer of power from India. In fiscal year 2016/17, about 35% of Nepal's total electricity consumption was imported from India (the provisional figure for 2016/17 is 2,175 GWh, with average power imports of 250 MW) (Nepal Electricity Authority (NEA), 2017). Nepal's imports mostly occur during peak hours in the evening, although there is also a small amount during daytime during the dry season. The NEA has power purchase agreements (PPAs) with NTPC Vidyut Vyapar Nigam (NVVN) (which acts as the nodal agency of India for power trading with Nepal). The rate at which Nepal buys electricity from India varies for different sources and voltage levels but the average was 7.36 Nepalese Rupees/KWh in 2017 (see NEA, 2017, for price differentiation). The 11th Power Exchange Committee meeting (8 August 2017) between Nepal and India fixed the power exchange rate at INR 5.55, 6.00, and 6.45 at the 132 kilovolt (kV), 33kV, and 11kV voltage levels, respectively, and stopped the annual escalation rate of 5.5% that was agreed previously. Within the next two years, after the completion of two hydro plants, Nepal is expected to nominally import from India during the dry season, but will be able to sell a large surplus of electricity to India throughout the other seasons.

Another evolving bilateral electricity market in the region is that between India and Bangladesh. This started in October 2013, with Bangladesh importing about 600 MW (through two points, Bengal and Tripura) (Singh *et al.*, 2018). Power from India has helped to reduce load shedding in Bangladesh since 2013; the max load shedding was 1,048 MW in financial year (FY) 2013 and this had reduced to 307 MW in FY 2015 (SARI, 2016b). The lack of primary energy resources and rapidly growing electricity demand persist in Bangladesh. Studies (e.g. SARI, 2017b) predict 26 and 64 GW capacity and demand by 2030 and 2045, respectively, and highlight that it would be more economical to import, over other options (except for coal). In Bangladesh, the tariff for imported electricity from India is lower than the average power purchase cost in Bangladesh. The lower price of imported electricity has resulted in a lowering of the average power procurement cost of the Bangladesh Power Development Board (BPDB), with estimated savings of \$500 million (SARI, 2016b). In early 2018,

India's NRVN won a BPDB contract to supply an additional 300 MW electricity to Bangladesh, at an estimated tariff of INR 3.42/KWh.¹

Bangladesh's rapid increase in demand also opens up regional market prospects for Nepal and Bhutan. In the last two years, Bangladesh has been in talks with Bhutan and India to forge a trilateral memorandum of understanding (MOU) between the three countries to develop the 1,125 MW Dorjilung hydropower plant in Bhutan.

India now has bilateral electricity cooperation with all countries in Eastern South Asia. The Ministry of Power of India reported that India exported 5,798 million KWh in FY 2016/17 (April 2016–February 2017) to Nepal, Bangladesh, and Myanmar. This was 213 million KWh more than the imports coming from Bhutan (5,585 million KWh) in the same period. India's exports to Nepal and Bangladesh had increased by 2.5 and 2.8 times, respectively, in the three preceding years.²

5.2 Progress in developing regional power trade arrangements

Regional power trade arrangements are being discussed under the Bangladesh, Bhutan, India, Nepal (BBIN) and South Asian Association for Regional Cooperation (SARRC) frameworks. The BBIN and SAARC frameworks have not progressed much, with the exception that the BBIN Motor Vehicle Agreement was concluded recently between Bangladesh, India, and Nepal (Bhutan has not joined yet).

In 2006, the SAARC Energy Centre was established in Pakistan to focus on regional energy cooperation. In late 2014, a Framework Agreement with the objective of developing the SAARC Market for Electricity (SAME) was agreed by member states. It included the establishment of a regional electricity market with non-discriminatory transmission access, market-based electricity pricing, and a body to coordinate regional power integration and trade.³

Thus far, SAARC has been paralysed by geopolitical issues. The absence of a coordination body for supporting regional electricity cooperation persists in the region.

In terms of the promotion of stakeholder dialogue and knowledge facilitation, USAID's SARI/EI has been working in the region for several years. The first three phases of SARI focused on cross-border energy trade (CBET), energy market formation, and regional clean energy development; the fourth phase (2012–2017) focused on advancing the regional energy integration and increasing CBET. A series of regional and country studies highlighting the benefits of CBET, stakeholder dialogue, barrier identification, and policy engagement have been carried out.⁴

India is central to facilitating and developing CBET in Eastern South Asia on a regional scale, since both Nepal and Bhutan (the potential suppliers of hydroelectricity), and also Bangladesh (market) and Myanmar (market/supplier), are unable to be connected with other countries except via India and are unlikely to do anything without the support of India in any CBET arrangement.

India's Central Electricity Regulatory Commission's (CERC's) 2017 draft regulation could present a potential barrier for all neighbouring countries willing to engage in CBET with Indian entities. The draft regulation states that 'cross border trade of electricity shall involve issues of strategic, economic and national importance', and clearly restricts certain generators from accessing the Indian market. The regulation excludes privately owned or foreign direct investment (FDI) owned (other than those owned by India) projects from the 'eligible generators' list (CERC, 2017). Such a provision impedes the

¹ <https://timesofindia.indiatimes.com/business/india-business/nptc-arm-wins-bangla-bid-as-bilateral-power-trade-matures/articleshow/62905570.cms>

² <http://pib.nic.in/newsite/PrintRelease.aspx?relid=160105>, Press Release from the Ministry of Power on 29 March 2017.

³ www.saarc-sec.org/userfiles/SAARC-FRAMEWORK-AGREEMENT-FOR-ENERGY-COOPERATION-ELECTRICITY.pdf.

⁴ See <https://sari-energy.org/>

exporting of power to India produced from FDI-led hydro projects in Nepal and Bhutan, though both Nepal and Bhutan likely lack the investment capital for export-oriented large hydropower plants.

As a crucial country sitting at the centre of regional power trade, India has not presented a clear long-term vision of what a regional power pool might eventually look like in terms of flows. The clearest picture, outlined in the 20-Year Perspective Transmission Plan Report of Central Electricity Authority Report, is a modest scenario, with power exchanges between India's own five national grids and power exchanges with Bhutan and Bangladesh through the eastern grid⁵ (CEA, 2016). This scenario is not ambitious enough to realise the substantial benefits of regional power trade outlined earlier in this document.

⁵ Only a nominal flow to the north-eastern grid and Bhutan.

6 Electricity market structure and cross-border transmission capacity

For countries to trade power with one another, they must have both functional market institutions that govern the trade and transmission infrastructure to transport the electricity. This section outlines the state of the electricity market across Eastern South Asia, and the cross-border transmission line capacity between countries.

6.1 Electricity market structure

The electricity market structure in the region is largely vertically integrated and regulations are uncoordinated and country-specific. However, in recent years, the generation, transmission, and distribution functions have been unbundled in India and partially unbundled in Bangladesh, Bhutan, and Pakistan. The generation side has been partially liberalised for IPPs.

India, unlike other countries in the region, has already instituted domestic competition in the electricity market through generators signing PPAs with buyers or power traders, and through short- and medium-term transactions in power exchanges (i.e. Indian Energy Exchanges and Power Exchange India Limited (SARI, 2016b)).

The single buyer model (i.e. one buyer, many sellers) largely prevails in the rest of the region, not only inside countries, but also for cross-border electricity trade, with India the dominant buyer for Bhutan and potentially for Nepal (Singh *et al.*, 2018). For cross-border power trade, Bhutan is transacted through PTC India Ltd and Nepal through NVVN. In the case of Bangladesh, BPDB was contracted through PTC India Ltd initially and later through National Thermal Power Corporation Limited. Being closer to Bangladesh, PTC sourced power from the West Bengal State Electricity Distribution Company (SARI, 2016b).

6.2 Cross-border transmission line capacity

A key factor shaping potential power trade is the availability of transmission infrastructure in the region, which as yet remains limited. The total cross-border transmission line capacity in the region (between Nepal, India, Bhutan, and Bangladesh) is about 2,400 MW.

- Nepal–India has six 132 kV or higher interconnections, capable of 520 MW trade, in addition to a few smaller border town exchanges at 11 or 33 kV lines (NEA, 2017 and interviews at NEA). The Dhalkebar–Muzzaffarpur Link has the potential to expand up to 1,200 MW through charging up to 400 kV.
- Bhutan–India transmission capacity depends on the export capacity of the Tala, Chukha, and Kurichhu hydro plants of around 1,416 MW, although Bhutan and India have an MOU to develop capacity to expand the transmission link to up to 10,000 MW export in coming years (SARI, 2016b).
- Bangladesh–India transmission capacity is limited to 500 MW trade through the Bheramara–Behrampur link (400 kV) and HVDC Back-to-Back station (Singh *et al.*, 2018) but is being expanded to allow 1,000 MW trade through a new line and possibly augmentation of HVDC Back-to-Back station capacity (in addition to the existing Tripura–Comilla link, which transfers 100 MW in radial mode).

Large-scale regional electricity trade will require not only better cross-border transmission infrastructure across the region, but also within the countries themselves, to allow better flow and multiple linking points for smooth delivery.

7 Barriers to regional cooperation on power trade and grid integration

Removing barriers to regional power trade will be a complex task that, based on experience elsewhere in the world, could take many years. SIEPAC (the Central American Electrical Interconnection System) project took 23 years to complete after its initial feasibility study. The GMS region took over two decades to arrive to the current stage (Singh *et al.*, 2015), but GMS still has difficulties in regard to moving beyond bilateral trade in an effective manner, while projects such as LTMS (Lao-Thailand-Malaysia-Singapore) are under discussion. The Association of South East Asian Nations (ASEAN) Power Grid has a good work programme and regional power utilities are meeting regularly; some of the key transmission interconnections have been identified and are being developed and upgraded to facilitate regional power trade, but there is a long way to go toward integration itself.

Our review has revealed the multi-dimensional nature of the barriers to regional cooperation on power trade and grid integration in Eastern South Asia (see Figure 2 for a word cloud outlining the dimensions). Some of these barriers are regional in nature and include geopolitics, standardisation, coordination, and risks and uncertainties, while others are country-driven and emerge internally. Barriers can also be viewed as being either supply- or demand-side, but understanding them in totality is essential since many factors are intertwined.



Figure 2: Word cloud of dimensions

The region is at a very early stage of cooperation; this fact must be taken into consideration when discussing any barriers. We must therefore look at barriers at two levels:

- barriers to upscaling bilateral trade in the immediate term;
- barriers to building trade at a regional level involving more than two countries (i.e. Nepal, India, Bhutan, Bangladesh, and Myanmar) in the longer term.

Timilsina *et al.* (2015), Singh *et al.* (2015; 2018), and Singh (2013) have all identified the major barriers in South Asia as being the limited cross-border transmission links, bottlenecks in the domestic energy infrastructure, poor operational efficiency, poor financial performance and creditworthiness of the utilities in countries, absence of a competitive power market, institutional constraints, and, most importantly, the long-standing political disputes and oppositional mindsets between countries. This section summarises these barriers in further detail.

7.1 Lack of political will and trust

The most debated and cited barrier to regional electricity cooperation in South Asia is geopolitical, i.e. historical animosity leading to a lack of trust (Singh *et al.*, 2018; Tortajada and Saklani, 2018). The fact that SAARC is not functioning well is evidence of this mistrust. SAARC is adversely affected by the animosity between India and Pakistan.

In Eastern South Asia, however, the level of trust can be seen as relatively better than in South Asia as a whole – although primarily on an *ad-hoc*, issue-specific basis. Only Bhutan–India relations are conducive for water deals; in Nepal, any water and power deal with India represents a political

bombshell and cases emotions to run high, due to suspicion and past water treaties with India that are perceived to have been unfair.

Estimates of the benefits of cooperation and a transparent evaluation of potential win-win deals are essential for policymakers. Trust building, dialogue, and engagements at various levels of stakeholders across countries (research communities, investors, project developers, market operators, utilities, policymakers and regulators, etc.), backed by evidence-based information, could help.

The market and the private sector have the leverage to push policies that are conducive for cooperation if they see prospects, and therefore they must be engaged. The Bangladesh–India power deals are prompted by the acute shortage of power in Bangladesh, that country's lack of primary energy resources, expensive local electricity costs, and the country's need for power to feed its consistently high GDP growth rate. It is supported by a relatively stable government and a moderate political party in power that has warm relations with India.

Internal political instability is also a strong barrier to regional electricity cooperation (Singh *et al.*, 2015). Nepal–India electricity cooperation is partly plagued by past political instability in Nepal. The absence of necessary political will remains a key barrier in the region (ECA, 2010). ECA (2010) and Singh *et al.* (2015 and 2018) cite key possible factors for this as including historical distrust between countries, internal politics in countries, benefit-sharing complexities, and inability to operationalise past agreements.

7.2 Information barriers: scale of benefits, lack of trusted independent sources of information

Another key barrier to regional cooperation on power in the region is the lack of research and research expertise to evaluate the benefits and costs, as well as the diverse aspects of analysis that can help build trust. The modelling studies that do exist are largely limited to optimisation-based energy system models and some economic models that address the direct cost, pollution, and energy security benefits.

Existing studies fail to address other key factors:

- Indirect and other larger economy-wide and social benefits (due to improved energy access) are generally not considered.
- Upstream and downstream benefits from cooperation on multi-purpose hydro dams, such as flood control and irrigation, are not studied; nor are the potential trade-offs, such as displacement of people, biomass loss, and especially deforestation.
- Efficiencies due to economies of scale and risks in benefits estimations are rarely modelled.
- Further lacking are spatial or locational modelling analyses, which are necessary for considering transmission infrastructure in the integrated cost–benefit analyses as well as benefit-sharing discussions.
- Fiscal issues (debt or trade surpluses) associated with benefits or trade-off and investment needs are not modelled at all.
- There could be additional political benefits of increased infrastructure connectivity which have also not been sufficiently studied.
- The likelihood of the benefits proposed in the current literature being materialised remains murky and needs clarity, as does the distribution of these benefits across space and across agents in either bilateral or regional electricity cooperation.

Eastern South Asia lacks an independent think-tank, not aligned to any government, which can generate evidence-based analysis of the costs and benefits of power trade, and which can provide independent policy advocacy. Furthermore, a lack of negotiation skills persists in the region, especially in small nations such as Nepal and Bhutan. The SAARC Energy Centre could have been such a forum, but SAARC mechanisms are not functioning effectively.

A particularly glaring gap in current analyses is an understanding of the potential positive and negative implications of the rapidly declining cost of renewables (especially solar PV and onshore wind) and storage technologies for regional electricity trade. The cost of utility-scale solar PV has fallen by 73% in the period 2010–2017. Recent auctions have resulted in onshore wind power levelised cost of electricity (LCOE)s as low as \$0.03/kWh. By 2020, all the renewable power generation technologies currently in commercial use are likely to fall within the fossil fuel-fired cost range (IRENA, 2018). The density and cost of power storage are also expected to improve. This will have implications for the power trade, not only for supply and trade volume but also for regulation, dispatching, and transmission infrastructure.

7.3 Insufficient and non-operational regional mechanisms

Electricity cooperation under SAARC, BBIN, and the Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation has not gathered sufficient pace, for various reasons. As a result, no regional agencies are actively supporting regional cooperation, except modest initiatives such as USAID's SARI in South Asia. Regional institutional arrangements are necessary to facilitate electricity cooperation (Pollitt and Oseni, 2014). As was touched on above, SARRC has not been functional.

The lack of a regionally mandated institution hurts South Asia. Strong mechanisms are needed, especially for the discussion on regulation and the involvement of regulatory agencies to shape the legal and regulatory framework (World Bank, 2008).

One key task in regional cooperation is to ensure non-discriminatory access to the grid. While the SAME Framework Agreement in 2014 involved such provisions, the agreed framework has not moved forward. In a regional setting, a regional governance mechanism, such as an independent service operator or regional transmission organisation, is needed. At this moment, bilateral trade happens through state-owned nodal agencies and such an arrangement limits the entry of participants (Singh *et al.*, 2015). In policy forums, stakeholders in Nepal have repeatedly emphasised that a guaranteed open access grid with India is critical for building confidence in Nepal to develop export-oriented hydropower projects.

7.4 Inadequate cross-border transmission infrastructure and technical issues

Inadequate cross-border transmission capacities hinder large-scale electricity trade in Eastern South Asia. Earlier discussions in this report have covered the state of transmission infrastructure. The pace of developing such infrastructure is slow and sufficient cross-border transmission capacities are a must.

Experiences from successful electricity cooperation initiatives, such as the aforementioned SAPP and also the West Africa Power Pool, have shown that large loss in potential wheeling revenues and limited volume of trade occurred due to limited transmission capacities (Oseni and Pollitt, 2016). These issues further affected market integration in those regions.

If Bhutan and Nepal develop export-oriented hydroelectricity too quickly, without the matching transmission infrastructure, reaching the Indian and Bangladeshi markets will not be possible and

power will be lost. Moreover, barriers also emerge due to the lack of local transmission infrastructure inside countries.

Further, harmonisation of grid codes, grid operating procedures, and standards are key requirements for the safe and reliable operation of grids in cross-border power trade. Such codes cut across different countries and take time to harmonise and need to move step by step. SARI (2016c) proposed a set of Framework Grid Code Guidelines for South Asian cross-border integration, and these might be useful for further discussion in this area in the region, but more dialogue and discussion are needed.

7.5 Inadequate installed capacity and financial resources, and uncondusive market structures

Further barriers relating to the availability of power, insufficient financial resources, and uncondusive market structures for trade and investment are all intertwined.

While Eastern South Asia holds great potential for trade, there is currently a lack of adequate installed capacity for export. Bhutan's hydropower is being developed on a piecemeal basis, and mostly by India. Bhutan is also concerned about foreign debt. Nepal is struggling to meet domestic demand due to slow hydropower development and political and social conflicts inside the country (although the country is expected to be politically stable going forward). India itself has power shortages, and may face limitations in supplying more power to Bangladesh. Thus far, not more than 1,000 MW of power trade has been discussed with Bangladesh. India's supply to Myanmar is also small. To develop the electricity market, the installed capacity in the region must be scaled up.

Export-oriented large hydropower developments will require substantial financial resources and, likely, FDI for Nepal and Bhutan. The draft trilateral MOU between Bangladesh, India, and Bhutan (yet to be finalised) to invest in Bhutan could be one type of arrangement in the region but the limited role of the private sector and overreliance on a government-to-government arrangement for trade is a limiting factor in the region.

Limitations around investment pertain not only to the generation side, but also to the transmission infrastructure. In ASEAN too, investment in transmission lines is one of the key barriers to regional power trade (Li and Chang, 2015).

The current market structures that persist in the region are uncondusive to trade. Without serious efforts to address them, they pose a clear market risk and entail an uncertain return on investment.

As mentioned earlier, the power market structures in Eastern South Asian countries are all different in terms of generation, transmission, distribution, and market structures. While India has some degree of market competition, the single buyer model persists elsewhere in the region. Nepal is vertically integrated (with only some competition on the generation side), Bangladesh is horizontally unbundled, and Bhutan is partially unbundled (Singh *et al.*, 2015). Lack of market clarity and perceived risk impede investment in supporting infrastructure.

Another key barrier to trade is the lack of cost-reflective electricity tariffs (Oseni and Pollitt, 2016). When reasonable trade takes place, subsidies, export/import taxes, and the cost of demand-side energy efficiency measures all have an effect. Electricity pricing that reflects actual costs is a must. However, in a single buyer market, the price is dictated and unless the market opens to more than two countries, greater volumes of trade may not happen.

The traded electricity price in the region varies, with Bhutan to India being the lowest and India to Nepal and Bangladesh the highest, but these are more government-to-government arrangements than

true market operations. Such differences in market structure, operational arrangements, and tariffs represent a major barrier, especially when there are no meaningful regional coordination mechanisms and there is no dedicated regional entity.

Power sector reform is itself a complicated process. The prospects for unlocking power trade in Eastern South Asia will partly depend on the extent to which power sector reform can be synchronised across other sectoral reforms in the economy (Nepal and Jamasb, 2012).

7.6 Lack of a demonstrated model of regional cooperation

Another final barrier to regional electricity cooperation in Eastern South Asia is the lack of a regionally demonstrated model of electricity cooperation. The successful cooperation between Bhutan and India is unique, rather than being a model (Tortajada and Saklani, 2018). There is a serious lack of a champion project that demonstrates the benefits and provides positive signals to the market to build confidence. Regional conflicts have hindered such a demonstrated model. Even activities outside the electricity sector might help in this regard.

8 Conclusions and recommendations for EEG

This report provided an overview of the prevailing situation of regional electricity cooperation in Eastern South Asia. It outlined the opportunities associated with regional power trade, the current state of electricity trade, and the key barriers to further cooperation. A number recommendations can be drawn from this analysis for EEG to help unlock power trade in Eastern South Asia.

The following research projects are proposed that could help address the barriers identified in this report:

- Studies are required that identify and outline steps to reduce trade-distorting inefficient national regulations. Such a study could help promote market-based mechanisms that involve the private sector and facilitate non-discriminatory access to grids and FDI. The current reliance on bilateral power trade and 'government-to-government' measures is not sufficient.
- Research is needed to build a better knowledge base on alternative models of cooperation in the region, the governance of regional electricity cooperation, and the perceptions of stakeholders on barriers and solutions. Studies should draw on best practice in other regions.
- Modelling projects could guide the market and build confidence, particularly around the implications of technology change for regional energy trade, such as the declining costs of solar and onshore wind.
- Further research is needed to identify the specific transmission constraints that exist in the region. This research is necessary to inform a regional investment framework and mechanism for generation and transmission infrastructure. FDI and other sources are possible in the region for export-oriented projects, but the region must be very receptive to FDI in the power sector.

In addition to the research projects identified above, the following steps focused on research uptake could help ensure that findings are applied in practice:

- Workshops and training programmes are required to build domestic institutional capacity to promote regional electricity cooperation.
- The creation of an independent regional entity to coordinate, advocate for, and harmonise policies, markets, and grids is urgently needed to provide a non-biased view on the costs and benefits of electricity trade to each country.
- Stakeholders at various levels must engage in cross-border dialogue to build trust between countries. To this end, the role of independent think-tanks and strategic and research institutions is important, as such dialogue must be based on evidence-based analysis.

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