Energising Connectivity between Northeast India and its Neighbours

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Confederation of Indian Industry

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Preface

Energy is a common thread that connects multiple areas of sustainable development for countries and sub-regions in Asia. For the seven states of the North Eastern Region (NER) of India, energy connectivity with neighbouring countries assumes a critical importance. Ready access to affordable energy is essential for both economic and social development. NER has states, such as Assam and Tripura, which are rich in petroleum resources. Arunachal Pradesh has substantial hydro-power potential. Meghalaya has coal and uranium resources, while Mizoram has rich biomass. Sikkim and other North Eastern states also have hydro-potential. Assam, Nagaland, and Arunachal Pradesh have rich solar potential.

While there is a consensus amongst the states in the region on the need to fully harness abundant renewable energy potential, they also have the option of serving as a conduit for energy transmission amongst the neighboring countries of Bangladesh, Bhutan, Myanmar, and Nepal, and supply the surplus clean energy to the national power grids of India, thus helping to meet its Paris Climate Agreement targets on carbon emissions, if and when connectivity is established. There are multiple benefits in integrating NER energy markets with neighbouring countries, for which each state must calibrate its prospects and challenges. In view of this, the Indian government has been strengthening its Act East Policy that focuses on economic integration, including energy trade with the Association of Southeast Asian Nations (ASEAN). Mobilising knowledge, technology, and investment are essential parts of this strategy.

In response to this and to add to the existing knowledge base and catalyse actions, the Confederation of Indian Industries (CII) requested the Economic Research Institute for ASEAN and East Asia (ERIA) to develop a theme study entitled 'Integrating NER India with Neighbouring Countries through Cross-Border Energy Trade'. This publication takes stock of the prospects and challenges of making that energy integration.

It quantifies the potentials of the benefits and identifies some of the strategies for the region's policymakers to consider that balance the economic, social, and environmental dimensions of cross-border energy trade and provides a series of recommendations to enact a regional cooperation framework for the NER states. It is hoped that this theme study will provide a practical contribution to the deliberations of policymakers and the business community.

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President, Economic Research Institute for ASEAN and East Asia

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Executive Summary

The eight states in India's North Eastern Region (NER) and their neighbouring countries (including Southeast Asia) are experiencing significant economic growth and forging close ties in the energy sector. This process has been fueled by such factors as greater infrastructure connectivity, expanding production networks and supply chains, a commodity boom, and heightened demand for clean and green renewable sources of power. These have been complemented by significant advances in the energy trade, investment, and financial flows between the NER and its neighbours; however, progress has been hindered by bottlenecks and gaps in energy generation and transmission infrastructure, financial markets, and trade facilitation, as well as trade barriers and limited regional cooperation.

The recent economic and energy sector reforms in Myanmar, a key land bridge between the NER and the Association of Southeast Asian Nations (ASEAN), make possible a level of connectivity and energy trade integration that was previously unfeasible. The pro-business Government of India has renewed efforts to deepen domestic economic reforms, furthering India's Look East Policy and enhancing cross-border infrastructure investments. The move towards an ASEAN Economic Community, which was begun in 2015, provides a large and more integrated market with notable purchasing power and scale economies. Since the signing of the Paris Agreement, it has become clear that the NER states and neighbouring economies need to focus more on domestic and regional energy security to ensure sustainable growth. Against this backdrop, the Economic Research Institute of ASEAN and East Asia conducted this study to determine how improved energy connectivity and associated soft infrastructure (including such critical areas as the financing of infrastructure, trade and investment reforms, and institutions for coordination) can foster closer economic ties amongst the NER, South Asia, and Southeast Asia.

This study provides a framework for thinking about strategic cross-border infrastructure investments and policy reforms by (i) mapping evolving economic ties in trade, foreign investment, and finance between the NER and Southeast Asia; (ii) analysing the current state of cross-border energy infrastructure (using an energy demand supply model), and identifying bottlenecks and priority investment projects that could relieve those bottlenecks; and (iii) assessing the environment

for investing in cross-border energy sector development mechanisms and private sector partnerships.

This study led to several interesting findings with relevance for policymakers. Improving energy connectivity is crucial for building greater economic integration between the ASEAN countries and the NER. Given the region's diverse geography and wide range of clean energy portfolios, a subregional trade perspective offers a way forward for strategic energy security planning and the economic development of the NER. There are critical technical, policy, and financial barriers to cross-border energy trading (CBET) in India, Bangladesh, and Myanmar; and the NER, Bangladesh, Nepal, Bhutan, and Southeast Asia do not currently trade energy with each other, other than conventional shipments of coal, gas, and other fuels. Thus, there is much unexploited potential to be tapped. This study uses an energy supply and demand model to estimate the potential for CBET. The main opportunities for CBET lie in hydropower and gas pipelines, in addition to pooling and the interconnection of electric power grids. Myanmar has an important role to play in the energy trade, given its substantial reserves of potential hydropower and natural gas, in addition to its critical location as a gas pipeline corridor. Various impediments to energy trading include technical barriers related to grid synchronisation, grid codes, and electric power and natural gas pipeline technology, as well as regulatory barriers and distorted energy pricing and/or tariff regimes.

There are substantial investment costs associated with projects to enhance CBET. Due to high costs and the necessary multiplicity of projects as well as human capacity constraints, a sequenced approach based on priorities is required. However, financing CBET projects remains challenging. Cross-border financing vehicles do not exist, as risk-averse private investors are hesitant to cross borders on their own. Public sector funding plays a major role in financing infrastructure projects but is becoming increasingly subject to fiscal constraints in NER states. In neighbouring countries, commercial banks are major sources of infrastructure financing. Investment-grade projects and related initiatives need to be developed to facilitate the energy trade across the borders of the NER states, the rest of India, and the ASEAN countries. Infrastructure funds, both domestic and international, are essential. Public–Private Partnerships (PPPs) provide an important top-up for infrastructure funding, but are not a panacea. India's experience shows that the PPP model can be a useful part of the solution for financing energy sector development. Furthermore, support from multilateral development banks and international coordination for cross-border projects can help ensure that PPPs

succeed. Increasingly, multilateral development banks may be required to play multiple roles in a project's financial lifecycle, particularly in the NER and Myanmar.

There are sizable economic, environmental, and social benefits to be gained from greater energy connectivity amongst the NER, its South Asian neighbours, and Myanmar. To close coordination gaps amongst the NER, its South Asian neighbours, and ASEAN, it may be necessary to retool existing institutions and create new ones to facilitate economic links. This study used a modern energy supply and demand model to explore the potential economic effects of alternative energy trade schemes involving NER state economies. The results show that most participating states and countries will experience significant gains from CBET. The analysis in this report suggests that the benefits of greater energy market integration far outweigh the costs, especially since the benefits of economic development will spread to isolated areas of the NER. This will require cooperation at the subregional level.

CHAPTER 1

Energy Sector Development Needs and Electricity Generation Potential in Northeast India

1. Introduction

Policymakers and academics alike are growing increasingly interested in strengthening economic connections between the North Eastern Region of India (NER) and major economic centres in South and Southeast Asia. The NER comprises eight contiguous states: Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura. There are several critical and strategic advantages to this region participating jointly in the development of its neighbours, specifically Bangladesh, Bhutan, Myanmar, and Nepal. These adjoining countries, along with the rest of India, are amongst the most dynamic in Asia and have very impressive rates of socioeconomic development. The advantages of economic integration amongst these countries stem from politico-historical linkages, geographical proximity, socio-cultural cohesiveness, economic complementarities, and scope for further economic integration with the Association of Southeast Asian Nations (ASEAN) and China. However, the progress of trade and investment as well as industrial development in the NER has been relatively limited by various infrastructure bottlenecks, policy misalignments, and information gaps.

Energy sector development will be a major means of integrating the NER with the economic centres in neighbouring South and Southeast Asian countries. Lower tariffs and more reliable supplies are very distinct incentives for countries like

Bangladesh, India, and Myanmar to import power from Bhutan and Nepal. The NER could play a three-dimensional role in subregional energy security

2. Economic Rationale for Cross-border Energy Trade

In general, the economic benefits of energy connectivity are broadly similar to those that arise from international trade. To evaluate the economic value of energy sector interconnection, a cost–benefit network can be envisioned. The costs predominantly comprise the initial capital investment in the infrastructure, plus future operation and maintenance costs for the investment's planned lifespan, which will likely constitute only a small part of the total. The benefits, however, are far less well defined and hard to derive due to challenges in assigning monetary value to some benefits. For new energy connectivity programmes, the benefits may manifest in the following ways:

(i) savings in terms of reductions in unserved energy (typically measured in terms of value of lost load);
(ii) attainment of energy security;
(iii) climate change mitigation through the exploitation of low-carbon energy sources;
(iv) increasing competition in the energy supply and hence lower energy prices for consumers;
(v) postponing of investments in additional capacities to meet domestic demand; and
(vi) operating cost savings in terms of transmission and distribution as cheaper generation sources are substituted for costly ones.

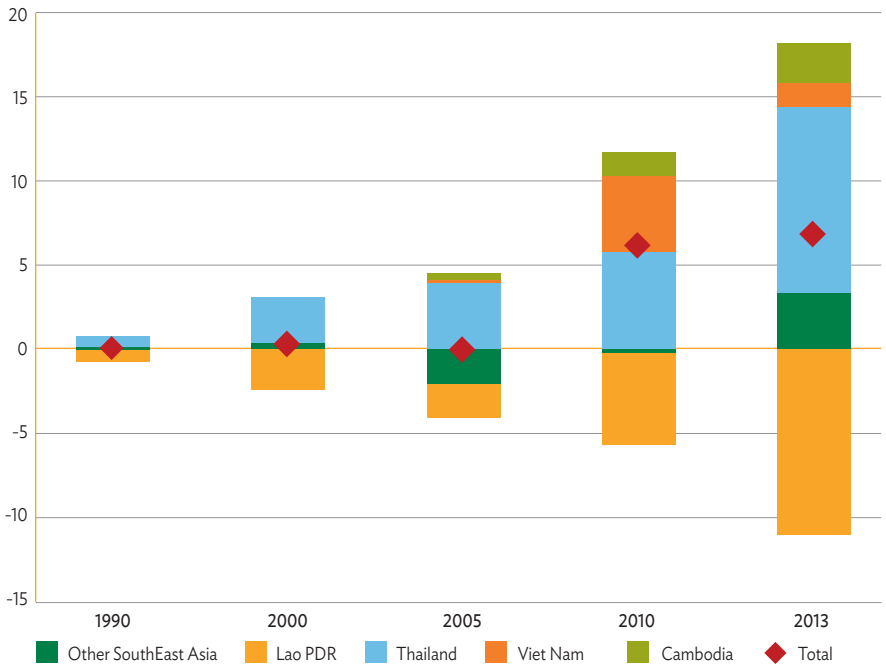
Indirect or secondary economic benefits may arise at the local level as the stability and reliability of the power system increases. Cheaper electricity may also lead to local economic and infrastructure development, improved public services, and additional effects as savings resulting from cheaper electricity translate into more disposable income. Moreover, energy connectivity enables neighbouring countries to integrate their markets, which may incentivise investment in domestic power-generation facilities and thereby contribute to lower electricity prices in the long term (Economic and Social Commission for Asia and the Pacific, 2018). The occurrence and extent of these benefits may

differ significantly depending on whether the markets being interconnected possess the necessary power-generation technologies and energy demand profiles.

3. Impacts of Improved Energy Connectivity

An overview of the energy trade and evolution of interconnection in international markets can illustrate the intended impacts of improved cross-border connectivity. Cases relevant to NER–ASEAN connectivity include (i) the Greater Mekong Subregion (GMS), the first significant project in Asia to involve several countries sharing power and facilitating trade in clean energy; (ii) Nord Pool, which operates as part of the European electricity market; and (iii) the South African Power Pool (SAPP), which facilitates multilateral energy trade amongst 12 African countries.

Figure 1.1 Electricity Trade in the Greater Mekong Subregion



Lao PDR = Lao People's Democratic Republic. Note: Negative values indicate net exports while positive values indicate net imports. The diamond represents the total electricity traded in the region.

Source: Association of Southeast Asian Nations Studies Centre (2013), ASEAN Energy Market Integration (AEMI): From Coordination to Integration. Bangkok: ASEAN Energy Market Integration Group, Chulalongkorn University.

3.1. Energy Cooperation in the Greater Mekong Subregion

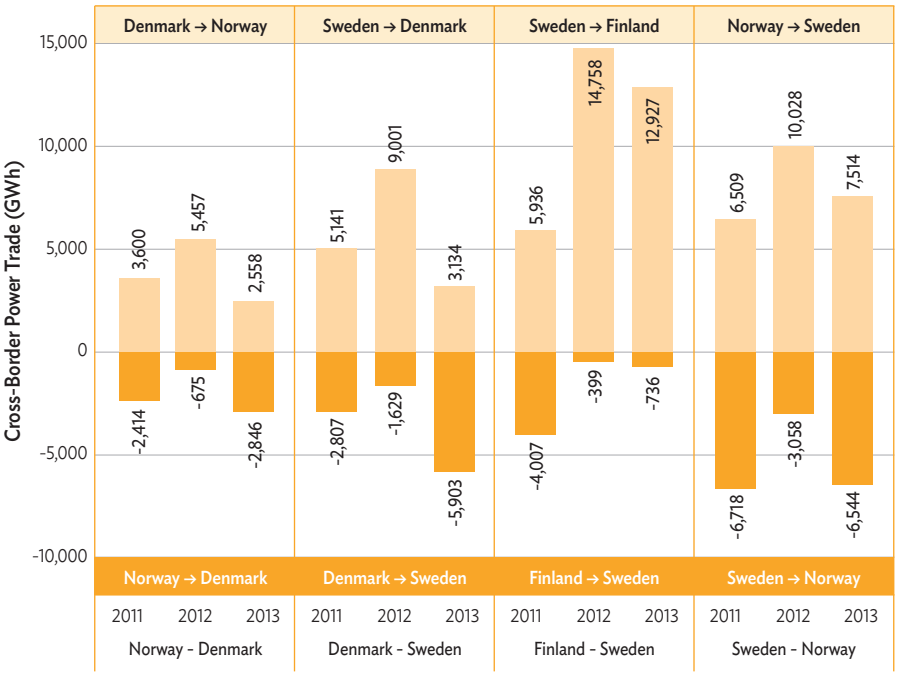
Figure 1.1 shows an overall increasing trend in the historical volume of traded electricity in Southeast Asia since 1990. Most of the electricity is exchanged amongst GMS members. The Lao People's Democratic Republic (PDR) has grown into a major net exporter of hydropower, and its electricity exports quadrupled from 2.8 terawatt-hours in 2000 to 12.5 terawatt-hours in 2013. This has been largely facilitated by the operation of the Nam Theun 2 Dam. Thailand receives 80% of the country's energy exports, and other neighbouring countries receive the rest. Thailand's steady economic growth and increasing energy demand are the main reasons for this increase in electricity imports.

The benefits of creating a GMS- or ASEAN-wide grid connectivity system include cost and fuel savings, enhanced energy security for countries like Thailand, and environmental benefits for the region. Increased geographical coverage and the integration of common grids allow other countries like Viet Nam and Cambodia to take advantage of all available resources. Displacing the use of hydrocarbons with cheaper hydropower is benefitting growing economies through reduced electricity costs and lower carbon emissions.

3.2. Nord Pool

The Nord Pool market was first opened between Norway and Sweden, which were soon joined by Finland, Denmark, and the Baltic states. The geographical power flows amongst Nord Pool countries are shown in Figure 1.2. In 2013, the highest recorded trade volume was between Norway and Sweden, followed by that between Sweden and Finland. The energy trade follows daily and seasonal patterns that depend heavily on the availability of renewable power sources in the region. Nord Pool has multiple interconnections with other European countries, with a total capacity of more than 6,000 megawatts. Over 50% of all electricity supplied in Nord Pool comes from hydropower, given the region's ample water resources. However, annual hydropower generation can vary by +/- 20% based on weather conditions. Another 20% of the electricity supply is supplied by nuclear power, 14% by combined heat and power, 7% by fossil-fuel generators, and another 7% by wind power.

Figure 1.2 Cross-Border Energy Trade between Norway, Sweden, Denmark, and Finland



GWh = gigawatt-hour.

Source: Nord Pool Consulting (2014), South East Europe Wholesale Market Opening: Final Report. Lysaker: Nord Pool AS.

The success of the Nord Pool energy trade is largely due to high levels of transparency, as equal access to information for all participants improves trust and efficiency. Because of this, Nord Pool is becoming increasingly connected with European electricity markets. Although Nord Pool is exposed to weather-related uncertainties in the output of renewable energy, energy prices have remained steady, indicating the benefits of energy interconnection. Interconnection has also resulted in falling carbon dioxide emissions in the Baltic region. An interesting fact about Nord Pool is that the scheme permitted multilateral cross-border trading before establishing the Nord Pool spot market. Thus, reforming the power sector by separating the generation and transmission sectors is not a requirement for the multilateral market. Nevertheless, this unbundling played a crucial role in the later success of the scheme in terms of competition and efficiency.

3.3. South African Power Pool

The SAPP was launched as a cooperative pool scheme that encouraged members to share information about generation and transmission costs for price-setting purposes. There are currently 16 SAPP members comprising 12 national power utilities, two independent power producers, and two independent members. Most of the members are national utilities of countries operating under the single-buyer model. The statistics of electricity trading amongst the 12 members are in Table 1.1.

The energy trade of the SAPP can generally be divided into two networks that rely on different electricity supply sources. The southern region mainly uses coal-powered plants, while the northern region mainly uses hydropower. Connectivity allows the southern region to take advantage of cheap hydropower generated in the north during the rainy season; conversely, during the dry season the net flow is reversed and the thermal south exports energy to its northern neighbours.

A cost–benefit study of the SAPP concluded that both immediate and long-term befits can be reaped from the cross-border energy trade (CBET) and coordination of electricity investments. An estimated $100 million per year can be gained through the short-term optimisation of regional opportunities, and a total of $1.5 billion in net present value of investments could be saved in the long term. Coordinating regional capacity development plans under a single umbrella could yield $48 billion in savings by 2025, compared to a scenario in which the capacity plans made by each country remain uncoordinated (Energy Coordination Agency, 2010).

The cases of the GMS, Nord Pool, and the SAPP show that cross-border connectivity has multiple benefits. They also illustrate that, while a single system operator is not a prerequisite for trading energy, a harmonised set of rules and grid codes can evolve over time.

Table 1.1 Electricity Trade amongst the South African Power Pool Members

Country	Utility	Installed Capacity	Net Capacity	Maximum Demand (MD)	MD Growth	Sales	Sales Growth	Generation Sent Out	Net Imports	Net Exports	Transmission System Losses
		MW	MW	MW	%	GWh	%	GWh	GWh	GWh	%
Angola	ENE	2,210	1,805	1,599	0.49	3,427	-0.051	5,613	0	0	0.1
Botswana	BPC	892	460	610	0.06	3,118	0.003	371	1207	0	0.037
DRC	SNEL	2,442	1,485	1381	0.18	7,584	0.1181	8,185.2	95	0	0.1
Lesotho	LEC	71	72	150	0.16	488	0.062	487	175	27	0.11
Malawi	ESCOM	351	361	326	317	1,476	0.02	1,809	0	0	0.09
Mozambique	EDMHCB	2,308	2,279	830	0.18	2,380	0.13	390	1004	233	0.064
Namibia	NamPower	501	392	629	0.03	3,648	0.012	1,305	1337	37	0.032
South Africa	ESKOM	46,963	41,071	36,170	0.01	224,446	0.027	237,430	542	4,909	0.0327
Swaziland	SEC	70.6	70	221	0.08	1,018.6	0.037	288.1	889	0	0.06
Tanzania	TANESCO	1,380	1,143	935	0.05	3,370	0.209	3,034	0	0	0.0612
Zambia	ZESCO	2,128	2,029	1,987	0.12	10,688	0.072	11,381	165	3,441	0.046
Zimbabwe	ZESA	2,045	1,600	1,671	0.08	7.367	0.045	6,951	979	1,231	0.04

BPC = Botswana Power Corporation, DRC = Democratic Republic of the Congo, EDM = Electricidade de Moçambique,
ENE = Empresa Nacional de Electricidade de Angola, ESCOM = Electricity Supply Corporation of Malawi, GWh = gigawatt-hour,
LEC = Lesotho Electricity Company, MW = megawatt, SEC = Swaziland Electricity Company, SNEL = Société Nationale d'Électricité,
TANESCO = Tanzania Electric Supply Company, ZESA = Zimbabwe Electricity Supply Authority, ZESCO = Zambia Electric Supply Company.

Source: South African Power Pool (2014), SAPP Annual Review Report 2013. Harare: South African Power Pool Secretary General.

4. Integration and Cooperation in the India–Association of Southeast Asian Nations Energy Market

India is already engaged in energy infrastructure development in the ASEAN region, particularly in Cambodia, Lao PDR, Myanmar, and Viet Nam. India is building hydropower projects, power transmission lines and substations, and oil and gas pipelines in these countries. India's trade in electricity and energy commodities is largely limited to coal imports from Indonesia and exports of Indian petroleum products. Singapore, Thailand, the Philippines, and Cambodia depend more heavily on imports than India does; however, the resource positions of India and ASEAN indicate that India can import much more, particularly natural gas and electricity (Table 1.2).

Table 1.2 Energy Balances in India and the Association of Southeast Asian Nations Countries

Country	Production (MToe)	Imports (Mtoe)	Exports (Mtoe)	TPES (Mtoe)	Net imports	Import dependency
India	540.94	277.98	64.52	749.45	213.46	0.28
Brunei Darussalam	18.69	0.24	14.85	3.83	-14.61	-3.81
Cambodia	3.79	1.57	0.00	5.33	1.57	0.29
Indonesia	394.57	47.30	232.11	209.01	-184.8	-0.88
Malaysia	84.27	43.0	47.04	75.91	-4.05	-0.05
Myanmar	22.39	0.24	8.63	14.06	-8.39	-0.60
Philippines	23.89	21.36	3.32	40.45	18.04	-0.45
Singapore	0.93	135.98	56.98	33.45	79.00	0.99
Thailand	68.74	66.06	11.84	119.15	54.22	0.46
Viet Nam	66.6	15.08	21.85	61.21	-6.77	-0.11

Mtoe = million tonnes of oil equivalent, TPES = total primary energy supply.

Source: International Energy Agency (2016), World Energy Outlook 2016. Paris: International Energy Agency.

ASEAN is in the process of developing two region-wide grids: the ASEAN Power Grid and the Trans-ASEAN Gas Pipeline. India's NER can connect to these two grids via transmission lines and gas pipeline connections through Myanmar. India's electricity grid is already connected to Bangladesh's grid, and Bangladesh is planning to link its grid with Myanmar's. As countries recognise the multiple benefits of interconnectivity, significant discussions have arisen over a potential

Myanmar–Bangladesh–India natural gas pipeline. India and Myanmar have also revived a discussion concerning a proposed gas pipeline connecting India and Myanmar through Bangladesh. Various design options are being considered, including a land route via the NER states of Tripura and Mizoram, an offshore route through the coastal areas of Bangladesh, and a deep-sea route. In the future, India will be able to access not only electricity and gas from Myanmar but also gas from faraway fields in Indonesia, Malaysia, and Brunei, as well as electricity from the Lao PDR.

5. Objectives and Scope of the Study

India's energy connectivity, particularly that of the NER with ASEAN, is one of the foundations of the Act East Asia policy, which envisages accelerated and wide-ranging engagement between ASEAN and India. While working to establish a comprehensive free-trade area through the proposed Regional Comprehensive Economic Partnership, India's cooperation with ASEAN will be key to promoting economic stability, competitiveness, growth, and integration in the region. From this perspective, the NER is in a good position to meet the common requirements of economic growth through energy connectivity.
The aim of this study is to (i) determine the energy sector development needs and potential for electricity generation in the NER; (ii) analyse the opportunities for CBET between the NER and its neighbours such as Bangladesh, Myanmar, and Nepal; (iii) estimate the cost of such arrangements and investment possibilities; and (iv) draw policy implications for prioritised investment needs, including regulatory reforms, financial flows, and institutional cooperation at national and international levels.

This study is an effort to improve existing knowledge on infrastructure connectivity and other relevant issues related to the energy sector. This book is the outcome of a study that addressed the prospects and challenges of NER–ASEAN connectivity, and it provides a policy framework for strengthening energy market integration.

To meet these objectives, this book addresses the following topics:

5.1. Energy Sector Development Needs and Electricity Generation Potential in the North Eastern Region of India

Economic growth in India has been uneven as the states are developing at different speeds. Growth acceleration in the NER must be supported by parallel development of the energy sector to create rebound effects. This region possesses 23% of India's estimated reserves of crude oil as well as the nation's largest supply of potential hydropower, which remains unexploited. Securing an adequate physical energy supply and extending the benefits of modern electricity to the region's estimated 3 million people who still live without it also presents a challenge. Looking further ahead, this region must harness all potential sources of energy, secure sufficient energy for itself, and sell the surplus. The NER's energy demand and supply will be estimated at state levels, with appropriate assumptions based on business as usual and alternate economic development scenarios.

5.2. Advancing Energy Infrastructure Development for Cross-Border Energy Trading

The development of energy infrastructure (as well as transport and industrial infrastructure) and cross-border trading will be driven by several factors, including energy resource endowments relative to demand, timing of the peak load, locational factors that favour cross-border connectivity, and economies of scale and operation from linking the NER's electric power grids with those of neighbouring countries. CBET can provide substantial benefits, including the efficient use of the NER's energy resources, improved energy security and reliability at the subregional level via diversification of supply, and an optimised transmission network to meet varying peak load demands in the NER and neighbouring countries. This should lead to lower energy costs and will provide direct economic and social benefits to the NER in terms of higher growth, increased productivity, and access to energy. The costs and benefits of new energy infrastructure development and cross-border trade will be estimated and opportunities analysed. There are numerous potential barriers to CBET, including technical, environmental, and political issues (these range from grid synchronisation to purchase agreements). Other international working CBET

models include ASEAN, Lao PDR–Thailand, Nord Pool, the SAPP, and the latest initiatives like the Central American Electrical Interconnection System.

5.3. Realising Priority Infrastructure Investments for the North Eastern Region of India

Investment in gross fixed-capital formation is crucial for the development of new energy infrastructure. However, compared to current and future investment needs, the level of capital formation in the NER states is not as high as it should be. Several attempts to raise this in line with India's approach to prioritise critical energy infrastructure needs have been made by the North Eastern Council, the acting agency for development; the North Eastern Development Finance Corporation; and the Ministry of Development of North Eastern Region. Realising domestic and cross-border energy infrastructure projects requires funding across the entire project cycle from initial concepts to eventual maintenance of the commissioned infrastructure such as dams, transmission lines, and utilities. Generally, several sources of finance should be tapped, including public financing, private investors, and international financial institutions; and extensive consultations should be held with international financiers of energy infrastructure projects in the NER and across borders, to identify obstacles and barriers. Economically viable, environmentally sound, and socially acceptable projects should be prioritised. After discussing the challenges faced by the financing community in advancing investments in the NER, implications for policy reform or choice will be drawn from the perspective of (i) the specific nature and type of the energy project, (ii) current policies and the investment climate of the NER states and neighbouring countries, and (iii) the feasibility of using different forms of national and international financing.

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CHAPTER 2

Energy Infrastructure Development for Cross-border Energy Trade in Northeast India

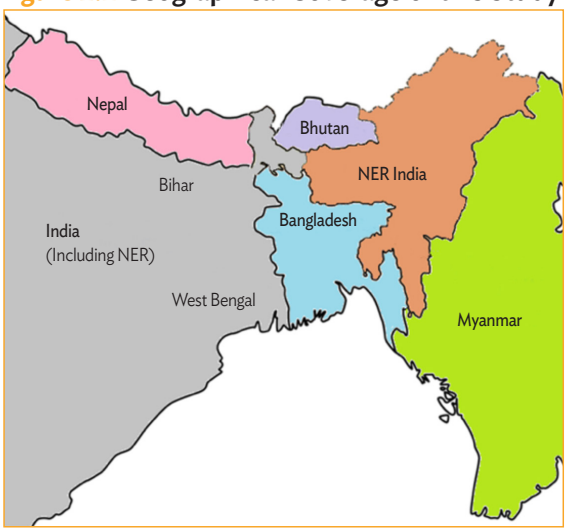
1. Energy Markets in the North Eastern Region of India

To analyse opportunities for cross-border trade in electricity between the North Eastern Region of India (NER) and the neighbouring countries of Bangladesh, Bhutan, Myanmar, and Nepal, this study uses a linear-programming model developed by the Institute of Energy Economics, Japan (IEEJ), known as the electricity supply and trade model. The aim of this study is to find the optimal electricity supply scenario during 2015–2030 in terms of power generation in each region and cross-border grid connections amongst these regions, while minimising costs overall to meet the increasing demand for electricity in the region as a whole.

This study refers to government development plans, such as the Power Sector Master Plan of the Ministry of Power, Energy and Mineral Resources of Bangladesh, to project future electricity demands, and the capacity of each type of power plant in each region. Several different cases are calculated to determine the potential of the NER as a transit provider, generator, and exporter that can promote energy connections and trade in the region.

This study covers Bangladesh, Bhutan, Myanmar, Nepal, and the NER (the NER includes the states of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, and Tripura). To analyse the electricity trade in this region thoroughly, the study also looks at the rest of India as a whole ('Other India').

Figure 2.1 Geographical Coverage of this Study



NER = North Eastern Region of India.

Source: Author.

1.1. Current Situation of the North Eastern Region of India and the Neighbouring Regions Population and Gross Domestic Product in Each Country

Of the countries that neighbour the NER, Bangladesh has the largest population and highest gross domestic product (GDP), surpassing the sum of Bhutan, Myanmar, Nepal, and the NER. The GDP per capita in most of these regions is around $1,000, much lower than the global average ($10,000), as well as the average of countries not in the Organisation of Economic Cooperation and Development (OECD) ($4,400). As such, these regions have significant potential to expand their economic activities and increase their consumption of energy.

Electricity Demand and Supply

In Bhutan, which has abundant hydropower resources and the highest income level of all the regions under study, electricity consumption per capita in 2015 was 3,415 kilowatt-hours (kWh) per person. This was more than triple the consumption of Other India, which came second at 1,066 kWh/person. In contrast, electricity consumption per capita in Bangladesh, Myanmar, Nepal, and the NER was less than 400 kWh/person (Figure 2.2).

Table 2.1 Population and Gross Domestic Product of Each Region (2015)

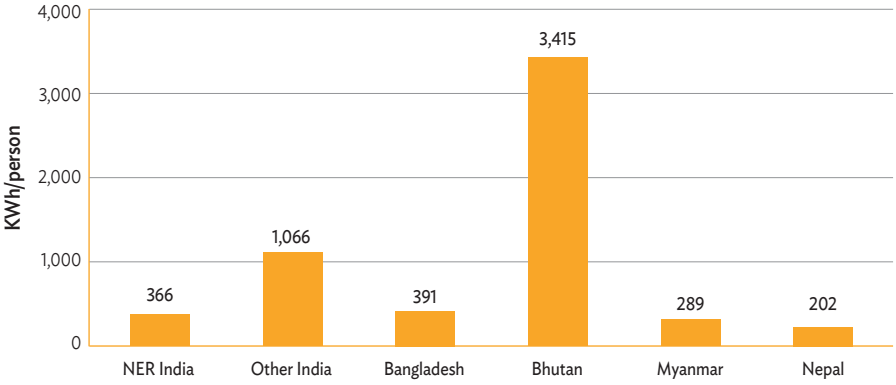
	Population (million people)	GDP ($ billion)	GDP per capita ($/person)
India	1,311	2,089	1,593
NER	49	53	1,077
Other India	1,262	2,036	1,613
Bangladesh	161	195	1,212
Bhutan	1	2	2,656
Myanmar	54	63	1,161
Nepal	29	21	743

GDP = gross domestic product, NER = North Eastern Region of India.

Note: 'Other India' refers to all Indian states and territories other than the eight states in the NER (Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura).

Sources: World Bank (2017), World Development Indicators; Government of India, Ministry of Home Affairs.

Figure 2.2 Electricity Consumption per Capita in Each Region (2015)



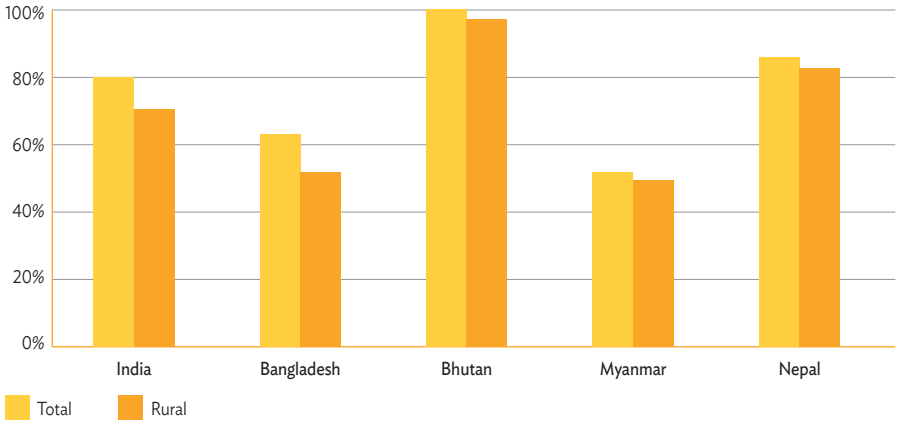
kWh = kilowatt-hour, NER = North Eastern Region of India.

Note: 'Other India' refers to all Indian states and territories other than the eight states in the NER (Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura).

Source: Estimated from data from the World Bank, International Energy Agency, and Central Statistics Office of India, amongst others.

Amongst these regions, the rate of electrification in Bhutan is the highest at nearly 100% (95% in rural areas), followed by Nepal (82%) and India (78%). On the lower end, the electrification rate is 60% in Bangladesh and 50% in Myanmar, and many residents in these regions currently have no access to the power grid.

Figure 2.3 Rate of Electrification (2015)



Source: World Bank.

The NER is currently a net importer of electricity, with about 30% of its electricity supply imported from Bhutan and Other India. The largest sources of power generation in the NER are gas and hydropower.

Bangladesh's power supply depends on fossil fuels, with more than half of its supply generated from natural gas-fired power, one-third from oil-fired power plants, and 2% from coal-fired power plants. The country imports the remaining 10% of its electricity supply from India.

Nepal generates nearly 100% of its electricity from hydropower plants. However, due to a lack of investment, its domestic power generation capacity is lower than demand, and Nepal imports electricity from India to meet both peak demand and annual consumption.

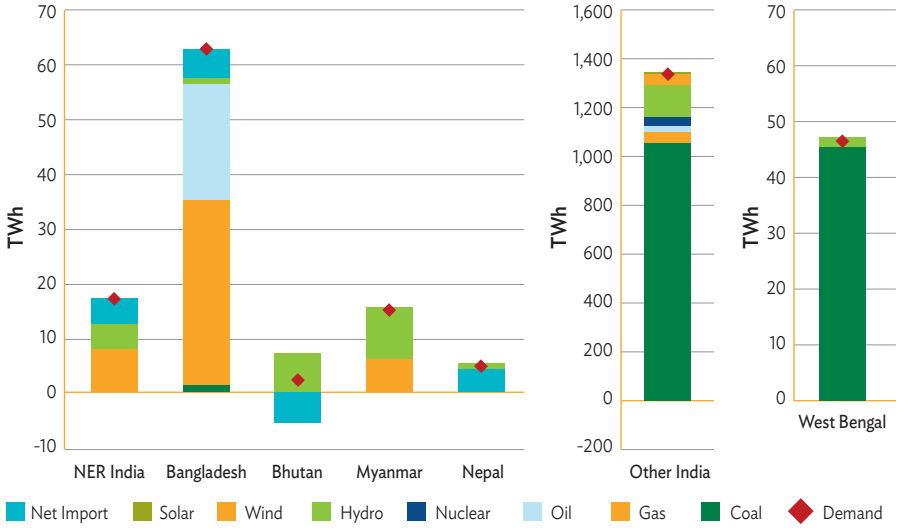
Bhutan is a major exporter of electricity to these regions. Due to its abundant resources, 100% of its power supply comes from hydropower, and its capacity is around five times the domestic peak demand. In 2015, more than 60% of all generated power was exported to India.

Myanmar is currently self-sufficient for electricity. Its primary sources of generated power are hydropower, which accounts for 58% of the total supply; and natural gas, which accounts for 40%. The remaining 2% of its supply comes from coal-fired power plants.

In Other India the power generation structure is much different, with coal accounting for around 80% of the total power supply in 2015. Hydropower provides about 10%, and wind, natural gas, and nuclear each provide about 3% of the total supply.

Currently, the main electricity trade flows in these regions are as follows: Bhutan to India, India to Bangladesh, and India to Nepal.

Figure 2.4 Electricity Demand and Supply (2015)

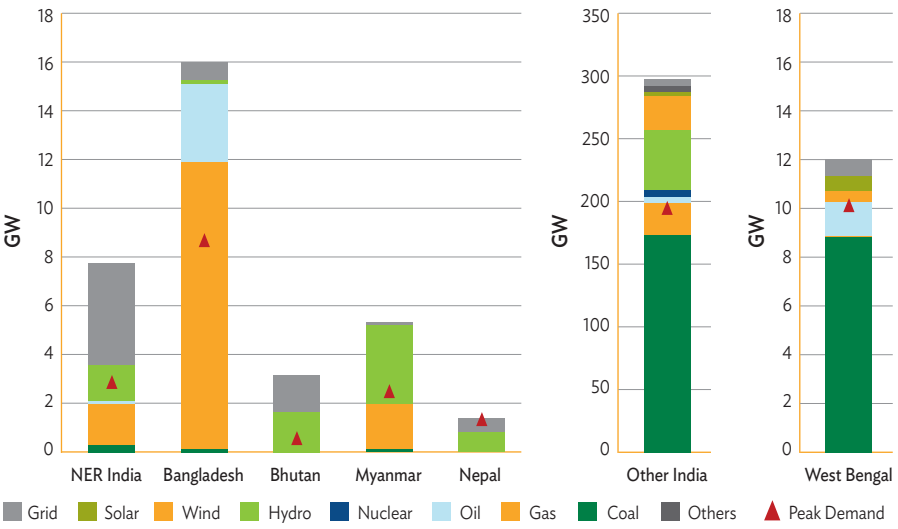


NER = North Eastern Region of India, TWh = terawatt-hour.

Note: 'Other India' refers to all Indian states and territories other than the eight states in the NER (Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura).

Sources: International Energy Agency, national master plans and statistics.

Figure 2.5 Power Supply Capacity and Peak Demand (2015)

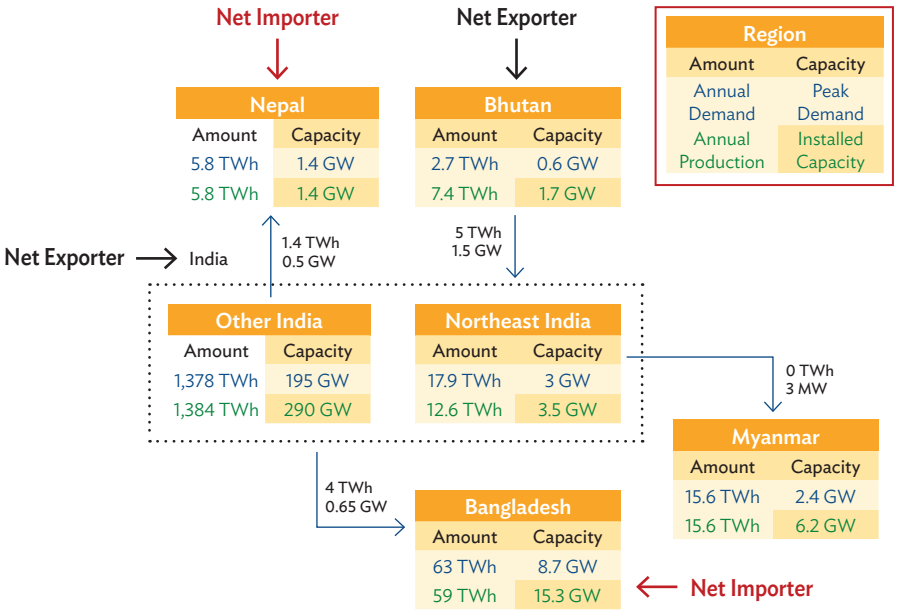


GW = gigawatt, NER = North Eastern Region of India.

Note: 'Other India' refers to all Indian states and territories other than the eight states in the NER (Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura).

Sources: International Energy Agency, national master plans and statistics.

Figure 2.6 Electricity Balance (2015)



GW = gigawatt, TWh = terawatt-hour.

Note: 'Other India' refers to all Indian states and territories other than the eight states in the North Eastern Region of India (Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura).

Sources: International Energy Agency, national master plans and statistics.

2. Methodology and Major Assumptions

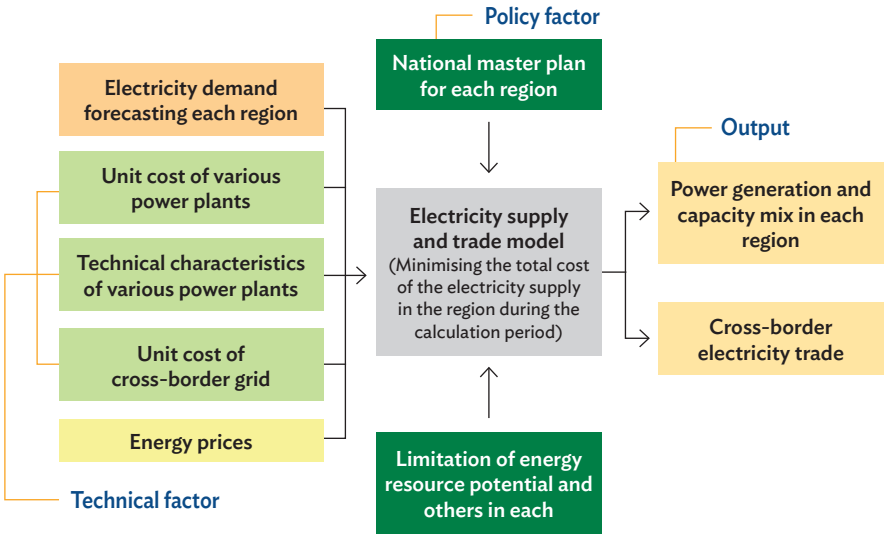
2.1. Overview of the Model

The electricity supply and trade model used in this study was designed to determine a cost-optimal solution for the electricity mix and trade to satisfy given electricity demand levels in multiple countries or regions. The electricity demand forecast in each region is drawn from the government plan or official outlook. The unit cost of various power plants and cross-border grids are given values estimated from various sources such as related reports and papers. Finally, the price of fossil fuels during the calculation period (2015–2030) was determined by referring to the IEEJ's Energy Outlook 2018.

To determine whether power supply will meet demand at any time in the future, this study refers to the planned capacity (set out in the official power and/or energy master plans) of nuclear, renewable, and some fossil fuel-fired power plants, as well as cross-border grids, to determine the specific capacity range.

As the solution to a linear programming problem, the capacity of the power mix and cross-border grid in each time period, power generation, and electricity trade can be determined in each hour of each time period.

Figure 2.7 Framework of the Model Analysis



Source: Authors.

As described in equation 1, the objective function of the calculations is to minimise the total net present value of the power supply cost during the whole period, including investment costs of power plants and cross-border grids, fixed costs such as maintenance and labour, and variable costs for fossil fuels. In this study, the discount rate is set at 5% referring to the average level of public investment in OECD countries.

The major relations in the model are (i) the balance between demand and supply (production and import or export) at each time point (equation 2), and (ii) the limitation of power generation by the current capacity of power plants (equation 3). In the model, one time period is 5 years, each containing three seasons (wet, dry, and inter-season), and there are 24 hours (time points) in a typical day in each season.

$$Min \quad Total\_C = \sum_{t=0}^{T}\left(\frac{1}{(1+r)^{t}}\left(\sum_{reg=1}^{REG}\sum_{p=1}^{P}\left(I\_P_{t,reg,p} + F\_P_{t,reg,p} + V\_P_{t,reg,p}\right)\right.\right. \\ \left.\left. + \sum_{r1=1}^{REG}\sum_{r2=1}^{REG}\left(\frac{1}{2}\left(I\_G_{t,r1,r2} + F\_G_{t,r1,r2}\right) + V\_G_{t,r1,r2}\right)\right)\right) \quad (1)$$

Min Total_C: total cost during the simulation period in present value; r: discount rate; t: time period; reg: region; p: type of power plant;
I_P, F_P, V_P: investment, fixed cost, variable cost of power plant;
I_G, F_G, V-G: investment, fixed cost, variable cost of cross-border grid.

$$Demand_{t,s,h,reg} \le \sum_{p=1}^{P} Gen_{t,s,h,reg,p} + \sum_{r2=1}^{REG}\left(Tran_{t,s,h,r2,reg} - Tran_{t,s,h,reg,r2}\right) \quad (2)$$

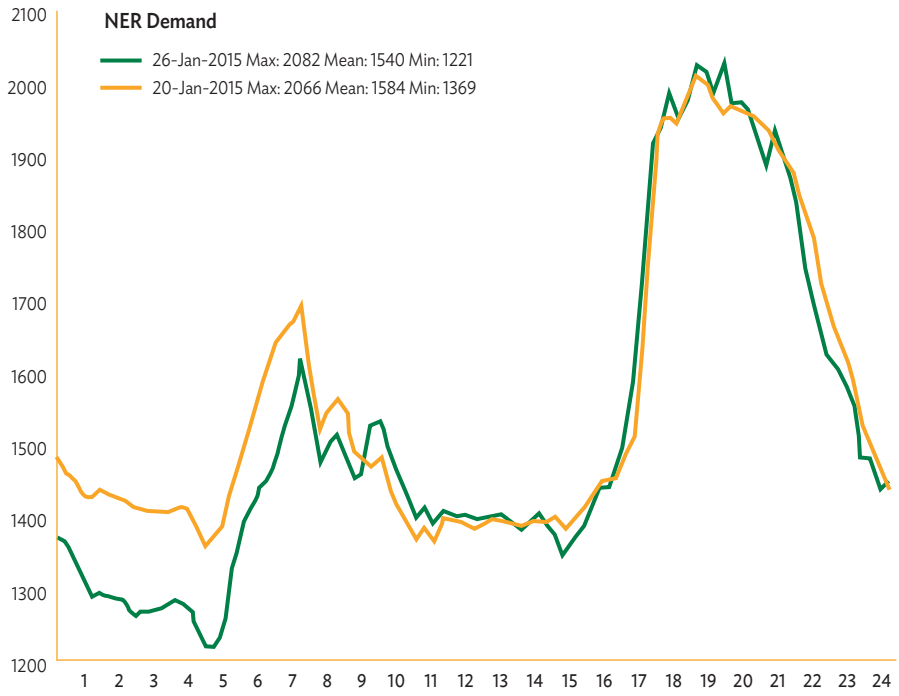
Demand: electricity demand; Gen: electricity generation; Tran: electricity transmission; s: season; h: hour.

$$Gen_{t,s,h,reg,p} \le \sum_{p=1}^{P}\left(Cap\_E_{reg,p,t} + \sum_{t'=0}^{t} Cap\_N_{reg,p,t'}\right) \quad (3)$$

Cap_E: existing power plant; Cap_N: new power plant.

In the model, the load curves of electricity demand in each region are set in each season.

Figure 2.8 Load Curve of Electricity Demand (in the North Eastern Region of India)



max = maximum, min = minimum, NER = North Eastern Region of India.

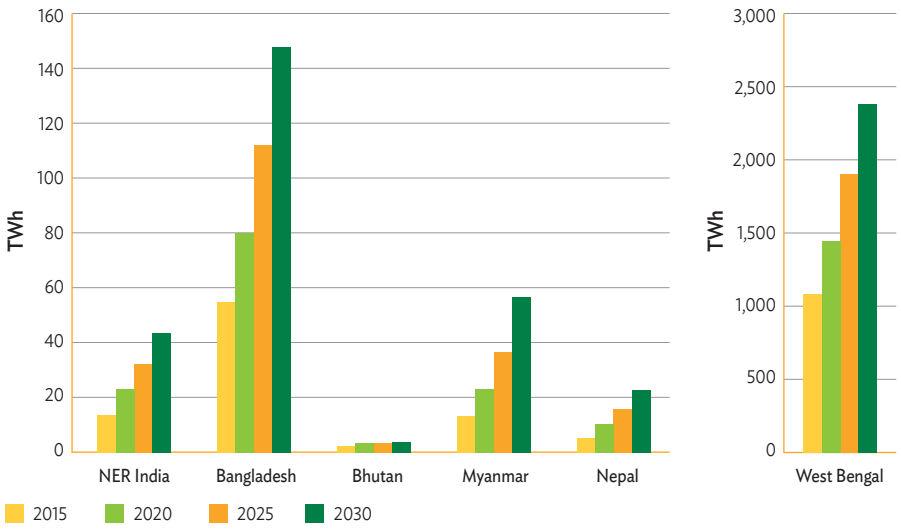
Source: Government of India, Ministry of Power (2016), Report of the Technical Committee on Large Scale Integration of Renewable Energy, Need for Balancing, Deviation Settlement Mechanism (DSM) and Associated Issues. Delhi.

2.2. Major Assumptions

Electricity Demand Forecast

To estimate the future electricity demand in each region, this study refers to forecasts in government plans. According to these forecasts, from 2015 to 2030 the demand for electricity will increase 3 times in the NER, 2.7 times in Bangladesh, and 1.7 times in Bhutan. In Myanmar and Nepal, which have the lowest electricity consumption per capita of the regions under study, the power demand will more than quadruple from current levels. The sum of the electricity demand in all these regions will reach 273 terawatt-hours in 2030, triple the demand in 2015. During the same period, the electricity demand of Other India will increase to about 2,400 terawatt-hours, 2.2 times the current level.

Figure 2.9 Power Supply Capacity and Peak Demand (2015)



NER = North Eastern Region of India, TWh = terawatt-hour.

Note: 'Other India' refers to all Indian states and territories other than the eight states in the North Eastern Region of India (Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura).

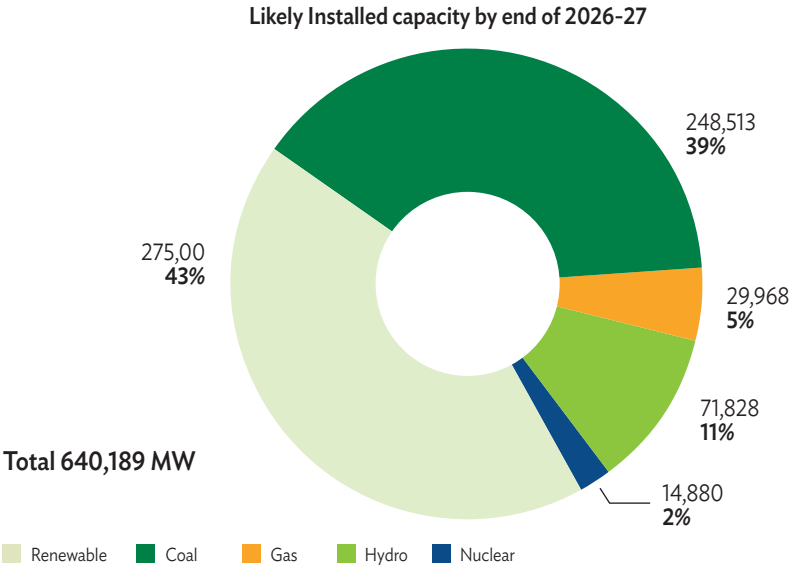
Sources: International Energy Agency, national master plans and statistics.

Plans for Power Supply and Cross-Border Grid Expansion

As announced in its National Electricity Plan, India is planning to accelerate the introduction of renewable energy such as wind power and solar photovoltaics. It is also aiming to increase the share of renewable power including hydropower to more than 50% by the mid-2020s. Currently, the installed capacity of coal-fired power plants is about 180 gigawatts (GW), 60% of total installed capacity. In the coming decades, while growth in this area will be lower than in renewables, coal-fired power plants are projected to continue increasing, remaining the largest source of power generated in this region.

Given the low-cost of coal, Bangladesh is planning to expand the share of coal-fired power in the domestic supply capacity to meet the increasing demand for electricity. The country is also planning to introduce nuclear power plants as a baseload electricity source in the mid-2020s. Currently, more than 70% of installed capacity comes from gas-fired power, which will remain a major source of power in the future. However, due to a lack of domestic resources, Bangladesh will also increasingly depend on imported electricity.

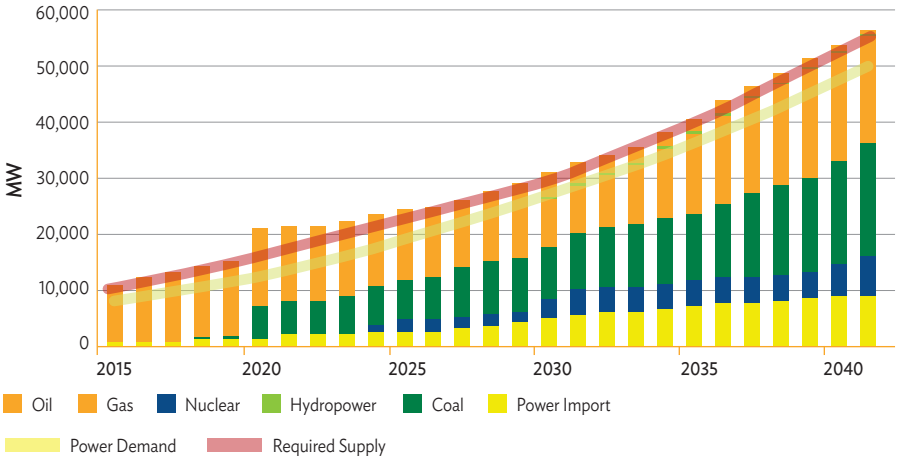
Figure 2.10 Generation Expansion Plan of India



hydro = hydropower, MW = megawatt.

Source: Central Electricity Authority of India (2016), Draft National Electricity Plan. Delhi.

Figure 2.11 Power Development Plan of Bangladesh



MW = megawatt.

Source: Government of Bangladesh, Ministry of Power, Energy and Mineral Resources (2016), *Power System Master Plan 2016*. Dhaka.

Table 2.2 Hydropower Development Plan of Bhutan

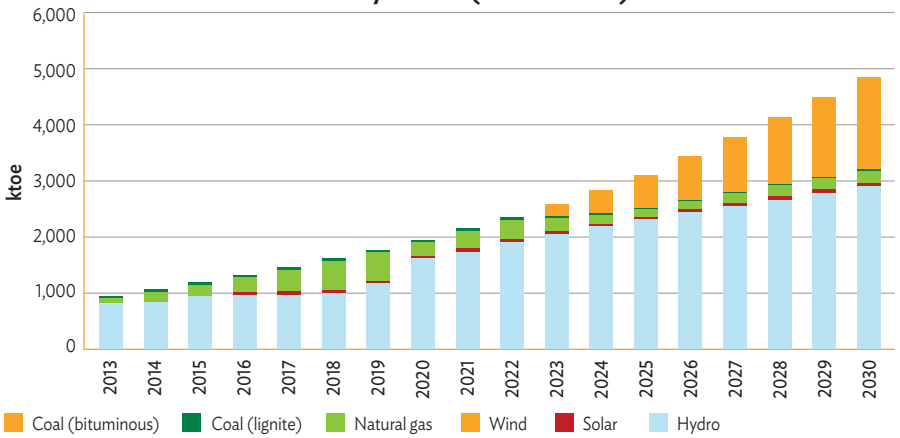
Existing I.C.	Capacity addition by 2020	I.C. at the end of 2020	Capacity addition during 2020–2030	I.C. at the end of 2030
1,480 MW	10,334 MW (fourteen HEPs)	11,814 MW	14,720 MW (sixtyone HEPs)	26,534 MW

HEP = hydroelectric project, IC = installed capacity, MW = megawatt.

Source: Central Electricity Authority of India (2012), National Transmission Grid Master Plan for Bhutan, 2012. Delhi.

As announced in its Energy Master Plan, Myanmar will develop more hydropower and coal-fired power to meet the increased electricity demand. By 2030, it is projected that 60% of all power generated in the country will come from hydropower and 30% from coal, with most of the remainder provided by gas-fired power.

Figure 2.12 Projected Power Generation Fuel Mix in Myanmar (2013–2030)



hydro = hydropower, ktoe = kilotonnes of oil equivalent.

Note: Case 2 (balanced hydropower: less planned hydropower displaced by coal and solar photovoltaics).

Source: Government of Myanmar, National Energy Management Committee (2015), *Myanmar Energy Master Plan, 2015*. Nay Pyi Taw.

Nepal is currently a net importer of electricity. The country's hydropower capacity is projected to increase to nearly 5 GW by 2030, through the utilisation of the huge potential of its domestic hydropower resources (Nepal Electricity Authority, 2014). As power generated mainly from hydropower surpasses annual domestic demand, Nepal will become a net exporter of electricity. However, in the dry season, due to the low supply capacity of run-of-river hydropower plants, Nepal will still need to import electricity from India when the available supply capacity, which relies on hydropower, falls below peak demand.

Table 2.3 Power Development Plan of Nepal

Base Case

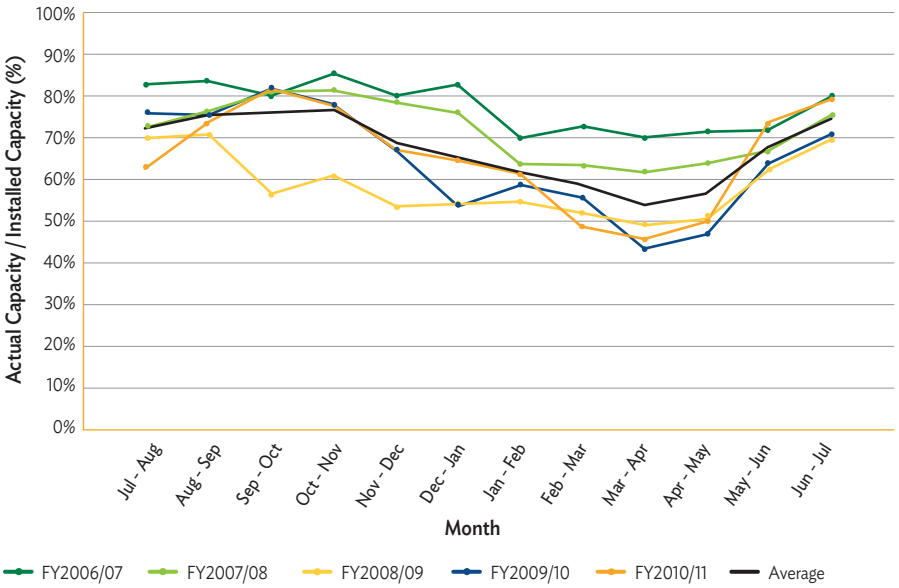
FY	Project	Total Installed capacity (MW)	LOLP (%)
(2011/12)	(Existing)	862.1	-
2012/13	-	862.1	50.375
2013/14	-	862.1	53.789
2014/15	-	862.1	57.975
2015/16	Kulekhani No. 3 (14), Chameliya (30), Khani Khola (25)	1,081.1	32.637
2016/17	Upper Sanjen (11), Sanjen (42.9) Upper Trishuli 3A (60), Uppper Tamakoshi (456)	1,651.0	2.733
2017/18	Madhya (Middle) Botekoshi (102), Rasuwagadi (111), Rahughat (32), Upper Marsyangdi (50), Mistri (42)	1,988.0	1.575
2018/19	ROR (100 in total)	2,088.0	1.927
2019/20	Upper Trishuli 3B (37), ROR (100 in total)	2,225.0	2.579
2020/21	Tanahu (140), Upper Modi A (42), ROR (100 in total)	2,507.0	1.919
2021/22	Tamakoshi V (87)	2,594.0	3.087
2022/23	Budhi Gandaki (600)	3,194.0	0.130
2023/24	-	3,194.0	0.516
2024/25	ROR (100 in total)	3,294.0	1.225
2025/26	Upper Arun (335), ROR (100 in total)	3,729.0	0.666
2026/27	Dudh Koshi (300)	4,029.0	0.336
2027/28	-	4,029.0	1.079
2028/29	Nalsyau Gad (410)	4,439.0	0.440
2029/30	Andhi Khola (180), ROR (300 in total)	4,919.0	1.331
2030/31	-	4,919.0	1.330
2031/32	Chera-1 (149), Madi (200)	5,268.0	1.232

LOLP = loss of load probability, MW = megawatt, ROR = run-of-river.

Notes: 'FY' before a calendar year denotes the year in which the fiscal year ends, e.g., FY2018 ends on 15 July 2018. The number in the case arc is the capacity of identified power plants in MW.

Source: Nepal Electricity Authority (2014), *Nationwide Master Plan Study on Storage-Type Hydroelectric Power Development in Nepal, 2014*. Kathmandu.

Figure 2.13 Rates of Maximum Output to Installed Hydropower Capacity in Nepal by Month



Note: 'FY' before a calendar year denotes the year in which the fiscal year ends, e.g., FY2018 ends on 15 July 2018.

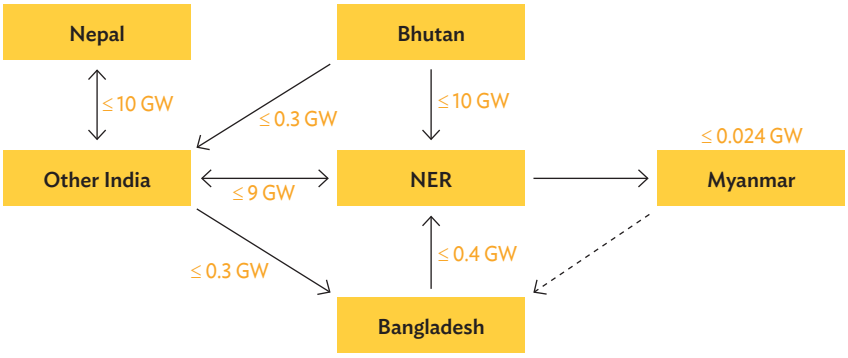
Source: Nepal Electricity Authority (2014), *Nationwide Master Plan Study on Storage-Type Hydroelectric Power Development in Nepal, 2014*. Kathmandu.

Based on national energy and master power plans, this study determined the limitations of cross-border transmission capacity (Figure 2.14). Under the current plans, the interconnections between Bhutan and the NER, and between Nepal and India will be enhanced. In addition, Bangladesh will import more electricity from India via the expanded capacity of the interconnection line between the two countries.

Economic and Technical Parameters of Power Generation and Cross-Border Lines

This study refers to the IEEJ's Energy Outlook 2018 for the estimated price of fossil fuels (the inputs to thermal power plants). This report projects that oil prices will rise gradually in the coming decades, mainly due to increasing oil demand in non-OECD countries and the depletion of existing low-cost oil fields. Natural gas and coal are also projected to increase in price by 2030.

Figure 2.14 Estimated Capacity of Cross-Border Grids

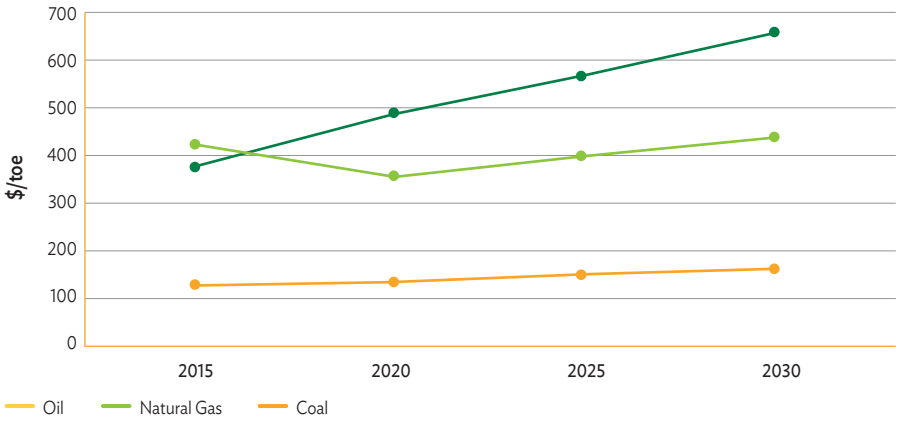


GW = gigawatt, NER = North Eastern Region of India.

Note: 'Other India' refers to all Indian states and territories other than the eight states in the NER (Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura).

Source: Authors.

Figure 2.15 Estimated Fossil Fuel Prices

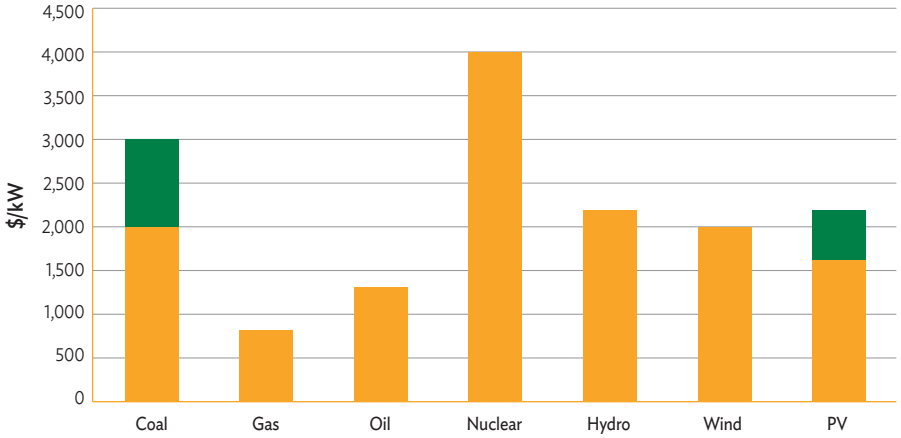


toe = tonnes of oil equivalent.

Source: Institute of Energy Economics, Japan (2017), *Energy Outlook 2018*. Tokyo.

The estimated investment costs for various power plants are shown in Figure 2.16. The initial investment cost of nuclear power is the highest, and that of gas-fired power is the lowest. The investment cost of coal-fired power plants differs by region; for example, it is higher in inland mountain countries. The investment cost of solar photovoltaics will decrease gradually as the technology develops further and production and sales increase.

Figure 2.16 Estimated Investment Cost of Power Plants



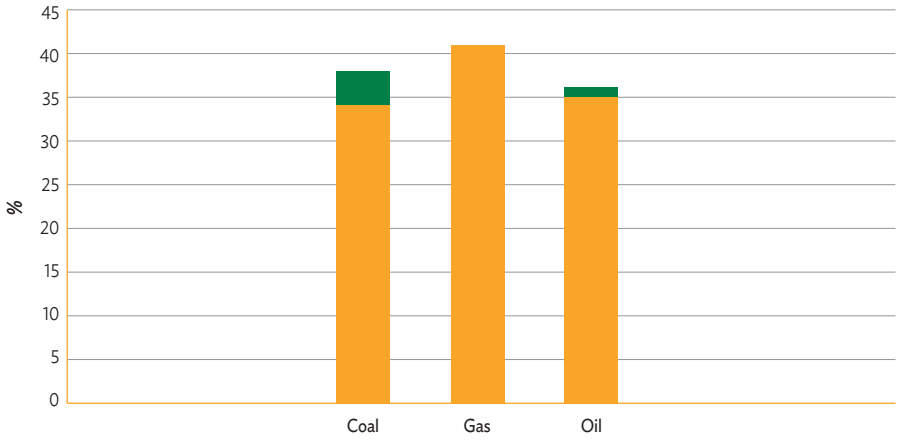
hydro = hydropower, kW = kilowatt, PV = solar photovoltaics.

Note: The cost of investing in coal-fired power plants differs by region. The cost of investing in photovoltaics differs by period.

Source: International Energy Agency, Organisation for Economic Cooperation and Development (2015), *Projected Costs of Generating Electricity*. Paris.

Of all fossil fuel-fired thermal power plants, those fired by gas have the highest thermal efficiency (40%) in the NER and neighbouring regions. The thermal efficiency of coal-fired plants in mountain countries such as Bhutan and Nepal is assumed to be lower than in the other countries.

Figure 2.17 Estimated Thermal Efficiency of New Thermal Power Plants



Source: Institute of Energy Economics, Japan.

Information on the cost of cross-border lines is limited. This study refers to an Asian Development Bank report on cross-border power trading in South Asia to estimate the investment cost (Wijayatunga, Chattopadhyay, and Fernando, 2015). In the model, fixed operation and maintenance costs per year ($/kW) is estimated at 3% of the investment cost, and variable costs per unit of electricity ($/MW-hour) are assumed to be proportional to the investment cost (1% thereof).

Table 2.4 Estimated Cost of Major Cross-Border Grids

Major cross-border line	Investment cost ($/kW)
BHUTAN–NER	71
Nepal–Other India	372
NER–Bangladesh	400
NER–Myanmar	200

kW = kilowatt, NER = North Eastern Region of India.

Note: 'Other India' refers to all Indian states and territories other than the eight states in the NER (Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura).

Source: Estimate from Wijayatunga, P., D. Chattopadhyay, and P.N. Fernando (2015), 'Cross-Border Power Trading in South Asia: A Techno Economic Rationale', *Asian Development Bank South Asia Working Paper Series*, No. 38, Manila: Asian Development Bank.

2.3. Case Settings

To estimate the potential of the NER as a transit provider, generator, and exporter, this study calculates three cases. In the reference case, the installed capacity of the major energy sources of power plants to meet the increasing electricity demand in the NER and neighbouring regions aligns with the power development plans mentioned in Section 2.2. The upper capacity limits of cross-border lines are set out in Figure 2.14.

The power plant development scenarios are the same in the enhanced hydropower case (EGC) as in the reference case. The only difference is that in the EGC there is no upper limit on the capacity of cross-border lines connected to the NER, meaning that the capacity of cross-border lines can be expanded as much as necessary to achieve maximum economic efficiency (lower net present value of total cost).

In the reference case, the NER's installed hydropower capacity reaches nearly 5 GW in 2030, triple the 2015 level. However, this only represents 8% of the

region's identified potential hydropower capacity (58 GW), far below the current average level in India (around 25%). In the enhanced hydropower and grid case (EHGC), the NER's hydropower capacity is estimated to reach triple the levels in the reference case and EGC. In the EHGC, the impact of the NER as a generator and exporter is also estimated.

Table 2.5 Case Settings

	Reference case	Enhanced grid case	Enhanced hydropower and grid case
Capacity of hydropower plants	Government's plan	Same as reference case	Enhanced in the NER (25% of the potential, threefold increase from the reference case)
Capacity of other power plants	Government's plan	Same as reference case	Same as reference case
Capacity of cross-border grids	As planned*	No high limit	No high limit

*see Fig 2.14.

NER = North Eastern Region of India.

Source: Authors.

3. Results and Discussion

3.1. Results of Reference Case

According to the reference case, by 2030 the NER will need to import electricity to fill the gap between domestic demand and its capacity to generate electricity, with 24% of its annual electricity demand provided by imports from Bhutan. In Bhutan, the expanded production of electricity from hydropower will substantially surpass domestic demand, and the country will increase its presence as an electricity exporter. Due to the geographical location of these regions, these exports will mainly be directed to the NER; however, as these exports will far exceed the NER's import requirements, most of the imported electricity will be sent to Other India and Bangladesh. As such, the NER will play an important role as a transit corridor.

Fossil fuel-fired thermal power will account for a large share of Bangladesh's total installed capacity by 2030. However, given the high cost of oil-fired thermal power, it will be more economical to import electricity from neighbouring

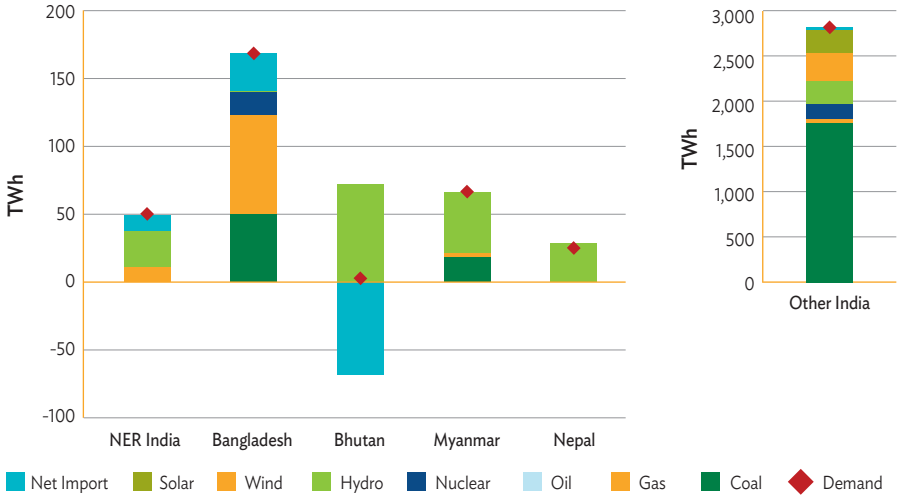
countries. Thus, Bangladesh will import more electricity, most of which will be imported indirectly from Bhutan via the NER and Other India.

Nepal still needs to import power from India to meet peak demand; however, due to its expanded hydropower capacity, Nepal will be able to export electricity when domestic demand is low. Based on annual averages, Nepal will become a net exporter of electricity.

Myanmar's domestic electricity demand and supply will remain almost balanced.

The increasing energy demand in Other India will be satisfied by domestic production, mainly from coal-fired power but also from renewables, which are expanding rapidly.

Figure 2.18 Electricity Demand and Supply in 2030 (Reference Case)

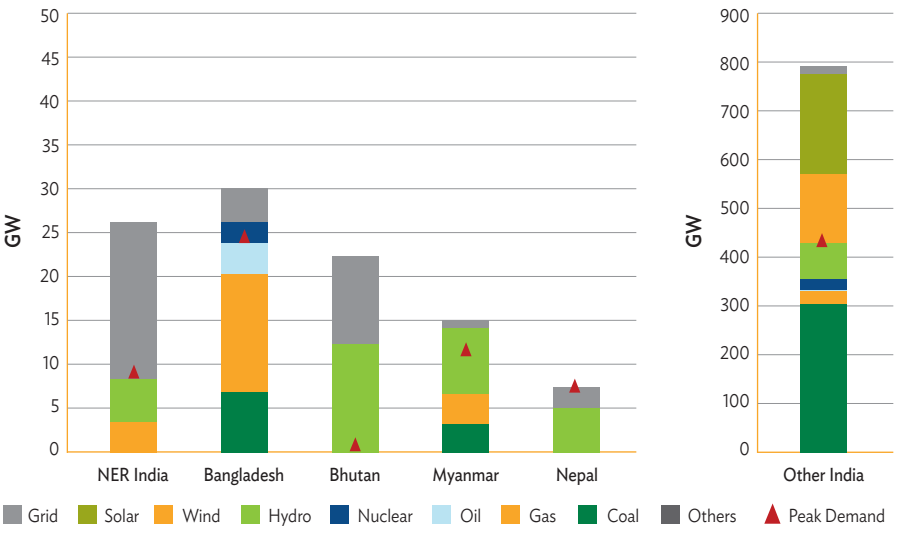


NER = North Eastern Region of India, TWh = terawatt-hour.

Note: 'Other India' refers to all Indian states and territories other than the eight states in the NER (Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura).

Source: Authors.

Figure 2.19 Power Supply Capacity in 2030 (Reference Case)

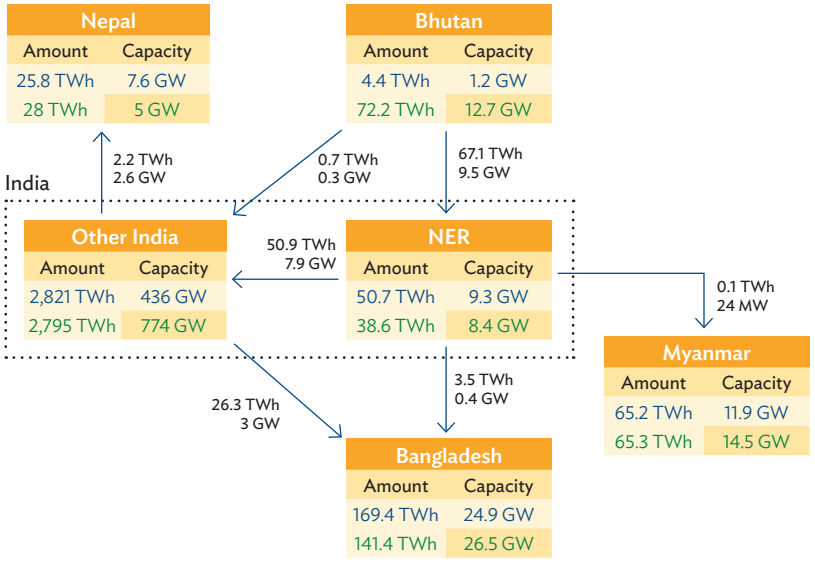


GW = gigawatt-hour, NER = North Eastern Region of India.

Note: 'Other India' refers to all Indian states and territories other than the eight states in the NER (Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura).

Source: Authors.

Figure 2.20 Electricity Balance and Trade in 2030 (Reference Case)



GW = gigawatt, NER = North Eastern Region of India, TWh = terawatt-hour.

Note: 'Other India' refers to all Indian states and territories other than the eight states in the NER (Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura).

Source: Authors.

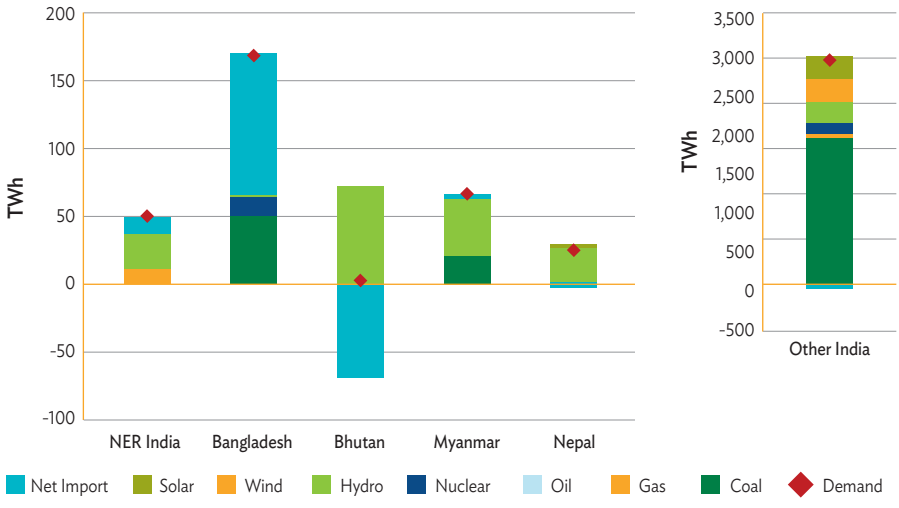
3.2. Results of the Enhanced Grid Case

In the EGC, the electricity generation scenario in the NER, Bhutan, and Nepal is almost the same as in the reference case. Bangladesh imports more electricity from the NER, and generates less gas-fired power; Myanmar replaces electricity produced from domestic gas-fired power with energy imports from the NER; and Other India generates more electricity by boosting the operation rate of coal-fired power, the capacity of which will relatively exceed demand by 2030.

Compared to the reference case, the capacity of the NER–Bangladesh connection line increased from 0.4 GW to 10.4 GW, while that of the NER–Myanmar line increased from 24 MW to 1.5 GW in the EGC. The role of the NER as a transit corridor between neighbouring regions became more important, as Bhutan's hydropower and Other India's coal-fired power are transported to Bangladesh and Myanmar via the NER.

In the EGC as a whole, gas-fired power generated from high-cost fuel is replaced by power generated from low-cost coal.

Figure 2.21 Electricity Demand and Supply in 2030 (Enhanced Grid Case)

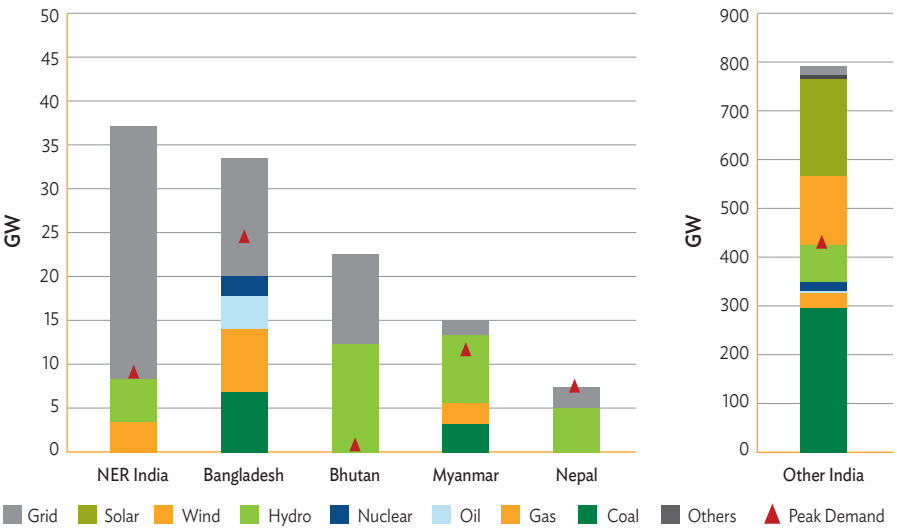


NER = North Eastern Region of India, TWh = terawatt-hour.

Note: 'Other India' refers to all Indian states and territories other than the eight states in the NER (Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura).

Source: Authors.

Figure 2.22 Power Supply Capacity in 2030 (Reference Case)

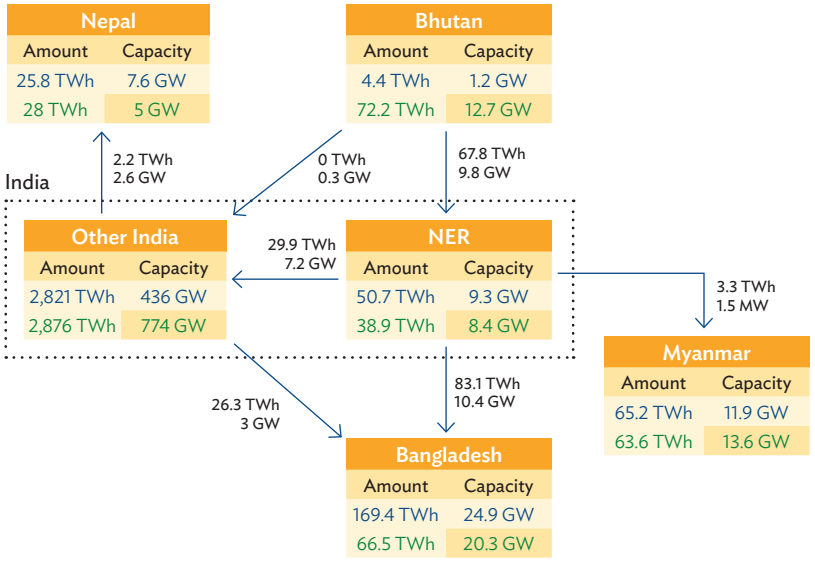


GW = gigawatt, NER = North Eastern Region of India, TWh = terawatt-hour.

Note: 'Other India' refers to all Indian states and territories other than the eight states in the NER (Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura).

Source: Authors.

Figure 2.23 Electricity Balance and Trade in 2030 (Enhanced Grid Case)



GW = gigawatt, NER = North Eastern Region of India, TWh = terawatt-hour.

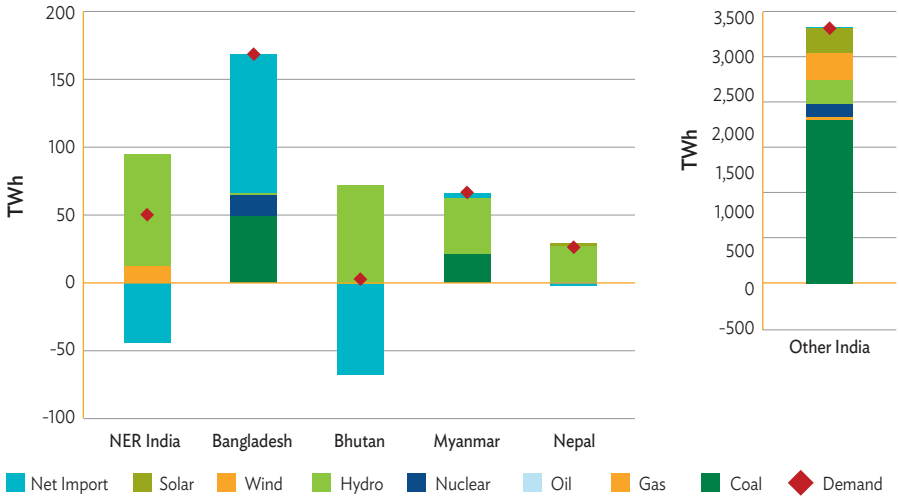
Note: 'Other India' refers to all Indian states and territories other than the eight states in the NER (Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura).

Source: Authors.

3.3. Results of the Enhanced Hydropower and Grid Case

In the EHGC, the NER generates more electricity from hydropower, and exports it to neighbouring regions. In the EHGC, in Other India, the increase in coal-fired power generation narrows and exports slow. The capacity of the NER–Bangladesh connection line expands further to 12.4 GW. In the EHGC, the NER acts as generator and exporter as well as a transit corridor. Overall, in the EHGC, fossil fuel-fired power generated from gas and coal is replaced by low-cost, zero-emission hydropower.

Figure 2.24 Electricity Demand and Supply in 2030 (Enhanced Hydropower and Grid Case)

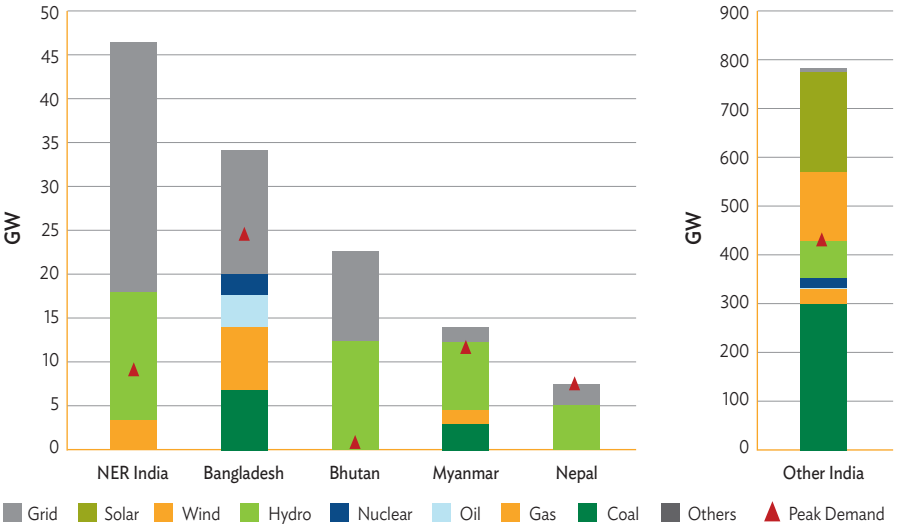


NER = North Eastern Region of India, TWh = terrawatt-hour.

Note: 'Other India' refers to all Indian states and territories other than the eight states in the NER (Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura).

Source: Authors.

Figure 2.25 Power Supply Capacity in 2030 (Enhanced Hydropower and Grid Case)

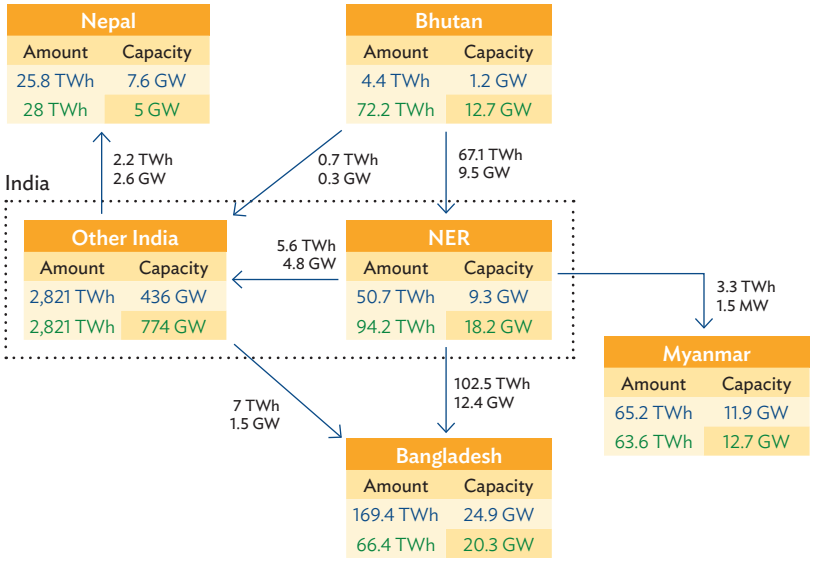


GW = gigawatt, NER = North Eastern Region of India.

Note: 'Other India' refers to all Indian states and territories other than the eight states in the NER (Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura).

Source: Authors.

Figure 2.26 Electricity Balance and Trade in 2030 (Enhanced Hydropower and Grid Case)



GW = gigawatt, NER = North Eastern Region of India, TWh = terawatt-hour.

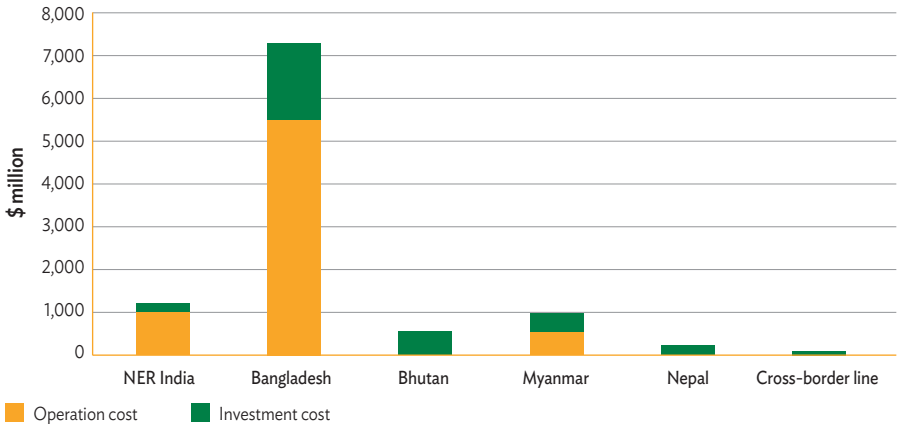
Note: 'Other India' refers to all Indian states and territories other than the eight states in the NER (Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura).

Source: Authors.

4. Cumulative Electricity Supply Cost and Carbon Dioxide Emissions

In the reference case, to meet the rapidly increasing electricity demand, the NER and neighbouring regions need to more than double their power generation capacity from 2015 to 2030. The average annual costs of the electricity supply[1] in these regions during 2015–2030, including the investment costs of new power plants (except in Other India), cross-border lines, and their operation, reach $10 billion. Of this, investment accounts for 30%, and operations (mainly fuel costs) account for 70%. The annual investment cost of the cross-border grids is $74 million.

Figure 2.27 Average Annual Costs of the Electricity Supply in the Reference Case (2015–2030)



Source: Authors.

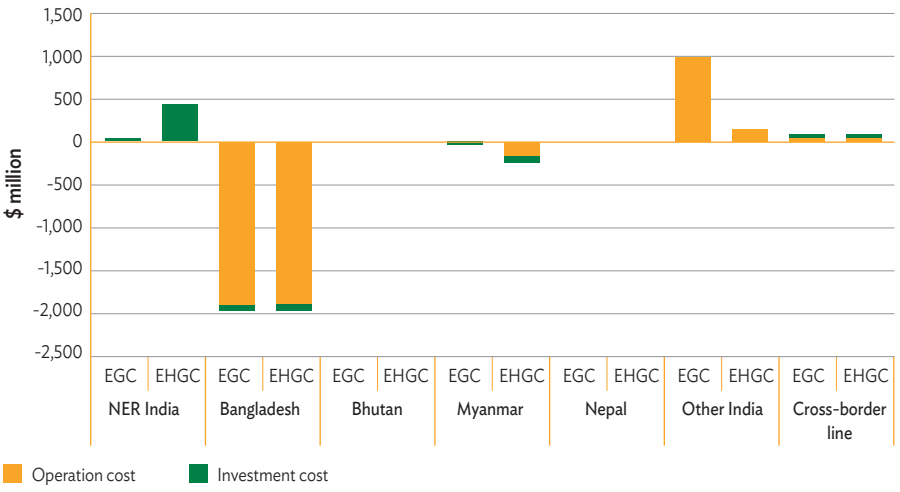
Compared to the reference case, electricity supply costs will be 10% lower in the EGC and 15% lower in the EHGC, due to increased use of lower cost hydropower instead of thermal power. In terms of the region, the cost of power generation is lower in Bangladesh and Myanmar, and higher in Other India in the EGC compared to the reference case. In the EHGC, the cost of power generation in Other India is lower than in the EGC, and hydropower investment grows in the

[1] The scale of the electricity system in Other India is much larger than in the other regions considered here, and it is fundamentally self-sufficient for electricity. Therefore, the total cost here only refers to the cost of Other India trading electricity with other regions.

NER. The annual cost of investing in cross-border lines increases to $146 million in the EGC, and $149 million in the EHGC compared to the reference case.

Importers must pay to import electricity instead of generating it domestically. On the other hand, exporters can use what they earn from their exports to cover the increased cost of generating additional electricity. Thus, it is necessary to determine how best to set the prices of traded electricity (including wheeling charges) between the concerned countries and regions. Stakeholders must also discuss the fair allocation of the benefits (cost reduction).

Figure 2.28 Changes in Average Annual Costs against the Reference Case



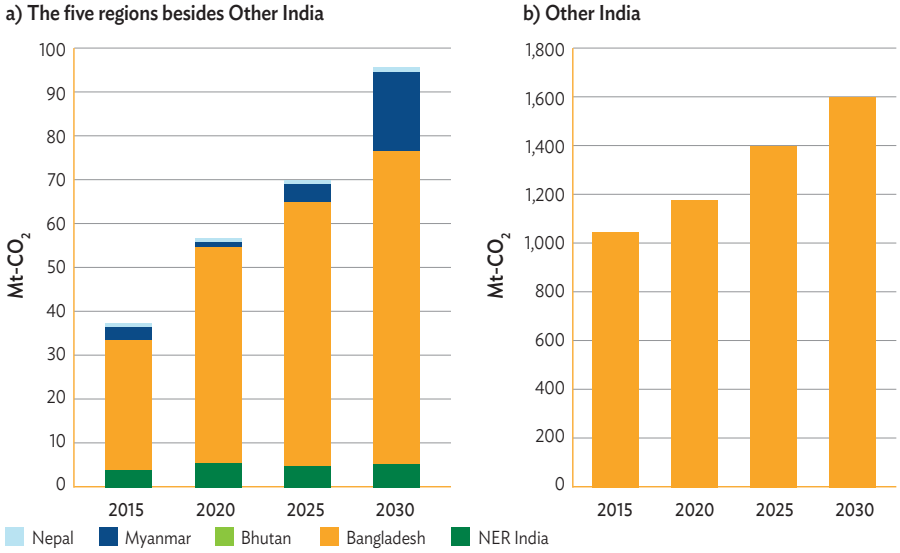
EGC = enhanced grid case, EHGC = enhanced hydropower and grid case, NER = North Eastern Region of India.

Note: 'Other India' refers to all Indian states and territories other than the eight states in the NER (Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura).

Source: Authors.

In the reference case, carbon dioxide (CO_2) emissions related to power generation will increase significantly in Bangladesh and Myanmar due to the expansion of fossil fuel-fired power generation in these countries, especially coal-fired power. The sum of CO_2 emissions in the regions excluding Other India will reach 94 million tonnes of CO_2 equivalent in 2030, 2.6 times the 2015 level; and CO_2 emissions from power generation in Other India will almost double, reaching 159 million tonnes of CO_2 equivalent in 2030.

Figure 2.29 Annual Carbon Dioxide Emissions in the Reference Case



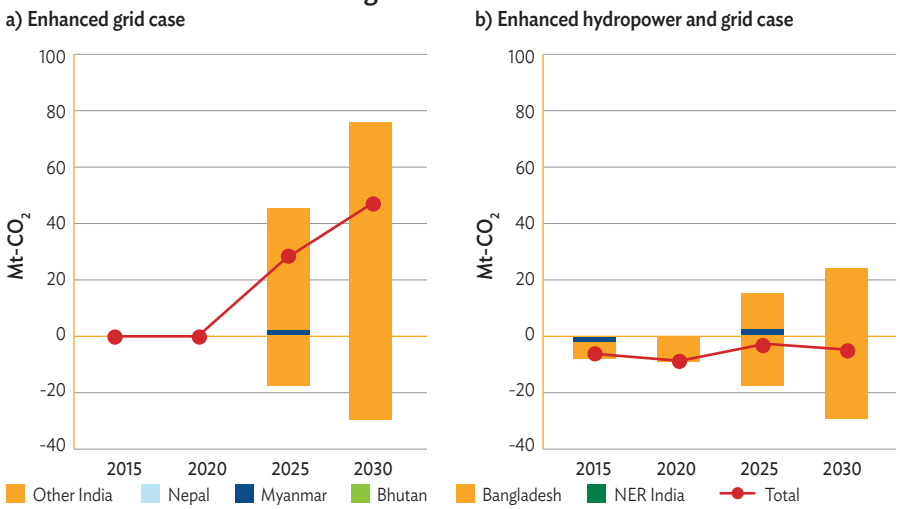
$MT\text{-}CO_2$ = metric tonnes of carbon dioxide equivalent, NER = North Eastern Region of India.

Note: 'Other India' refers to all Indian states and territories other than the eight states in the NER (Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura).

Source: Authors.

Compared to the reference case, total CO_2 emissions will increase in the EGC due to the larger amount of coal-fired power generation. In the EHGC, owing to the larger amount of hydropower, total CO_2 emissions during 2015–2030 will be 9% lower than in the reference case.

Figure 2.30 Changes in Annual Carbon Dioxide Emissions against the Reference Case



MT-CO2 = metric tonnes of carbon dioxide equivalent, NER = North Eastern Region of India.

Source: Authors.

5. Conclusions

The NER and neighbouring regions have significant potential for economic development, and the electricity demand in these regions is forecasted to grow rapidly in the coming decades. To meet the increasing electricity demand, these regions need to expand their power generation capacity to triple the current level by 2030.

Bhutan, which has huge hydropower potential, will increase its presence as a net exporter of electricity. Bangladesh needs to increase its thermal power capacity significantly to meet demand when it cannot count on imported electricity.

Thanks to its geographical location, the NER can play an important role as a transit corridor between exporters and importers by enhancing cross-border lines. Furthermore, by utilising its large hydropower potential, the NER can also become an important generator and exporter of renewable power, benefiting both the economy and the environment of these regions.

Additionally, enhancing the cross-border lines in these regions will yield the following benefits, not only for the NER but also for other regions in an economically efficient way:

(i) India can fully utilise the planned capacity of its coal-fired power plants. However, the region needs to create a mechanism to share the cost of emissions amongst the countries;
(ii) Bangladesh can avoid constructing large thermal power plants by importing electricity, making its electricity supply less dependent on fossil fuels.
(iii) Nepal, Bhutan, and Myanmar can reduce the risk of a serious seasonal supply gap for hydropower, and also realise the enormous potentiality for hydropower to contribute significantly to the regions, which will become more prosperous economies.

Thus, it must be asked how best to set the prices (including wheeling charges) of electricity traded between the concerned countries and regions. Stakeholders must also discuss the fair allocation of the benefits (costs and emissions reduction).

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CHAPTER 3

Centrality of Northeast India as an Emerging Electricity Trading Hub

International borders are key to any cooperation dynamics in the subregion consisting of Bangladesh, Bhutan, the North Eastern Region (NER) of India, and Nepal (BBIN); as well as the contiguous Southeast Asian region and Myanmar. This tightly integrated subregion – where 10 Indian provinces including Bihar and West Bengal form the core interface and provide points of connection to other neighbouring countries – is one of the most attractive and challenging geographies in Asia in terms of energy security dynamics, both from the viewpoint of sustainable development complexities and national interest security perspectives (Lama, 2017a). The BBIN subregion, also known as the South Asia Growth Quadrangle (Dubey, Baral, and Sobhan, 1999; Lama, 2002), constitutes a critical segment of the four crucial border energy junctions that have emerged very distinctly in four corners of South and Southwest Asia, where project-based subregionalism is quickly becoming an instrument of effective energy trading. These junctions are the India–Nepal–China junction to the north, the India–Pakistan–Afghanistan–Iran junction to the west, the India–Sri Lanka–Maldives junction to the south, and the India–Bhutan–Bangladesh–Myanmar and Southeast Asia junction to the east. Although India is the central actor, each member country in these four energy junctions plays a critical role in their respective political economy. Each junction has its own unique characteristics and, if interconnected both within and outside their respective junctions, could trigger durable gains of unprecedented variety (Lama, 2017b).

The cascading and spiralling impact of this trans-border junction approach on energy exchanges, regional investment, trade, connectivity, and people-

to-people contacts, as well as and other social and economic development parameters could eliminate national prejudices that hamper regionalism (Lama, 2017c).

This could trigger huge energy exchanges and transform the orientation and content of existing regionalism initiatives (including the South Asian Association for Regional Cooperation [SAARC], Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC), Bangladesh–China–India–Myanmar Forum for Regional Cooperation, BBIN, and Indian Ocean Rim Association), which remain shallow and lacklustre in terms of their progress. Under this junction framework, a large number of national and international companies will participate in various types of energy production on a regional basis.

This subregion, which was once integrated as a powerful geographic-economic entity, abruptly disintegrated in 1947 and again in 1971 for various politico-historical reasons. It is now trying to reintegrate – a rather cumbersome and daunting task. In the process of reintegration, a major challenge is to re-recognise and relocate borders as borderlands, with a political economy characterised by an intrinsic interplay of natural resources, culture, societies, trade-commerce, tourism, water towers, technology, roads and communications, security, migration, federalism, politics, and international relations. Cross-border energy trading (CBET) is emerging as the most practical, potentially beneficial, and socio-politically acceptable project in this new reintegration initiative.

1. Centrality of the North Eastern Region of India

Severe geographical constraints, topographical variations, and scarce physical infrastructure have constrained the growth and development of the NER. Even in the high-potential energy sector, the power system remains relatively undeveloped with an annual per capita power consumption (257.98 kilowatt-hours [kWh]) almost one-third the national average (778.71 kWh), and aggregate technical and commercial losses of more than 30%, compared to the national average of less than 20%. This has undermined the optimal use of resources (both human and natural), alienated the people both within the region and vis-à-vis the rest of the country, and created an acute sense of deprivation and alienation in the region. This has had far-reaching implications for the

region's development trajectory, societal values, political orientations, and, more seriously, conflictual dynamics. Inaccessibility and physical constraints have not only severely constrained the growth of institutions and social infrastructure in the region, but have also inhibited and discouraged a variety of development actors, including the private sector and multilateral institutions.

Conscious efforts are being made to highlight the development lag caused by poor connectivity, from very local to national levels and throughout the entire subregion. In its North Eastern Region Vision Document 2020, the Ministry of Development of North Eastern Region (MDONER) states the following:

> 'The infrastructure deficit is a major deficit in the region, and acceleration in economic growth and the region's emergence as a powerhouse depend on how fast this deficit is overcome. The lack of connectivity has virtually segregated and isolated the region not only from the rest of the country and the world, but also within itself. Poor density of road and rail transportation within the region has not only hampered mobility but also hindered the development of markets.... The blocking of access to the Chittagong port and the land route through Bangladesh, has closed the sea transportation routes for the region altogether....Critical to improving connectivity are issues of diplomacy and an improvement in border infrastructure and trade facilitation with neighbouring countries, particularly China and Bangladesh. Diplomatic initiatives and an extension of the rail network to Chittagong could help open up India's access to the Chittagong port and significantly reduce transportation time and cost.' (MDONER, 2008)

Two major types of physical infrastructure essential for the development of this region are those related to transport and communication, and energy infrastructure. Multiple committees and expert groups (Planning Commission, 1997; 2006; Lama, 2001; Ministry of Panchayati Raj, 2006; Reserve Bank of India, 2006; World Bank, 2007; Ministry of Finance, 2013) have highlighted the urgent need to devote time and allocate resources to infrastructure, and have suggested bold and substantive interventions. Several vital infrastructure initiatives have been launched to integrate the NER's economy with that of neighbouring countries, including the Asian Highway Link, the Asian Railway Network, and a natural gas pipeline grid. These projects, which are being actively considered by the BIMSTEC, have tremendous implications for lifting

the communication isolation of the NER. Many of these projects come directly under the broader purview and promotion of the India Look East (Act) policy. The NER will have access to the Asian Highway via the Imphal–Tamu feeder road, and to the Asian Railway Network via the planned linkage of the railway systems of India and Myanmar at the Dibrugarh railhead. In 2001, India constructed a road in Myanmar linking the township of Tamu with the railhead at Kalemyo that connects to Mandalay, Myanmar's commercial hub. To increase trade between the two countries, India and Myanmar have also agreed to open four checkpoints: the Pangsau Pass, Paletwa, Lungwaanyong, and Pangsha–Pangnyo.

The NER vision document stresses this as follows:

> 'Infrastructure and connectivity could support the Look East policy and provide [an] impetus to trade with [the] Eastern part of the globe. Although the policy has been in place for a decade and a half and has benefitted the rest of the country appreciably, the NER has gained very little. It is important to note that the NER shares 98 percent of its borders with the neighboring countries of Bhutan, Nepal, China, Bangladesh and Myanmar and the Look East policy focus on the region can help it to access the markets in East Asia and South East Asia. Indeed, there is a considerable potential for the policy to benefit the region but that would call for a qualitative change in the relationship with the neighboring countries, particularly the larger countries of Bangladesh, China and Myanmar. Given that the fortunes of 38 million people depend on good neighborliness, the bureaucratic and defence dominated approach to relationships must give way to the one based on mutual economic gains.' (MDONER, 2008)

Recently, the Government of India has further consolidated its infrastructure development projects by pumping a huge amount of funds into the projects, redeploying and making the central government agencies more accountable and completing several long-pending projects. While addressing the 65th meeting of North Eastern Council in Shillong in May 2016, the Prime Minister and Chairman of the North Eastern Council stated specifically:

'The government has been focussing on the development of the North East region through its pro-active 'Act East Policy'. As part of this policy, we are focussing on reducing the isolation of the region by improving all round connectivity through road, rail, telecom, power and waterways sectors.

If the western region of the country can develop, if other regions of the country can develop, I see no reason why the North East region of the country cannot develop. I am also convinced that India can move forward if all the regions develop including the North East region. The North East region is also very important to us for strategic reasons. And it is my conviction that we have to bring this region at par with the other developed regions of the country.

In the current Budget, more than Rs.30,000 crores have been earmarked for the North East region. It should be our endeavour to ensure that this money is spent well for the development of the region...However, it has taken us many years to complete these projects. We have to ensure that we are able to complete our projects in time and without cost over-runs. Only then can we realise the true benefits of these projects. The North East is the gateway to South East Asia and we need to take advantage of this. We are opening up both road and rail routes to our neighbouring countries. This should give a boost to the economic development of the region.

We have created a specialised highways construction agency for the North East—the 'National Highways and Infrastructure Development Corporation'—that was incorporated on 18th July 2014. Since then it has set up its Branch Offices, one each in every North Eastern State. As of today, it is implementing 34 projects in the North Eastern States covering a length of 1001 kilometres at a total cost of over Rs. 10,000 crore...We have recently implemented an improved internet connectivity project for the North East region in collaboration with Bangladesh. This will make available 10 GB of seamless alternate bandwidth for the region. This integration will benefit the North East region tremendously.

The Government is also making a heavy investment in power transmission projects covering all the eight North Eastern states at a cost of around

> Rs 10,000 crore. This would ensure power to more areas. The recent commissioning of [the] Bishwanath-Chariyali-Agra transmission line has also brought 500 MegaWatt additional capacity to the region…In the North East, the Indian Railways has commissioned about 900 kilometres of Broad Gauge in the last two years, leaving only about 50 kilometres Meter Gauge lines to be converted in 2016-17.' (Prime Minister, 2016)

These sentiments clearly show that, unlike in the past, the urge to link domestic infrastructure to spread and strengthen cross-border connectivity and willingness to harness the high potential of cross-border cooperation is remarkably high amongst political leaders at both the national level and amongst the NER states. This also means that, given the proper institutional and governance framework, it is only a matter of time before the NER will have connectivity-related infrastructure to realise at least some of the primary goals of subregional cooperation. This was well summed up by the then-Finance Minister of India.

> 'Finally what I would like to say is if you look at the list of projects that are being implemented, clearly what strikes (i) is the lack of capacity to implement the projects in time and the cost. Unless governance structures improve, unless you have good implementing agencies or persons placed in these agencies who have the drive and commitment to implement these projects on time. I am afraid it will be more of the same in the years to come. There is money, there is good will, there is good response from [the] World Bank and Asian Development Bank. We can bring in more projects but [it] ultimately lies in your hands to fund the agencies that it [sic] will implement it in time or fund the men who will head the existing agencies to implement it in time. All the States have revenue surplus in the North East.' (Finance Minister, 2007)

2. Emerging Subregional Contexts

While the signing of the BBIN Motor Vehicle Agreement in 2015 laid the groundwork for far-reaching subregionalism initiatives, the essential and central nature of energy trading in the eastern junction is driven by the following eight politico-economic factors:

'i) the gradual emergence of energy as a core and sensitive politico-economic-commercial entity in the larger context of development reforms and foreign policy matrices;

ii) increasing recognition of the importance of power-generating hubs and their commercial harnessing in Bhutan, Nepal, the NER, and the Myanmar–Lao People's Democratic (PDR) axis, both in the context of the huge unharnessed potential of hydropower and the distinct trend toward green and renewable energy-oriented policies and intended nationally determined contribution (INDC) commitments;

iii) India's Act East Policy that positions the NER and neighbouring Myanmar as the bridgehead to connect with the Mekong Ganga Cooperation (MGC) and other Southeast Asian countries, and uses subregionalism (a new genre of regionalism) as an instrument to enlarge the strategic scope for Bangladesh, Bhutan, and Nepal to approach Southeast Asia through this corridor;

iv) burgeoning domestic pressures on the NER to integrate with neighbouring countries (with which it shares over 98% of its physical borders), and conscious initiatives by the Government of India under 'cooperative federalism' to reposition the NER on the development map;

v) the seasonal demand for and supply of power throughout the rest of South and Southeast Asia, and the demonstration effect of ongoing power trading between India and Bangladesh, Bhutan, and amongst the Greater Mekong Subregion (GMS) through cross-border projects and successfully attractive trading models;

vi) strong emerging possibilities of investment in the power sector by diverse players, including the World Bank, Asian Development Bank (ADB), Asian Infrastructure Investment Bank (AIIB), Japan International Cooperation Agency, independent power producers (IPPs), and other investors; and further integrative attraction under the following frameworks: India–Association of Southeast Asian Nations (ASEAN), MGC, BIMSTEC, Bangladesh–

> China–India–Myanmar Forum for Regional Cooperation, SAARC, and Regional Comprehensive Economic Partnership;
>
> vii) a highly developed transmission network in the borderlands and growing partnership in cost-effective generation sources and reliable supply sources; and
>
> viii) discourse changes triggered by a gradual shift to democratic regimes in the whole subregion, including Myanmar, and major regional connectivity that is expanding rapidly through energy projects like the Central Asia–South Asia project, Bangladesh–China–India–Myanmar Forum for Regional Cooperation Economic Corridor, China-Led Growth Quadrangle in the eGMS, China–Pakistan Economic Corridor, and One Belt One Road initiatives in Asia.'

The challenges of integrating Myanmar into this framework are complicated by many decades of economic neglect, a lack of management and market reforms in the energy sector, unexplored interconnections with the NER, and a general lack of information. Myanmar's goal of national electrification (45% by 2020–2021, 60% by 2025–2026, and 80% by 2030 [Government of Myanmar, 2015]) will require substantial increases in capital, public–private cooperation, effective grid expansion, and off-grid and cross-border development with both South Asian and ASEAN countries.

Five broad power-exchange models are now emerging in the BBIN subregion and its inter-linkages with Myanmar and Southeast Asian countries. These models, which are essentially based on specific projects, draw from successful past experimentation with interconnection (both within and outside the region): India's gradual policy of openness in the NER and conscious engaging of the MGC (Cambodia, Lao PDR, Myanmar, Viet Nam, and Thailand); Myanmar and Thailand's core role in BIMSTEC and GMS energy dynamics; changing institutional linkages; the actions of private, bilateral, and multilateral agencies; unfolding policy regimes; and commitments made under the 2015 Paris Agreement. These models include the following:

> '(i) exclusive bilateral exchanges such as those between India and Bhutan, and Bangladesh and Nepal;

(ii) integration with subregional initiatives like amongst the GMS countries;

(iii) the regional power pool located in the NER–Myanmar junction;

(iv) a highly local integrative exchange, like the Palatana (Tripura)–Comilla (Bangladesh) model based on the location of generation-load centres; and

(v) wheeling facilitators in the form of a 'virtual energy grid', like that implemented by India between eastern and western Bhutan, and amongst the NER, Bangladesh, and Southeast Asia.'

Similar to the India–Nepal power exchange, the India–Bhutan interconnection is a prime example of bilateral exchange. Bhutan's installed hydropower capacity (1,615 megawatts [MW]) constitutes less than 6% of its total hydropower potential (30,000 MW). Most hydropower projects in the country were built with Indian support on an initial basis of economic assistance, which now has much higher soft loan content. Unlike in the past when Indian participation came wholly from public-sector organisations such as the National Hydro Power Corporation, participation by private sector companies such as Tata Power has steadily increased. All bilateral CBET transactions between Bhutan and India are carried out by the Bhutan Power System Operator and the National Load Dispatch Centre–New Delhi under the Power System Operation Corporation. All surplus power (75% of the generated total) is exported to India (5,179.26 million gigawatt–hours in 2014), and accounted for more than 34% of the country's total exports in 2015–2016. During this period, the exported power generated more than Nu12.124 billion (1 ngultrum = 1 Indian rupee), over one-third of government revenues and more than 13% of the country's gross domestic product (GDP) (Ministry of Finance, 2016; National Statistics Bureau, 2016). The transmission to India is handled by both public and private agencies under a forward-looking bilateral power purchase agreement.

Bhutan, which has the highest per capita energy consumption in South Asia (2,800 kWh), aims to generate 10,000 MW by 2020 at a total cost of $10 billion–$12 billion, via several power projects. These include the Kholongchhu Hydroelectric Project (HEP) with Satluj Jal Vikas Nigam (SJVN) (600 MW); the Bunakha Reservoir Scheme with THDC (180 MW); the Wangchhu HEP with

SJVN (570 MW); and the Chamkharchhu-I HEP with NHPC (770 MW). In April 2014, the governments of Bhutan and India signed an intergovernmental agreement to develop these four joint venture projects. The projects are to be financed through a 70:30 debt–equity ratio, with a 50:50 equal shareholding for Druk Green and the Government of India's public sector undertakings (PSUs). The Government of India will provide the Druk Green equity in these projects in the form of grants (Government of Bhutan, 2014). India is keen to diversify its export market partners in South Asia, and has been exploring the possibilities of bringing other South Asian countries and Myanmar into its generation and export trajectory.

With over 2,330 MW exchanged amongst Bangladesh, Bhutan, India, and Nepal; and with Myanmar exporting roughly 520 MW to China, CBET is in a fairly nascent stage. However, the very fact that the process has begun significantly widens the scope for CBET. For instance, Bangladesh plans to import 6,000 MW by 2034 (Japan International Cooperation Agency, 2014). The South Asia Regional Initiative for Energy Integration has developed four scenarios for Indian electricity imports and exports (Table 1). This shows that India will emerge as a major market for electricity generated in neighbouring countries.

3. India-Bangladesh Power Exchange

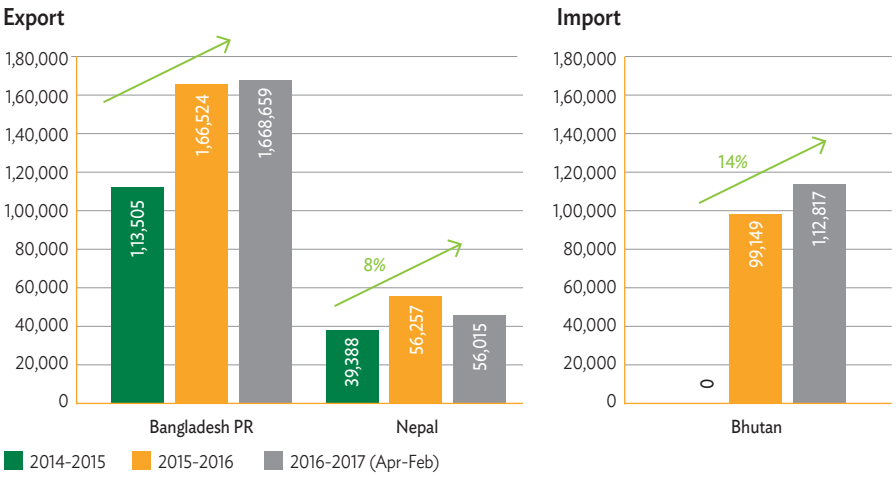
During 2010–2011, India and Bangladesh agreed on several crucial areas of energy cooperation, including a renewable energy interconnection study (covering Ishurdi, Bangladesh–Baharampur, India); imports of at least 500 MW from the western interconnection (Bangladesh–West Bengal) and 300 MW–500 MW from the eastern interconnection (Bangladesh–Tripura); the construction of regional power-trade grids; human resource development for utility professionals; and joint venture power-generation projects (especially large coal-power projects). In 2015, India demonstrated its readiness for Indian companies to enter Bangladesh's power-generation, transmission, and distribution sector to help the country achieve its goal of 24,000 MW of installed capacity by 2021.

Table 3.1 Electricity Import/Export by India from/ to Neighbouring Countries (GW)

Scenarios	2017	2022	2032	2042
Import				
Least effort	3	3.5	4	7
Aggressive effort				
Determined effort				
Heroic effort	15	25	35	50
Export				
Least effort	1	1	1.5	2
Aggressive effort				
Determined effort				
Heroic effort	1	2	3.5	7

Source: Kharbanda, V.K. and R.R. Panda (2016), 'Institutionalize Cross Border Electricity Trade', *Energy & Power* (1 June). Dhaka.

Figure 3.1 India's Power Trade with Neighbouring Countries (₹'000,000)



Source: North Eastern Development Finance Corporation (2017), Guwahati (March).

The two countries also agreed to evacuate power from the NER (Rangia and Rowta) to Muzaffarnagar in India through Bangladesh through a ±800 kilovolt (kV), 7,000 MW, high-voltage direct-current (HVDC), multi-terminal, bipolar grid line with suitable power-tapping points at Barapukuria in Bangladesh (Joint Declaration, 2015). As a result, three very far-reaching projects have been launched: (i) 500 MW of power exported from India, (ii) a grid interconnecting Bheramara in Bangladesh and Baharampur (West Bengal) in India, and (iii) a 1,320 MW coal-based unit at Rampal (350 kilometres [km] southwest of

Dhaka) under the Bangladesh–India Friendship Power Company consisting of the Bangladesh Power Development Board and NTPC. This project is expected to begin commercial generation by December 2018.

These ground-breaking projects (Lama, 2013) have widened the scope for Bangladesh to import power from Bhutan and Nepal using Indian grids. Bhutan has overcome its landlocked status by using Indian territories and facilities as permitted by India's agreement with Bangladesh on land customs stations (namely Tamabil–Dawki, Nakuagaon–Dalu, Gobrakura, Koroitoli–Gasuapara, and on the India–Bangladesh border), and the use of inland waterways and access to the ports of Chittagong and Mongla in Bangladesh. In fact, the Bangladesh–Bhutan–India trilateral hydroelectric power-generation agreement is likely to be signed soon, as mentioned in the Joint Statement by the prime ministers of Bangladesh and Bhutan on April 2017.

> 'The two Prime Ministers emphasized the advantages of sub-regional cooperation in the areas of power, water resources, and connectivity for mutual benefit. Recognizing the importance of enhancing regional connectivity, both sides agreed to work bilaterally and sub-regionally towards that end. They also welcomed the proposed Trilateral Memorandum of Understanding [MOU] between Bangladesh, Bhutan and India for cooperation in the field of Hydroelectric Power on the principles of agreed regional framework. They expressed the hope that this MOU could be signed at an occasion when leaders of all three countries would meet next.' (Joint Statement, 2017)

Similarly, Article I of the MOU signed between Bangladesh and Nepal in 2016 states that it 'will act as a framework for trading power between Bangladesh and Nepal at a mutually agreed upon price and procedure. Both the countries agree to exchange power as and when it is possible and feasible.' Further, under this MOU the two countries decided to facilitate joint cooperation to develop power-generation projects, especially hydropower development, transmission, efficiency, and the development of various types of renewable energy; and to support cooperation between the public- and private-sector entities of the two countries in the areas of power generation, transmission, distribution, energy efficiency, the development of hydropower projects, investment, design,

construction, installation, commissioning, operation, and production in both countries.

In a recent energy-secretary level talk between Bangladesh and Nepal, the two countries decided to develop hydropower projects in Nepal with government-to-government investment, and to export the electricity produced by these schemes to Bangladesh through the Indian transmission system. Bangladesh will likely import 500 MW of electricity from the 900-MW Upper Karnali Hydropower Project in Nepal being built by an Indian joint venture company, the National Thermal Power Corporation Vidyut Vyapar Nigam (Subedi, 2018).

This is a prime example of Track II diplomacy transforming into Track I wherein discussions on projects, cooperation potentials, and constant deliberations on various other contentious issues and constraints discussed primarily by the civil society, academics, the private sector, and other professionals find their way into policy making circles and institutions, who in turn adopt and internalise them as policies and government projects. It also shows that India–Bangladesh relations have become more realistic and mature, and are characterised by unprecedented 'political will'. There now exist harmonised and coordinated approaches amongst various ministries within the countries and vis-a-vis the partner countries. These exchanges contain strong commercial and professional elements. This paves the way for related institutions to come together in a much more comprehensive and sustainable manner, builds confidence in cross-border investments amongst private-sector players, and widens the scope for their participation in the energy sector.

Traditional national security issues have for the first time been overtaken by more serious concerns about non-traditional threats such as energy and human insecurity. Borders are now being viewed as sources of opportunities rather than threats. Although these are essentially bilateral projects, they contain strong threads of subregionalism based on physical contiguity and socio-cultural exchanges. This subregional arrangement recognises the role of international agencies like ADB, the World Bank, the United Nations Development Programme, the United States Agency for International Development, and other private conglomerates that have invested in various energy sector projects across Asia and Africa.

These projects will be landmark starting projects. At a large number of points along the India–Bangladesh border the distance of interconnections between the two sides may be well within 20–60 kms. For instance, there are 21 grid substations with combined levels of 230/132 kV where the distance from the border is less than 20 kms. Some of these substations are so close that they could be interconnected at a very nominal cost and within a very brief timespan to facilitate power exchange and trade. Grid interconnections on both sides would permit larger power flows and would integrate the two grid systems to bring them to the same frequencies.

4. Intended Nationally Determined Contribution Commintments

The INDCs of the BBIN countries are another major factor likely to trigger tangible changes in the future energy mix. INDCs outline the measures countries intend to undertake mainly to (i) reduce greenhouse gas (GHG) emissions; (ii) adapt to climate change; and (iii) provide financial, technological, and capacity-building support (from developed to developing countries). The INDC commitments will likely be renegotiated to include renewables in the near future (Table 3.2). In the BBIN countries, renewable energy is growing massively, with India projected to reach 175 GW by 2022, Bangladesh 3,168 MW by 2021, and Myanmar 2,000 MW by 2030. This output could be integrated as a second line of CBET. Three border junctions (east, west, and north) could even plan for hydropower regional balancing. These are definite new paths to green and sustainable growth.

India is aiming to cut GHG emissions for each unit of GDP by 33%–35% (from 2005 levels), and to produce 40% of its electricity from non-fossil-fuel sources by 2030. Bhutan, a relatively smaller mountainous country, plans to remain carbon-neutral as targeted in 2009, and to keep 60% of its territory forested. Similarly, Nepal is aiming to reduce its dependency on fossil fuels by 50%, and achieve 80% electrification through renewable energy sources with an appropriate energy mix by 2050. Bangladesh is aiming to reduce GHG emissions by 5% (or 15% with international support) from business-as-usual levels by 2030.

Table 3.2 Intended National Development Contribution Commitments of Bangladesh, Bhutan, India, Nepal, and Myanmar

Countries	Commitments
Bangladesh	Cut GHG emissions by 5% (15% with international support) by 2030 compared with business-as-usual levels in the power, transport, and industry sectors.
Bhutan	Remain carbon-neutral as set out in 2009, and keep 60% of its territory forested.
India	Cut GHG emissions for each unit of GDP by 33%–35% from 2005 levels by 2030.
	Source 40% of electricity from non-fossil fuels by 2030.
Nepal	Reduce dependency on fossil fuels by 50% by 2050, and achieve 80% electrification through renewable energy sources with an appropriate energy mix.
	Maintain 40% of its territory forested.
Myanmar	With the largest expanse of tropical forest in mainland Southeast Asia, Myanmar is already a net GHG sink.
	Myanmar's permanent forest estate target by 2030 is to increase forest land as a share of the total national land area as follows: • Reserved forest and protected public forest = 30% of total national land area • Protected area systems = 10% of total national land area
	Increase the share of hydroelectric generation within the limits of technical hydroelectric potential (indicative goal = 9.4 GW by 2030)
	Boost rural electrification with at least 30% of supplies generated from renewable sources.
	Realise an electricity savings potential of 20% of the total forecast electricity consumption by 2030.

GDP = gross domestic product, GHG = greenhouse gas, GW = gigawatt.

Source: Intended National Development Contribution Commitment documents of Bangladesh, Bhutan, India, Nepal, and Myanmar.

To achieve these goals, these countries require three critical instruments related to finance, technology transfer, and capacity building. For example, in its Climate Change Strategy and Action Plan, Bangladesh estimated that it will need to invest $40 billion from 2015 to 2030 to implement measures addressing the adverse impacts of climate change. These ambitious commitments by BBIN countries are formidably challenging to achieve and sustain, and will require an extensive exchange of information at the cross-regional level, policy harmonisation at the sectoral level, and strategy coordination at the global level.

5. The North Eastern Region of India: An Emerging Electricity Trading Hub

The Pasighat Declaration estimates the NER's total power potential at about 50,000 MW, against the projection of the North Eastern Electric Power Corporation (NEEPCO) of roughly 58,900 MW (40% of the estimated national potential). In terms of other energy sources, it is estimated that the NER has 151.68 billion cubic feet of natural gas reserves, which could generate 7,500 MW for 10 years, and 864.78 million tonnes of coal reserves (against the total national reserve of 186 billion tonnes), which could generate 240 MW per day for a period of 100 years. However, so far only 1,242 MW (2.1% of the total potential) has been harnessed, and about 2,810 MW of hydropower is under development (Table 3.3). NEEPCO is expected to generate 2,060 MW by 2018–2019 with the commissioning of two plants (with capacities of 600 MW [at Kameng] and 110 MW [at Pare in Arunachal Pradesh]), as well as a 60-MW plant in Mizoram.

By the end of the Eleventh Five-Year Plan in 2011, the NER's installed capacity was 2,530 MW, of which hydroelectric power constituted 47%, thermal (coal, gas, and diesel) 42.25%, and renewable sources 10.67%. Assam contributed the highest share (38%) and Nagaland the lowest (4%) of the total installed capacity. (Planning Commission, 2012). Although five states (other than Mizoram, Sikkim, and Tripura) maintain a power deficit, ambitious plans have been drawn up to make the NER not only self-sufficient for power but also the 'powerhouse' of the rest of the country. By the end of the Twelfth Five-Year Plan in 2017, the total capacity addition was expected to be 5,353 MW (78% from hydroelectric) from 13 ongoing projects across the region. Of this, projects supported by the central government were expected to contribute 71.8%, followed by private-sector projects (25.53%), and state projects (2.6%). Since the availability of hydropower in the region declines drastically during winter, including off-peak hours, it is essential for the region to meet its base-load generation capacity from thermal power and centrally allocated thermal power from the eastern regional stations.

Table 3.3 Development Status of Potential Hydroelectricity (June 2014)
(installed capacity of more than 25 MW)

Region/State	ICRS (Total)	ICRS (above 25 MW)	CUO (MW)	(%)	CUC (MW)	(%)	CUOUC (MW)	(%)
Meghalaya	2,394	2,298	282.0	12.27	40.0	1.74	322.0	14.01
Assam	680	650	375.0	57.69	0.0	0.00	375.0	57.69
Nagaland	1,574	1,452	75.0	5.17	0.0	0.00	75.0	5.17
Arunachal	50,328	50,064	405.0	0.81	2,710.0	5.41	3,115.0	6.22
Mizoram	2,196	2,131	0.0	0.00	60.0	2.82	60.0	2.82
Sikkim	4,286	4,248	669.0	15.75	26,22.0	61.72	3,291.0	77.47
Manipur	1,784	1,761	105.0	5.96	0.0	0.00	105.0	5.96
Tripura	150	0	0.0	0.0	0.0			0.0
Subtotal (NER)	63,392	62,604	1,911	3.05	54,32.0	8.67	7,343	11.72
ALL INDIA	**148,701**	**145,320**	**35,944.5**	**24.73**	**13,131.3**	**9.04**	**49,075.8**	**33.77**

CUC = capacity under construction, CUO = capacity under operation, CUOUC capacity under operations + under construction, ICRS = identified capacity as per reassessment study, MW = megawatt, NER = North Eastern Region of India.

Source: North Eastern Electric Power Corporation, http://neepco.co.in (accessed 18 December 2018).

Other renewable sources in the NER include solar, with 'average solar insulation in the range of 5 kWh/m2 for more than 300 sunshine days' (Indian Chamber of Commerce, 2017). India aims to increase its renewable energy capacity by 175 GW by 2022, including 100 GW from solar, 60 GW from wind, 10 GW from bio-power, and 5 GW from small hydropower plants (with capacities of no more than 25 MW). Tripura already has a 5-MW solar plant, and various state governments have allocated land for solar parks to bring the regional capacity up to 250 MW (Bhattacharjee, 2015). NEEPCO alone under the Clean Development Mechanism (CDM) plans to generate 1,500 MW of power from non-conventional sources of energy by 2020.

Significant emphasis has been placed on the transmission network within states, amongst the NER states, and with other Indian states. This is bound to facilitate far-reaching interconnections with neighbouring countries. Arunachal Pradesh, Sikkim, and Tripura currently have interstate power sale arrangements. In 2015–2016, a comprehensive scheme of transmission, sub-transmission, distribution, and interstate transmission was implemented by the Powergrid Corporation of India (POWERGRID) at the cost of ₹113.48 billion. To evacuate the power from the Lower Subansiri and Kameng HEPs in Arunachal Pradesh, and the Punatsangchu-1 HEP (1,200 MW) in Bhutan to northern and western

India, POWERGRID has erected an 800-kV, 6,000 MW HVDC bipolar line from Biswanath Chariyalli in Assam to Agra in Uttar Pradesh (1,728 km) at the cost of ₹12 billion ($179.1 million). The North East Transmission Company (NETC) has also completed two 400-kV, direct-current lines (Palatana, Tripura–Silchar, Assam, and Silchar–Bongaigaon) as a means of interstate transmission, at a cost of more than ₹17.7 billion.[1] In addition, several interstate and regional transmission networks with a large number of substations have been completed or are in the pipeline.

A large number of IPPs developing projects that are scheduled to launch during the Thirteenth Five-Year Plan (2017–2022)[2] in Lohit, Siang, Tawang, and Kameng Basin in Arunachal Pradesh have applied to the Central Transmission Utility (CTU) for grid connectivity and long-term access in Arunachal Pradesh. These include Athena Demwe Power, Jayprakash Power, Siyom Hydro Power, Tato II Hydro Power Project, Naying DSC Power, Bhilwara Energy; Energy Development Company, KSK Dibbin Hydro Power, Patel Hydro Power, Adishankar Power, SEW Nafra Power Corporation, and GMR Londa Hydropower.

The Planning Commission envisages the establishment of 'basin wise pooling stations for pooling of power from generation projects in individual basins, which may further be pooled at a bigger pooling station for onward transfer to load centres in various regions through high capacity HVDC/EHVAC [extra-high voltage alternating current] transmission lines' (Planning Commission, 2013). This plan has three components: (i) an immediate evacuation system for the transfer of power from individual generating stations to the nearest basin-pooling station/s, (ii) a common transmission system from basin-pooling stations to bigger pooling stations, and (iii) a transmission system from the large pooling stations to load centres in other regions via HVDC or extra-high voltage alternating current lines.

[1] The NETC is a joint venture of the Oil and Natural Gas Corporation (ONGC) Tripura Power Company; POWERGRID; Assam Electricity Grid Corporation; and the governments of Manipur, Meghalaya, Mizoram, and Tripura.

[2] Niti Aayog (the National Institution for Transforming India), which replaced the Planning Commission, has discontinued the Five-Year Plan. The new plan, which is essentially a vision document, is a 7-year strategy for 2017–2024, and a 3-year 'Action Agenda' from 2017–2018 to 2019–2020.

Some of the project developers encountered major setbacks in the form of civil society protests related to serious environmental and livelihood concerns; land acquisition, rehabilitation, and resettlement concerns; unexpected geological incidents; inaccessible project sites; inadequate survey and investigation; environment and forest clearances; corruption in the award of projects; and, more critically, the technical and financial capacity, capability, and soundness of some of the IPPs to carry out and sustain projects that are mostly located in difficult terrains. A lack of available construction materials like cement and steel, poor carrying capacities of roads and bridges, and law and order issues continue to constrain project development. Furthermore, many project developers are undertaking projects in hilly and mountainous regions for the first time. At the same time, the NER states (except Assam, Meghalaya, and Tripura) have made very slow progress in unbundling utilities, and continue to suffer from protracted losses.

Given the proper institutional and governance framework, it is only a matter of time before the NER will have connectivity-related infrastructure directly related to the goals of subregional cooperation.

6. Prospects

The BBIN countries could adopt the successful practices of the GMS, which covers an area of 2.6 million square km and has a population of more than 320 million. Generation takes place mostly in Lao PDR, Thailand, and Viet Nam; and transmission and distribution in Cambodia, the Lao PDR, Viet Nam, and Yunnan province and the Guangxi Zhuang Autonomous Region in China. There are bilateral agreements on cross-border power trade between countries (e.g., Malaysia–Thailand, Thailand–Lao PDR, and Lao PDR–Viet Nam), and cross-border power interconnections like the 500-kV direct-current China–Lao PDR–Thailand interconnection, the 500-kV GMS Power Interconnection Project (Thailand–Lao PDR–Viet Nam), and the GMS Power Transmission Project (Cambodia). In the BBIN region, Bhutan, Nepal, and the NER would be generation hubs, and Bangladesh, the rest of India, and other neighbouring countries (including China, Pakistan, Sri Lanka, and Myanmar) would be export destinations. Besides hydroelectric power, the NER's 151.68 billion cubic feet of natural gas reserves alone could generate 7,500 MW for 10 years, and its 864.78

million tonnes of coal reserves could generate 240 MW per day for a period of 100 years (Government of India, Ministry of Petroleum and Natural Gas, 2016). Figure 3.2 shows what the power exchanges between the NER and neighbouring countries could look like by 2021–2022. This will reposition Bhutan, Nepal, and the NER as generating and distribution hubs under India's Act East Policy. The region has an exclusive Ministry of Development (the MDONER), regional planning body (the North Eastern Council), several specialised institutions (including the North East Development Finance Corporation and NEEPCO), and multiple exclusive development and policy interventions (such as the North East Industrial and Investment Promotion Policy, 2007; North East Industrial Development Scheme 2018; and the Special Accelerated Road Development Programme for the North East). The NER receives specific funding provisions as Special Category States, and 10% of the plan budgets of the central ministries and departments has been allocated to this region since 1997–1998 via a provision of the Non-Lapsable Central Pool of Resources.

7. Central Electricity Authority Projection: Surplus in the North Eastern Region

In 2016, the Central Electricity Authority (CEA) projected that the NER would be a surplus power region by 2021–2022, provided that the projected capacity additions meet the targeted date of commissioning. This, along with the fact that Bangladesh and Nepal will likely have deficits, could trigger exports from the NER and Bhutan to Bangladesh (1,100 MW) and within the country, and imports from Bhutan (5,082 MW) (Table 3.4 and Figure 3.2).

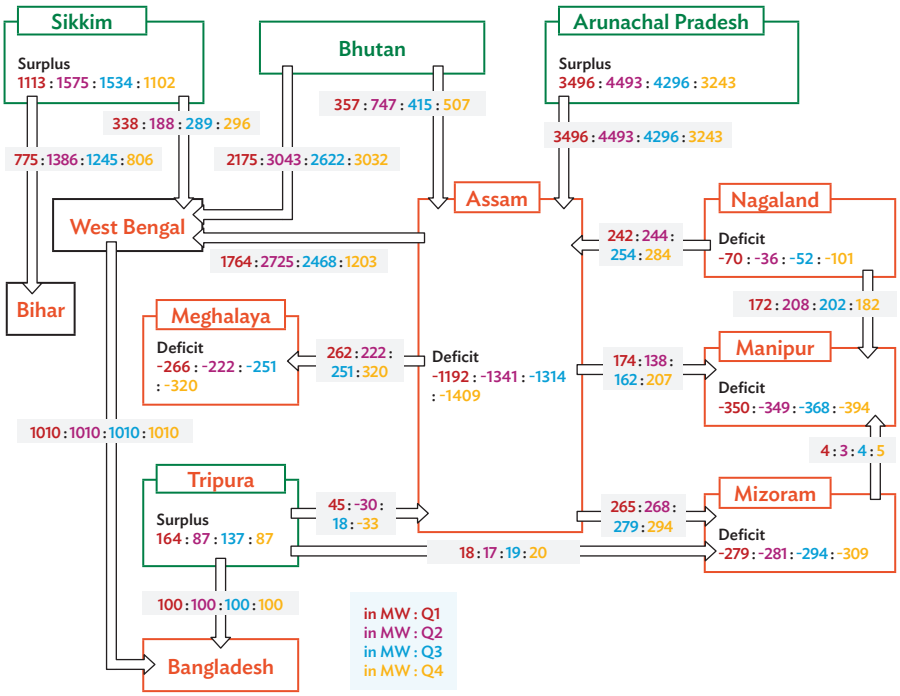
Table 3.4 Demand for and Supply of Power in Bangladesh, Bhutan, the North Eastern Region of India, and Nepal (2021–2022) (MW)

Quarter	Power availability	Power demand	Surplus/ deficit	Surplus/ deficit in Bhutan	Surplus/ deficit in Bangladesh	Surplus/ deficit in Nepal
1st	6,396	4,182	2,214	2,541	-1,100	-600
2nd	8,409	4,420	3,990	3,557	-1,100	-600
3rd	7,643	4,529	3,113	3,049	-1,100	-600
4th	6,459	4,582	1,877	3,557	-1,100	-600

MW = megawatt.

Source: Government of India, Ministry of Power, Central Electricity Authority (2016), Draft National Electricity Plan (Volume 1), New Delhi.

Figure 3.2 Interstate Power Supply Scenario (2021–2022)



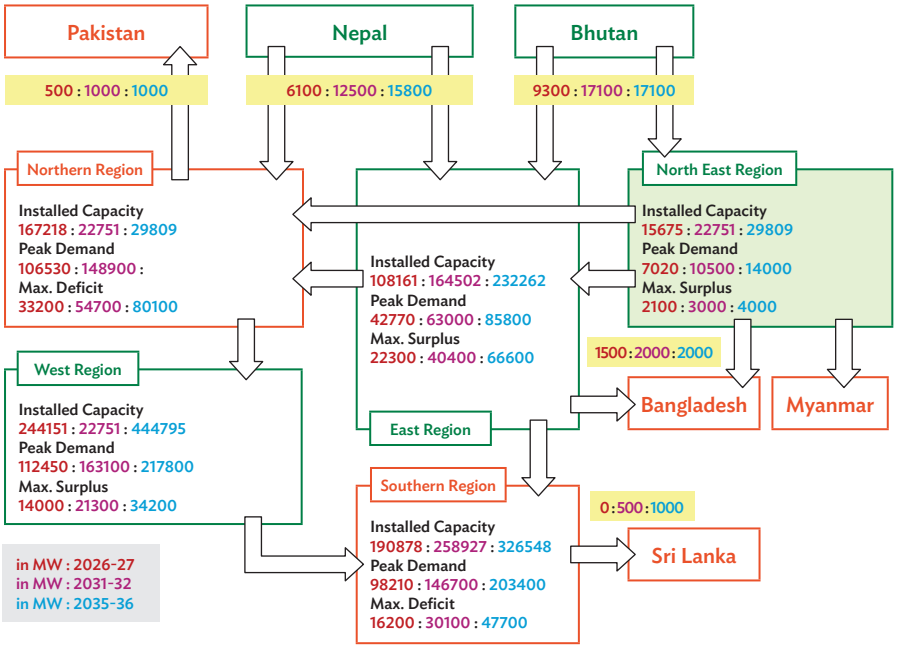
MW = megawatt, Q = quarter.

Note: Power-surplus regions are indicated in green, power-deficit regions in red.

Source: Macdonald, M. (2018), Draft Report on Study of Infrastructure Based on Act East Policy: Connectivity, Marketing Shed, Electrification etc. for NER States. October. Delhi. Prepared for the North East Development Finance Corporation, Guwahati.

The inter-regional and cross-border power supply at the end of the periods 2026–2027, 2031–2032, and 2035–2036 as estimated by the CEA for the Draft National Electricity Plan 2016 is illustrated in Figure 3.3.

Figure 3.3 Inter-Regional and Cross-Border Power Demand–Supply Scenario (2026–2027, 2031–2032, 2035–2036)



Max. = maximum, MW = megawatts, Q = quarter.

Note: The Eastern Region includes Sikkim; power-surplus regions are indicated in green, power-deficit regions in red.

Source: Macdonald, M. (2018), *Draft Report on Study of Infrastructure Based on Act East Policy: Connectivity, Marketing Shed, Electrification etc. for NER States*. October. Delhi. Prepared for the North East Development Finance Corporation, Guwahati.

The power exchange between Tripura in the NER and Bangladesh triggered by the new 726-MW combined-cycle gas turbine at Palatana (Tripura) offers a new direction for local integrative exchange. This gas reserve-based project is an exclusive generation-load centre location-based model between contiguous cross-border geographies. The Oil and Natural Gas Corporation (ONGC) Tripura Power Company is sponsored by the ONGC, Infrastructure Leasing and Financial Services, and Government of Tripura in the implementation of this project. The development and operation of the transmission system is being undertaken by the NETC, a joint venture of the ONGC Tripura Power Company, POWERGRID, and the NER beneficiary states.

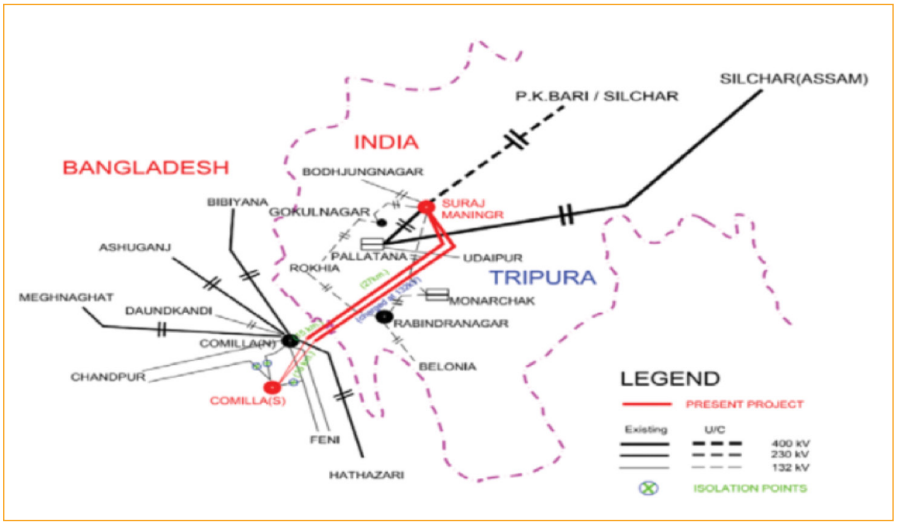
In addition to catering to power-deficit areas of the NER, this project exports 100 MW to Bangladesh (the Government of Tripura is discussing exporting another 100 MW), mainly in lieu of services provided in transporting the project-related equipment and goods and services through Bangladesh's waterways via Calcutta (Figure 3.4). About 2–3 MW is exported to the town of Tamu in Myanmar via a 11-kV transmission line from Moreh in Manipur. POWERGRID erected a 47-km, 400-kV, double-circuit transmission line from Suryamaninagar Power Grid in Tripura to Comilla in Bangladesh (OGNC Tripura Power Company; Telegraph India).

This project can claim emission reduction credits under the CDM scheme established as part of the Kyoto Protocol. This model could be replicated in the Sikkim–Tibet Autonomous Region of China trade route through the Nathu La pass (reopened in 2006), the Arunachal Pradesh–Myanmar route through the Pangsau Pass, and the Manipur, Mizoram, and Myanmar trade corridors. India's Central Electricity Regulatory Commission (CERC) has recently for the first time circulated its draft Cross Border Trade of Electricity Regulations, 2017, which states the following:

> 'The Government of India has also initiated measures in the direction of strengthening the cross border cooperation in electricity with its neighbouring countries. In order to facilitate and promote Cross Border Trade of Electricity with greater transparency, consistency and predictability in regulatory approaches across jurisdictions and minimise perception of regulatory risks, the Ministry of Power in consultation with the Ministry of External Affairs has issued Guidelines on Cross Border Trade of Electricity (herein after referred as 'Guidelines') vide OM No. 14/1/2016-Trans dated 5th December, 2016.' (CERC, 2016)

These guidelines are intended to (i) facilitate CBET between India and neighbouring countries; (ii) promote transparency, consistency, and predictability in regulatory approaches across jurisdictions; (iii) minimise perceptions of regulatory risks; (iv) meet the demand of the participating countries by utilising the resources available in the region; (v) ensure reliable grid operation and transmission of electricity across borders; and (vi) evolve a dynamic and robust electricity infrastructure for cross-border transactions.

Figure 3.4 India–Bangladesh Interconnection for Power Transfer (100 Megawatts)



kV = kilovolt, U/C = under construction.

Source: Central Energy Authority of India, 2017 as referred to in Macdonald, M. (2018), *Draft Report on Study of Infrastructure Based on Act East Policy: Connectivity, Marketing Shed, Electrification etc. for NER States.* October. Delhi. Prepared for the North East Development Finance Corporation, Guwahati.

The CEA of India, which also designed the conduct of business rule, will be the designated authority for CBET. Other agencies will be assigned specific tasks: the Transmission Planning Agency will plan transmission systems in neighbouring countries to facilitate CBET with India; the Settlement Nodal Agency will settle all charges pertaining to grid operations, including operating charges, charges for deviation, and other charges related to transactions with a particular neighbouring country; the CTU will grant and facilitate long- and medium-term open access with respect to cross-border trade and be responsible for billing, collecting, and disbursing the transmission charges; and the National Load Dispatch Centre will grant short-term open access to the Indian grid. The National Load Dispatch Centre will also be responsible for billing, collecting, and disbursing the related transmission charges; act as the system operator for India; be responsible for scheduling and dispatching electricity related to cross-border transactions; and carry out other monitoring and supervision activities required to maintain the security and stability of the international transmission links.

This comprehensive power-trade document has attracted both welcome and widespread comment from trading partners and various agencies. However, as the regulations focus on bilateral trade and 'shall be binding on all the participating entities undertaking such cross border transactions' (CERC, 2016), power-generating countries like Bhutan and Nepal have shown reservations and raised questions as to the eligibility conditions for participating entities as mentioned in this draft. These conditions include the following:

(i) import of electricity by Indian entities from generation projects located outside India and owned or funded by the Government of India, Indian public-sector units, or private companies with 51% or more ownership by an Indian entity or entities;
(ii) import of electricity by Indian entities from projects having 100% equity held by an Indian entity or entities and/or the Government of India, or government-owned or -controlled companies in a neighbouring country;
(iii) import of electricity by Indian entities from licensed traders of neighbouring countries with more than 51% ownership by an Indian entity or entities; and
(iv) export of electricity by distribution licensees or PSUs, if surplus capacity is available and certified by the concerned distribution licensee or PSU, as the case may be.

In particular, the condition that projects must be 51% owned or funded by Indian investors puts severe restrictions on Bhutan, Nepal, and other generating countries that are trying to attract investment from multiple sources with the aim of exporting power to India and other neighbouring countries. Bhutan also has concerns regarding the adverse impact of this draft policy on its ongoing and recently completed projects like the concession agreement for the Kholongchhu project, which was built on a joint venture modality between Druk Green Power Corporation and SJVN, who each held 50% equity shares. This project's financing modality consists of a 70% loan (to be raised by the two partners) and 30% equity shared equally between the joint venture partners). Similarly, in the first public–private partnership, Dagachhu (commissioned in 2015), the Druk Green Power Corporation holds 59% equity, India's Tata Power Company holds 26%, and the National Pension and Provident Fund holds 15%. However, the provisions of the draft guidelines will not give market access to India (Dorji, 2018).

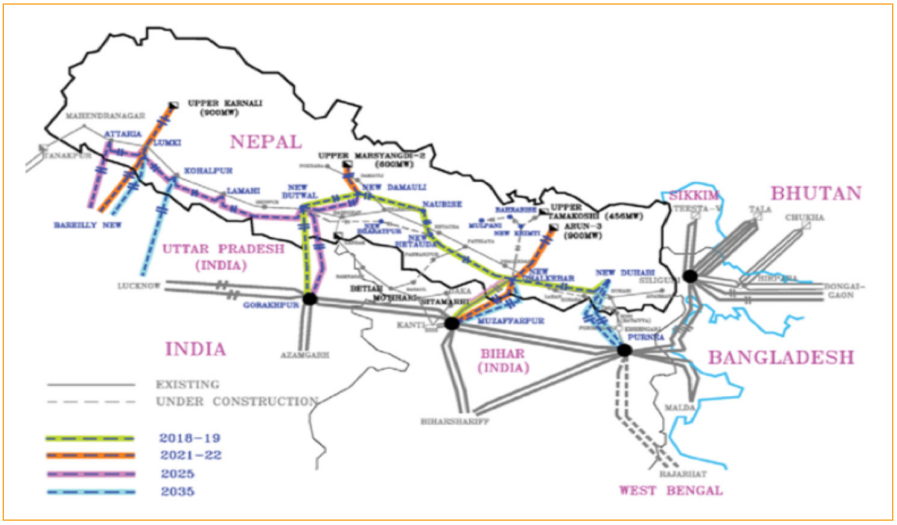
With regard to transmission issues, this draft framework provides the following useful hints as to the direction of power trading triggered by India's participation:

i) Transmission systems developed for cross-border trade will normally form part of the integrated transmission system on the Indian side of the border.
ii) The transmission interconnection between India and the neighbouring country shall be planned jointly by transmission planning agencies from the two countries with the approval of the respective governments. The generators located outside the country may, if required in light of technical and strategic considerations, develop transmission lines to supply electricity to the pooling station at their own cost. However, the associated transmission system in India shall be planned by the CEA and CTU with the approval of the Ministry of Power.
iii) Cross-border transmission lines may be constructed between a pooling station in one country to a second station in another country to ensure the secure, safe, and controlled operation of the grid. Interconnections between pooling substations in different countries shall be monitored and controlled by the respective system operators of the two countries, with proper coordination.
iv) The CTU will determine transmission access priority as per the CERC regulation on CBET.
v) The Ministry of Power shall notify the Indian nodal agency for each neighbouring country that shall be responsible for setting grid operation-related charges as per the CERC regulations. Indian generating stations supplying electricity exclusively to neighbouring countries may be allowed to build independent transmission systems to connect to the neighbouring country's transmission system keeping technical and strategic considerations in view and with the approval of the competent authority at the cost specified in the contract agreement signed by the Indian entity and neighbouring country.

This essentially bilateral framework could be a stepping stone to trilateral and multilateral frameworks that can be used in the BBIN subregion and extended to other neighbouring countries, both on the western borderlands (like those

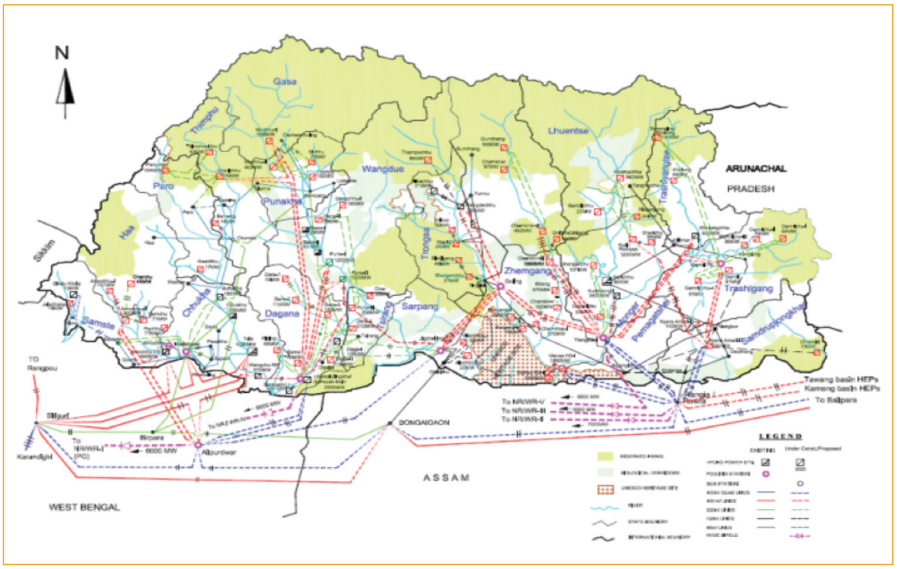
with Afghanistan, Pakistan, and beyond) and on the eastern borderlands with Myanmar and other Southeast Asian countries.

Figure 3.5 India–Nepal Cross-Border Transmission Line Intersections



Source: Central Electricity Authority, New Delhi.

Figure 3.6 India–Bhutan Cross-Border Transmission Line Intersections



Source: Namgay, K. (2015), 'Energy Security in South Asia—Perspective from Bhutan,' Executive Director. Thimpu: Druk Green Power Corporation.

8. Investment Models

The Twelfth Five-Year Plan projected that ₹542.15 billion in funding would be required to add the proposed 5,353 MW of new capacity (78% hydroelectric and 22% thermal) by 2017. In addition to this, strengthening and erecting new transmission and distribution lines would cost ₹263.92 billion. The plan also recommended prioritising lending to NER power projects to encourage financing for such projects, and financing power generation and transmission projects in the NER through a dedicated fund.

> 'Since the benefits of optimal utilization of mineral and water resources of NE North East would accrue to the whole country, establishing such a fund could channelize the funds collected from the country as a whole and release capital resources of banks/ GoI [Government of India] grants for community level developmental work in [the] NE region. Project developers could be further incentivised to set up projects in the NER through fiscal incentives like [a] waiver on Minimum Alternate Tax (MAT). It may be emphasised that MAT credits are utilized by a project developer between [the] 5th and 10th year of the project cycle. Hence, [a] MAT waiver would not impact the total tax payments but would only increase upfront equity returns to the project developer.' (Planning Commission, 2012: 430)

Three investment models have been practiced in the NER: public-sector triggered investment, private-sector investment, and multilateral agency-led investment. Thus far, the power sector in this region has been dominated by public-sector investment.

8.1. Public Sector-Triggered Investments

The 2008 Hydro Power Policy sets a low threshold of 350 MW for hydropower plants set up in the NER with mega power status (compared to the 500 MW threshold for the rest of the country) to qualify for the following fiscal concessions and benefits:

(i) Zero customs duty: Capital equipment imported for these projects would be exempt from customs duty.

(ii) Deemed export benefits: Deemed export benefits are available to domestic bidders (in both the public and private sectors) for projects following the stipulations in the Foreign Trade Policy.
(iii) Income tax waiver: A 10-year income tax waiver can be claimed by the promoter of a mega power project in any block of 10 years within 10 to 15 years. State governments have been asked to exempt supplies to mega power plants from sales tax and local levies. These measures and economies of scale in mega projects would substantially bring down tariffs.
(iv) Pre-conditions for accessing benefits: A regulatory commission must be formed with full power to fix tariffs and the state power purchase undertaking, in principle, for private distribution in all cities with a population of more than 1 million within a prescribed period by the Ministry of Power to access the benefits.
(v) Price preference for domestic PSU bidders: To ensure that domestic bidders are not adversely affected, a 15% price preference will be given to projects in the public sector.

In the case of private hydropower projects:

(i) The project will be exempt from tariff-based competitive bidding (as of 2008 this was only available to PSUs through January 2011).
(ii) The developer will have the facility of merchant sale of up to 40% of saleable energy in hydropower projects.
(ii) An additional 1% of free power over and above 12%, as the state's royalty, will be earmarked for local development funds to provide a regular stream of revenue for income generation, infrastructure creation, and welfare schemes in the affected areas.
(iii) Each project-affected family will receive 100 kWh of electricity per month free of charge for 10 years.
(iv) The project authority will construct homes at resettled sites for project-affected families, and an industrial training institute will be set up at every project site 6 months before project completion to train affected people for skilled and semi-skilled jobs.
(v) Project-affected families will be given jobs in the project (Ministry of Power, 2008).

With regard to public-sector investments, the Ministry of Power established NEEPCO in 1976 as an exclusive institution 'to plan, investigate, design, construct, generate, operate & maintain power stations' (NEEPCO). It operates one solar, three thermal, and five hydropower stations with a combined installed capacity of 1,251 MW, and has five power projects under development (NEEPCO). The national budget for 2017–2018 includes ₹15.612 billion in investment from NEEPCO (Energy World, 2017).

The Ministry of Power had announced a hydropower fund to provide ₹167.090 billion in support for 40 stalled hydroelectric projects with a capacity of 11,639 MW, and to classify all such ventures as renewable energy. This included a hydropower purchase obligation by the distribution companies from hydropower projects with a capacity of more than 25 MW. The Ministry is now revisiting this proposed policy to avoid financial implications (Athrady, 2018).

8.2. Private-Sector Participation

Private-sector participation has been occurring through two channels: (i) NER-specific national policies like the North East Industrial and Investment Promotion Policy, 2007 (NEIIPP) and North East Industrial Development Scheme, 2018 (NEIDS); and (ii) various state government policies that have attracted private investment.

To accelerate industrial development, the Ministry of Commerce and Industry (Department of Industrial Policy and Promotion) included a specific policy intervention in the NEIIPP known as the Central Capital Investment Subsidy Scheme, 2007 for industrial units in the NER. This scheme came into effect on 1 April 2007 and was to remain in force through 31 March 2017 (discontinued in 2014). Its provisions were applicable to all new industrial units in the NER set up after 1 April 2007 (no effective steps toward establishment must have occurred prior to this date). 'Industrial unit' refers to any industrial undertaking, suitable servicing unit (other than that run departmentally by the government), and existing unit being substantially expanded. It covered crucial areas like the bio-technology and power-generating industries. A crucial provision of this scheme was a 30% subsidy of an industrial unit's capital investment (or additional investments) in plants and machinery. This subsidy was applicable to units in the private, joint, and cooperative sectors, as well as to units set up by NER state governments. The limit for the automatic approval of the subsidy at this rate

was ₹15 million. An empowered committee decided on the granting of capital investment subsidies higher than ₹15 million, up to a maximum of ₹300 million.

Under the NEIIPP 2007, power-generating plants continued to receive incentives as governed by the provisions of Section 81A of the Income Tax Act. In addition, power-generating plants with capacities up to 10 MW (from both conventional and non-conventional sources) were eligible for a capital investment subsidy, interest subsidy, and comprehensive insurance.

The NEIIPP 2007 was replaced by the NEIDS 2018 for the period 2017–2022 which has a financial outlay of ₹30 billion up to March 2020. The new scheme includes power generating units with capacities up to 10 MW, and seven categories of incentives for investors. Table 3.5 outlines the nature and depth of the subsidies and incentives under various categories that are extended to all eligible industries, including power-generating units.

Table 3.5 The North East Industrial Development Scheme – Subsidies and Incentives Extended to Eligible Industrial Units by Category

Central Capital Investment Incentive for Access to Credit	30% of the investment in plant and machinery with an upper limit of ₹50 million on the incentive amount per unit
Central Interest Incentive	3% on working capital credit advanced by eligible banks or financial institutions for first 5 years from the date of commencement of commercial production by the unit.
Central Comprehensive Insurance Incentive	Reimbursement of 100% of the insurance premium on building and plant and machinery insurance for 5 years from the date of commencement of commercial production by the unit.
Goods and Service Tax Reimbursement	Reimbursement up to the extent of the central government's share of the central and integrated goods and service tax for 5 years from the date of commencement of commercial production by the unit.
Income Tax Reimbursement	Reimbursement of the centre's share of income tax for the first 5 years, including the year of commencement of commercial production by the unit.
Transport Incentive	• 20% of the cost of transportation, including the subsidy currently provided by railways and the railway public sector undertaking for the movement of finished goods by rail. • 20% of the cost of transportation for finished goods, for movement through the Inland Waterways Authority of India. • 33% of the cost of transportation by air freight of perishable goods (as defined by the International Air Transport Association) from the airport nearest to the place of production to any airport within the country.
Employment Incentive	The Government of India shall pay 3.67% of the employer's contribution to the Employees Provident Fund, and shall bear 8.33% of the employer' Employee Pension Scheme contribution in the Pradhan Mantri Rojgar Protsahan Yojana.

Source: Department of Industrial Policy and Promotion (2018), The Gazette of India, Extraordinary, Part I, New Delhi (13 April) https://www.narendramodi.in/cabinet-approves-north-east-industrial-development-scheme-neids-2017-539397 (accessed 18 December 2018).

Significant private-sector interventions also followed the introduction of the Hydro Policy 2008. This policy aims to provide ₹167.09 billion ($2,493.8 million) in support of 40 stalled hydroelectric projects (with a total capacity of 11,639 MW), and to classify all such ventures as renewable energy. It also aims to erase the distinction between large and small hydropower plants. By doing so, it hopes to create a capacity of 225 GW of clean power by 2022 (Times of India, 2017). The Foreign Direct Investment (FDI) Policy of India 2017 (Department of Industrial Policy and Promotion, 2017) does not refer to the power sector directly. It mentions mining, petroleum, and natural gas projects. A provision for power exchanges registered under the Central Electricity Regulatory Commission (Power Market) Regulations, 2010 caps the percentage of equity participation or FDI at 49%, and categorises them as automatic route.

At the national level, after the de-licensing of the electrical machinery industry and permission of 100% FDI, inflows in the power sector reached $9.7 billion from April 2000 to May 2015. Many of the states in the NER have designed their own polices for attracting investment in the power sector in line with national government policies. For instance, since 2007 Assam and Arunachal Pradesh have had a policy encouraging the development of small hydropower projects, under which these projects receive a 50% share of carbon credit as a CDM benefit, and indigenous tribal developers of projects with a capacity of up to 5 MW are exempted from supplying free power to the state government. Similarly, since 2006, Manipur has had a policy promoting the generation of additional power from renewable and non-conventional energy sources under which it exempts producers from electricity duty for 5 years from commercial operation date for captive use or sale to a third party. The producers are treated as industrial units, and receive incentives, including infrastructure, similar to those provided to undeveloped areas.

On the other hand, Meghalaya has a policy promoting power generation from non-conventional energy sources under which developers are provided with infrastructure facilities in industrial estates, are exempted from electricity duty for 5 years, and are eligible to defer or remit sales and value-added tax. Tripura's policy promoting the generation of electricity from new and renewable energy sources provides the same benefits as the NEIIPP 2007, and exempts developers from sales and value-added tax on renewable energy equipment and materials

(or reimburses these charges). It also provides developers with a 100% CDM benefit in the first year.

Both the NEIDS and India–ASEAN Free Trade Agreement present significant opportunities. Although the NEIDS does not specifically mention the participation of foreign investors, if investment participation is extended to the countries that neighbour South Asia and ASEAN (including in the power sector), this could substantively change the pattern of investment in power and other sectors in the NER. In fact, this would pave the way for both generation and trading between the BBIN and ASEAN countries. Similarly, if electricity or power is included as a commodity in the South Asian Free Trade Area of SAARC and the India–ASEAN Free Trade basket, the investment–trade linkage will flourish and market expansion and integration could be consolidated.

8.3 Multilateral Agency-Led Investment

Multilateral agencies are increasingly showing interest in investing in CBET. The Japan Bank for International Cooperation, the World Bank, AIIB, ADB, and the New Development Bank of Brazil, Russia, India, China, and South Africa (BRICS) are likely to play vital roles in future projects.

The Hydro Policy 2008 identified foreign assistance as a source of financing for central and state-sector hydroelectric projects in the NER. NEEPCO utilised this provision to finance the Pare Hydro Electric Project and the Meghalaya State Electricity Board project for the renovation and modernisation of Umiam II HEP. The World Bank is supporting six states in the NER with a $470 million loan (implemented by POWERGRID) to augment intra-state transmission, sub-transmission, and distribution networks by upgrading old lines, and constructing new lines, associated substations, and transmission and distribution networks. The project also includes capacity building and institutional strengthening of power utilities and departments of participating states. This will enhance the capacity of state-level institutions to extend last-mile electricity connections to households. This project will reduce technical and non-technical losses, frequent interruptions, and outages (World Bank, 2016).

AIIB, which has 87 approved members and a fund of $100 billion (India is the second largest shareholder with 7.50% against China's 26.06%) commenced

operations in January 2016. It will complement and cooperate with the existing multilateral development banks. It offers sovereign and non-sovereign financing for sound and sustainable projects in energy and power, transportation and telecommunications, rural infrastructure and agriculture development, water supply and sanitation, environmental protection, and urban development and logistics. Six of SAARC's eight members are signatory to AIIB. In the strategic document AIIB Energy Strategy: Sustainable Energy for Asia, it is stated that: AIIB's founding members stressed the need to increase regional connectivity of energy systems in Asia, especially power and gas, with a view to strengthening systems, improving the security and efficiency of energy supply, optimizing the use of resources, allowing for greater flexibility in their operation, reducing local, regional and global adverse environmental impacts, and fostering greater use of renewable energy resources (AIIB, 2016).

The NER and the BBIN countries now have another major source of investment in the power sector. AIIB has already approved investment in a series of energy-related projects in South and Southeast Asia including India. These projects include the Tarbela 5 Hydropower Extension Project (Pakistan) (co-financed with the World Bank); the Distribution System Upgrade and Expansion Project and Natural Gas Infrastructure and Efficiency Improvement Project (Bangladesh); and the Myingyan Power Plant Project (Myanmar) (AIIB, 2017). Approved projects in India include the Transmission System Strengthening Project, a subset of the HVDC Bipole Link between Western Region (Raigarh, Chhattisgarh) and Southern Region (Pugalur, Tamil Nadu)–North Trichur (Kerala); the India Infrastructure Fund to invest in infrastructure platforms and service companies covering sectors like energy and utilities (e.g., renewable energy, electric transmission and distribution networks, water and wastewater systems, and smart cities); and the Andhra Pradesh 24x7 Power For All Project.

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CHAPTER 4

Way Forward and Policy Recommendations

The North Eastern Region of India (NER), which, together with its neighbouring countries, was once integrated as a powerful geographic-economic entity, abruptly disintegrated in 1947 and again in 1971, for various historical reasons. However, a new reintegrating venture initiated in the last few years has led to this subregion becoming one of the most attractive and challenging geographies in South and Southeast Asia in terms of energy security and cooperation, and one in which the complexities of sustainable development and national interest security perspectives are well ingrained. This subregion constitutes one of the four border junctions crucial to energy sector cooperation. As a central actor in this junction approach, it has a pivotal role to play in mobilising the other countries to harness the cascading and spiralling impact of this approach on energy exchanges, regional investment, trade, connectivity, and people-to-people contact. This offers a means of eliminating the national prejudices that hamper the process of regionalism amongst these countries.

A major challenge is to re-recognise and relocate the geometric line-based national borders as borderlands along with its related political economy. Borderlands comprise an intrinsic interplay of natural resources, culture, societies, trade-commerce, tourism, water towers, technology, roads and communications, security, federalism, and politics and international relations. Cross-border energy trading (CBET) very much fits into this borderland concept and related interactions, and is emerging as the most practical and socio-politically acceptable project in this new reintegration initiative.

In the drive to trigger and consolidate CBET in the Bangladesh, Bhutan, NER, and Nepal (BBIN) subregion, the NER is emerging as a key geographical and strategic actor. Total power potential in the NER is about 58,900 megawatts (MW), an estimated 40% of the total national potential. However, so far only 1,242 MW (2.1% of the total potential) has been harnessed. Besides hydroelectric power, the NER has 151.68 billion cubic feet of natural gas reserves, which could generate 7,500 MW per year for 10 years, and 864.78 million tonnes of coal reserves, which could generate 240 MW per day for 100 years. The Central Electric Authority of India has projected that this region will be a surplus power region by 2021–2022, provided that the projected capacity additions meet the targeted date of commissioning. This, along with the fact that Bangladesh and Nepal will likely face deficits in the future, could result in the NER and Bhutan exporting 1,100 MW of power to Bangladesh, and the NER consuming 5,082 MW of power both produced in the region and imported from Bhutan. Significant emphasis has been placed on transmission networks within a state, amongst the NER states, and with other Indian states. This is bound to facilitate far-reaching interconnections with neighbouring countries. However, the NER's growth has been constrained by topographical variations, scarce physical infrastructural facilities, and an acute sense of deprivation and alienation amongst the people. Several vital infrastructure initiatives – including the Asian Highway Link, Trilateral Highways, Asian Railway Network, and a Natural Gas Pipeline Grid and waterways – have been launched to integrate the NER economy with that of neighbouring countries. These projects, which are being actively considered by regional organisations like the South Asian Association for Regional Cooperation, BBIN, and Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation, have tremendous potential to relieve the communication isolation of the NER. They also constitute a core element in the proposed Bangladesh–China–India–Myanmar Forum for Regional Cooperation initiative.

Within the BBIN subregion, energy has gradually emerged as a core and sensitive politico-economic-commercial entity, and there has been increasing recognition of the importance of power-generating hubs and their commercial harnessing in Bhutan, Nepal, the NER, and the Myanmar–Lao People's Democratic Republic axis. The new contexts are huge unharnessed hydropower potential and a distinct focus on green and renewable energy as expressed in each country's nationally determined contribution (NDC) commitments. India's Act East

Policy, which establishes the NER as the gateway, combined with 'cooperative federalism' as a new practice in India's foreign policy, enlarges the strategic scope for Bangladesh, Bhutan, and Nepal to approach Southeast Asia through this corridor.

CBET is a powerful instrument to ensure energy security and manage seasonal variations, the demand and supply gap, and regional imbalances in generation in South Asia, as well as the emerging possibilities of investment from diverse players in the power sector. This potential is further enhanced by a series of integrative attractions under various frameworks, including the ASEAN–India Free Trade Area, the Mekong–Ganga Cooperation, the Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation, the Bangladesh–China–India–Myanmar Forum for Regional Cooperation, the South Asian Association for Regional Cooperation, and the Regional Comprehensive Economic Partnership. A considerably developed transmission network in the borderlands and emerging energy-intensive projects (including the Central Asia–South Asia Project, Bangladesh–China–India–Myanmar Economic Corridor, China-led growth quadrangle in the Greater Mekong Subregion, China–Pakistan Economic Corridor, and One Belt One Road initiatives in Asia) could significantly change the scope of energy trading in this region. For example, the $60 billion+ China–Pakistan Economic Corridor project, which is based on a strategy of 'one corridor multiple passages', consists of 51 planned and undertaken projects; of these, 24 are energy-related, with an installed capacity of 17,608 MW. At least seven projects are now at the completion stage under its early harvest category (China–Pakistan Economic Corridor).

Broadly speaking, five models of specific project-based power exchanges are now emerging in the BBIN subregion and its potential inter-linkages with Southeast Asian countries: (i) exclusive and largely successful bilateral exchanges such as those between India and Bhutan, and Bangladesh and Nepal; (ii) integration with subregional initiatives like those amongst the countries in the BBIN and Greater Mekong Subregion (this model could be consolidated further as Bangladesh begins joint ventures in hydroelectric power projects in Bhutan and Nepal aimed at importing generated power); (iii) a regional power pool located in the NER–Myanmar junction (this is geographically the most feasible project as it would cover regions in Myanmar with huge power deficits, and also fits into the cooperation framework under India's Act East policy);

(iv) highly local integrative exchanges like the generation-load centre location-based model between Palatana (Tripura) and Comilla (Bangladesh) (this very much fits into India's domestic political dynamics of cooperative federalism); and (v) a wheeling facilitator in the form of a 'virtual energy grid', like that implemented by India between eastern and western Bhutan and the NER to Bangladesh and Southeast Asia. Under this scenario, India would acquire a new role as a transit country, which could be very far-reaching from the perspective of energy security based on the 'four junctions' strategy.

All five of these models are attractive and powerful examples of potential practices in the BBIN subregion and neighbouring subregions in Southeast Asia. In addition to the India–Bhutan interconnection, the latest ground-breaking example of bilateral exchange is that between India and Bangladesh. This has created a perfect opportunity for Bangladesh to import power from Bhutan and Nepal using Indian grids. This is a prime example of Track II diplomacy transforming into Track I , where ideas and advocacy generated at the level of professionals, experts, academics, the private sector, and the media are adopted upfront and implemented by policymakers and line ministries. Given the politico-historical dynamics of nation-building projects in this region, this transformation from Track II to Track I has been a cumbersome, complex, and slow process. It also demonstrates how unprecedented 'political will' and a harmonised and coordinated approach amongst various ministries within a country and their counterparts on the other side of the border can make a relationship mature and bear fruit. Under such initiatives, borders are now increasingly seen as opportunities rather than traditional sources of threats to national security.

These countries' intended NDC commitments indicate that they will consciously renegotiate the share of renewables in the energy mix in the near future. These countries have massive potential for renewable energy growth, with India projected to reach 175 gigawatts (GW) by 2022, Bangladesh 3,168 MW by 2021, and Myanmar 2,000 MW by 2030. This could then be integrated as a second line of CBET. Three border junctions (east, west, and north) could even plan for hydropower regional balancing. These are definite new paths to ensuring green and sustainable growth.

India's Central Electricity Regulatory Commission (CERC) has, for the first time, circulated its draft CBET Regulations 2017, triggering discussions and actions at various stakeholder levels on a cross-border basis. They are presented in Annex A and B. These regulations focus on bilateral trade and 'shall be binding on all the participating entities undertaking such cross-border transactions' (CERC, 2016). Power-generating countries like Bhutan and Nepal have expressed reservations and raised questions as to the eligibility conditions imposed on participating entities. Certain conditions, such as the requirement that power projects in countries like Bangladesh, Bhutan, and Nepal be at least 51% owned or funded by Indian investors in order to be eligible to export power to India puts severe restrictions on Bhutan, Nepal, and other power-generating countries that are trying to attract investment from multiple private, regional, and global sources with the aim of exporting power to India and other neighbouring countries. However, the very fact that such a framework is now in place inspires a range of stakeholders that are keen to undertake power generation and its cross-border transmission and distribution. Initiatives taken by the Government of Bangladesh in engaging with their counterparts in Bhutan and Nepal indicate a strong possibility and acceptance on the part of India to permit the use of its grids for multiple trans-border energy flows and exchanges. In fact, this essentially bilateral framework could be a stepping stone to trilateral and multilateral frameworks for use in the BBIN subregion, and extended to other neighbouring countries in South East Asia and beyond.

1. Cross-Border Trading Model and Three Alternative Scenarios

To analyse the opportunities for CBET between the NER of India and other neighbouring countries such as Bangladesh, Bhutan, Myanmar, and Nepal, this study applies a linear-programming model known as the electricity supply and trade model. This model attempted to find an optimal solution to the electricity supply question (power generation in each region and the cross-border grid connections amongst these regions), to meet the increasing demand for electricity in the region during 2015–2030 while minimising overall costs. The study also explores the potential of the NER to function as a transit provider, generator, and exporter; as well as that of neighbouring countries to expand their economic activities while increasing their energy consumption.

This study designed and used an electricity supply and trade model to determine a cost-optimal electricity mix solution that also meets the electricity demand in multiple countries or regions. Using government documents to understand both the demand forecast and unit cost of various power plants and cross-border grids, this model forecasts the load curves of electricity demand in each region in each season. In terms of the electricity demand forecast, this study revealed that from 2015 to 2030 the electricity demand will increase 3 times in the NER, 2.7 times in Bangladesh, 1.7 times in Bhutan, and 4 times in Myanmar and Nepal. Total electricity demand in the above regions will reach 273 terawatt-hours in 2030, triple the demand in 2015. In the rest of India during the same period, electricity demand will increase to about 2,400 terawatt-hours, 2.2 times the current level.

In India, unlike the present situation where coal-fired power plants account for about 180 GW (60% of total installed capacity), renewable energy sources including hydropower are planned to account for more than 50% of the energy mix in the mid-2020s. Bangladesh is planning to increase the share of coal-fired power in the domestic supply, and its dependence on imported electricity will grow steadily. Hydropower will remain dominant in Bhutan (26.5 GW by 2030) and Nepal (5.0 GW by 2030). In Myanmar by 2030, hydropower is projected to account for 60% and coal 30% of all generated power. India's Ministry of Power estimated that by 2036, India will import around 17,100 MW from Bhutan and 15,800 MW from Nepal, and will export around 2,000 MW to Bangladesh.

This study assumes that the price of fossil fuels (coal and oil) for thermal power plants will gradually increase as existing low-cost oil fields are depleted and oil demand increases in countries not in the Organisation for Economic Cooperation and Development. In terms of initial investment costs, that of nuclear power is the highest, and that of gas-fired power is the lowest. The investment cost of coal-fired power plants differs by region, and that of photovoltaics will gradually decrease with more technological intervention.

Information on the cost of cross-border lines is limited. However, based on the findings of the study by the Asian Development Bank (ADB), this study estimated the costs of investing in several major cross-border grids as follows: $71 per kilowatt (kW) for Bhutan–NER India, $372/kW for Nepal–India other

than the NER, $400/kW for NER India–Bangladesh, and $200/kW for the NER–Myanmar.

This study estimated the potential of the NER as a transit corridor, generator, and exporter under three different scenarios: a reference case, an enhanced grid case (EGC), and an enhanced hydropower and grid case (EHGC). In the reference case scenario, the installed hydropower capacity of the NER will rise to nearly 5 GW in 2030, three times the level in 2015. However, this is still hardly 8% of this region's estimated potential (58 GW). This implies that the NER will still need to import electricity from Bhutan as in 2015, and Bhutan's presence as an electricity exporter will expand.

As Bangladesh will also be a major importer of power from Bhutan, the NER will play an important role as a transit corridor. In the reference scenario, the NER's exports of electricity to Myanmar will be constrained to 2015 levels as domestic electricity supply and demand remain almost balanced. In 2030, the capacity of the NER–Bhutan cross-border line will approach the upper limit of 10 GW, while that between Nepal and India will only reach 2.6 GW. Given the likely large increase in imports to Bangladesh, these interconnections need to expand steadily.

To meet the rapidly increasing electricity demand, the NER and neighbouring regions must double their power generation capacity from 2015 to 2030. The average annual costs of electricity supply in these regions, including the cost of investment in new power plants (except in the rest of India), cross-border lines, and their operation, is expected to reach $10 billion during 2015–2030. Investment costs will account for 30% of this, and costs of operation (mainly fuel) will form the remaining 70%. The annual investment cost for the cross-border grid is estimated at $37 million.

In the EGC scenario, the levels of electricity generation in the NER, Bhutan, and Nepal are almost the same as in the reference case. Bangladesh imports more electricity from the NER, and generates less electricity from gas-fired power. In Myanmar, domestic electricity produced from gas-fired power is also replaced by imports from the NER. Compared to the reference case, the capacity of the NER–Bangladesh connection line increases from 0.4 GW to 10.4 GW, while that of the NER–Myanmar line increases from 24 MW to 1.5 GW. The NER plays an

important role as a transit corridor between the neighbouring regions. Via the NER, hydropower from Bhutan and coal-fired power from the rest of India are exported to Bangladesh and Myanmar.

However, compared to the reference case, electricity supply costs are 10% lower in the EGC, and 15% lower in the EHGC, mainly owing to the increased use of lower cost hydropower replacing thermal power. The cost of power generation decreases in Bangladesh and Myanmar and increases in the rest of India in the EGC compared to the reference case. On the other hand, the increase in the cost of power generation in the rest of India is lower in the EHGC than in the EGC. Conversely, hydropower investment grows in the NER. Compared to the reference case, annual investment in cross-border lines increases to $146 million in the EGC, and $149 million in the EHGC.

Under these circumstances, importers could pay to import electricity instead of generating it domestically. Furthermore, exporters can earn revenue by exporting electricity to cover the increased cost of generating additional electricity. Thus, it must be determined how to set the traded electricity prices (including wheeling charges) between the concerned countries and regions. Stakeholders must discuss the fair allocation of the benefits (e.g., reduced costs).

In the EHGC, the NER plays three crucial roles as a generator, exporter, and transit region. Its hydropower generation capacity increases and it exports the energy to neighbouring regions. The capacity of the NER–Bangladesh connection line is further enhanced to 12.4 GW. This scenario would steadily replace fossil fuel-fired power generated from gas and coal with low-cost, zero-emission hydropower.

This study found that, in the reference case, carbon dioxide (CO_2) emissions related to power generation increase significantly in Bangladesh and Myanmar due to the expansion of fossil fuel-fired (mainly coal) power generation. Total CO_2 emissions in the regions excluding the rest of India will reach 94 million tonnes in 2030, 2.6 times the level in 2015. Furthermore, CO_2 emissions from power generation in the rest of India could increase to around half the 2015 level, reaching 159 million tonnes of CO_2 by 2030. However, in the EHGC, owing to the increase in hydropower, total CO_2 emissions from 2015 to 2030 will be 9% lower than in the reference case.

Additionally, enhancing cross-border interconnections in these regions will bring multiple benefits, not only for the NER, but also for other regions in an economically efficient way. Not only will India be able to utilise fully the planned capacity of its coal-fired power plants, Bangladesh will avoid constructing large-sized thermal power plants and keep CO_2 emissions in check by importing reliable and cost-effective electricity. In addition, Nepal, Bhutan, and Myanmar can reduce the risk of serious seasonal supply gaps arising from lean hydrological flows in the dry season.

Some questions exist as to the correct approach to setting prices for electricity trading (e.g., wheeling charges between the concerned countries and regions). Solving these questions will involve stakeholder discussion and negotiations as to the fair allocation of both the costs of investing in cross-border interconnections (around $75 million per year in both the EGC and EHGC) and the ensuing benefits (costs and emissions reduction).

2. Investment Models

Three investment models have been practiced in the NER. The first is public-sector investment, which has been predominant in the power sector in this region. The second is private-sector participation, such as that encouraged by the North East Industrial and Investment Promotion Policy, 2007 (a NER-specific national policy), wherein the Ministry of Commerce and Industry (Department of Industrial Policy and Promotion) of the Government of India made a specific policy intervention known as the Central Capital Investment Subsidy Scheme, 2007 for industrial units in the NER to accelerate industrial development. The NEIIPP 2007 has been replaced by the North East Industrial Development Schemes 2018 for the period 2017–2022, with a financial outlay of ₹30 billion up to March 2020. This new scheme includes power-generating units with capacities up to 10 MW, and seven categories of incentives for investors, including the Central Capital Investment Incentive for Access to Credit, Central Interest Incentive, Central Comprehensive Insurance Incentive, Goods and Service Tax Reimbursement, Income-Tax Reimbursement, Transport Incentive, and Employment Incentive. The third is private-sector investment attracted by various state government policies, such as the Hydro Policy 2008, which triggered significant interventions from the private sector. Although the Foreign Direct Investment Policy of India 2017 does not mention the power

sector directly, many states have designed their own polices for attracting investment in the power sector that are aligned with national government policies.

Multilateral agencies are increasingly showing interest in this area, and the Japan Bank for International Cooperation, World Bank, Asian Infrastructure Investment Bank (AIIB), ADB, and New Development Bank of Brazil, Russia, India, China, and South Africa are likely to play vital roles in future projects. The Hydro Policy 2008 identifies foreign assistance as a source of financing for central and state-sector hydroelectric projects in the NER. For instance, the World Bank is supporting six states in the NER to augment intra-state transmission, sub-transmission, and distribution networks by upgrading old and constructing new lines and associated substations. The policy also includes Capacity Building and Institutional Strengthening of Power Utilities and Departments of Participating States, a $470 million loan project that will mitigate technical and non-technical losses, frequent interruptions, and outages.

AIIB, with its fund of $100 billion, will complement and cooperate with the existing multilateral development banks. It offers sovereign and non-sovereign financing for sound and sustainable projects like energy and power, transportation, and telecommunications. India's NER and the BBIN countries can access this new source of investment. AIIB has already approved investment in a series of energy-related projects in South and Southeast Asia, including India.

3. Policy Recommendations

To realise and ultimately graduate the NER subregion and energy junctions on its eastern border, the BBIN subregion must provide substantive policy interventions to fill seven gaps in the following areas: (i) knowledge and information; (ii) seed projects; (iii) match making, technical facilitation, human resources, and capacity building; (iv) policy coordination and institutional harmonisation; (v) start-up and real-time ladder steps (e.g., a three-way policy and institutional layer-building strategy to facilitate CBET amongst federal units within a country, between two countries, and in the region must be worked out in great detail); (vi) confidence building; and (vii) technology.

It is also necessary to discuss the political economy of CBET benefits and the cost of non-cooperation. In the very short term, for the NER to become a significant power hub on India's power map, at least eight levels of activities need to be conducted:

i) Sensitise and build capacity amongst the main development actors, including the political leadership, bureaucracy, and technocrats.
ii) Organise several workshops for the stakeholders, including government institutions, the private sector, civil society members, the media, academics, and grass-roots community leaders.
iii) Bring together central and state agencies in the power sector into a common forum like the Ministry for Development of North Eastern Region and North Eastern Council, and sensitise and train them in the wider dynamics and potential of cross-border power exchanges. The North East Industrial Development Schemes 2018 should be revised further by enhancing the coverage of incentives for generating plants with capacities up to 50–100 MW, and allowing foreign investors to participate under its provisions. It is also vital to coordinate with foreign policymaking institutions like the Ministry of External Relations and Ministry of Commerce so that the complex dynamics of cross-border electricity exchanges with neighbouring countries and subregions can be handled smoothly and effectively. The possibility of a joint venture between the NER states and any ASEAN partners, as well as treating generated electricity as a tradable item with unhindered market access in Southeast Asian countries under the India-ASEAN Free Trade agreement could also be explored.
iv) Make extensive surveys of the energy markets in neighbouring countries, and explore the possibilities of extending power trade deals under the framework in the recently issued CERC.
v) Explore the investment possibilities for harnessing these resources from multiple stakeholders including private investors, international development agencies, and financial institutions.
vi) Create a pool of technical and non-technical manpower to cope with the gradation, technological advances, scale of construction, and other operations. For instance, to handle the 5,353 MW capacity added during 2012–2017, the NER requires an estimated 21,687 MW in additional technical (78%) and non-technical (22%) manpower,

including generation, transmission (5,254 cubit kilometres), and distribution (10.8 million consumers). This calls for the setting up of multidisciplinary training institutes, particularly in the hydropower sector, and diversifying the training to cater to these needs.

vii) Coordinate closely with a cross-section of agencies that build infrastructure, including roads, railways, communications, and waterways. For instance, the carrying capacities of roads and bridges in the highlands must be planned in such a way that all of this physical infrastructure can both withstand and sustain the movement of heavy equipment and machinery required for generation plants, transmission set-ups, and distribution networks, while absorbing shocks like natural disasters.

viii) Initiate a dedicated fund in the form of a special purpose vehicle exclusively to finance power projects in the NER, as envisaged in the Twelfth Five-Year Plan.

However, in the long-term, the following issues need to be addressed.

(i) The Power Ministry along with the North Eastern Electric Power Corporation, Power Grid Corporation, Power Trading Corporation, and the state governments should consider the long-term perspective of power trading with neighbouring countries. Newly industrialising regions in southwest China like Sichuan, Yunnan, and the Tibet Autonomous Region, as well as Myanmar, and Bangladesh could absorb much higher tariffs on power purchased from India, thereby raising the level of interdependence. Surplus power from Bhutan and Nepal could be included in this projection.

(ii) It is essential to corporatise electricity entities in the NER to insulate them from political pressure and patronage in pricing, distribution, staffing, and forward planning.

(iii) Enabling documents, legal frameworks, and stepping-stone details should be constructed on all critical areas of CBET at the provincial, national, and regional levels. This includes grid harmonisation, grid code and security, investment and finance, reforms, and regulatory frameworks.

(iv) The existing State Electricity Boards or similar entities should be allowed to borrow for expansion purposes, and the central government should guarantee these borrowings under suitable terms and conditions.

(v) It is critical to coordinate the power sector with the inland water transport system, and with the roads and railways under the Special Accelerated Road Development Programme because the transportation of heavy, oversized consignments or cargo to power projects requires roads, bridges, and underpasses to be designed to ensure adequate capacity. Inland water routes remain untapped for this purpose.

(vi) A comprehensive trading tariff structure under different energy mix scenarios, scales, geographical situations, and institutional frameworks must be built and finalised after intense deliberation. This structure should include a trading license regime, transmission pricing rules, determinations of tariffs, coordination with cross-border agencies, and operational details of payment mechanisms. The table reveals the complexity of the tariff regime in the present bilateral exchanges, which vary according to country, agency, source of energy mix, and private and public production structures. However, understanding the political economy of this complex pricing system provides an opportunity to adopt the best instrument from a range of existing arrangements.

Table 4.1 Bangladesh, Bhutan, India, and Nepal Initiative Countries – Tariff Layout

Bhutan–India	India–Bangladesh	India–Nepal
• Tala: ₹1.80/kWh for the first year (now ₹1.98/kWh – $0.003/kWh) • Dagachhu: ₹2.40/kWh for the first year (started in 2015) ($0.04/kWh)	• NVNL: ₹2.40/kWh (August 2014), ₹2.86/kWh (May 2015) ($0.04/kWh) • PTC: ₹4.26–₹5.00/kWh (December 2013–May 2015) ($0.071/kWh) • Tripura–Comilla ₹5.50 per unit ($0.091/kWh)	• Treaty/bilateral: currently ₹5.40/kWh ($0.09/kWh) • PTC: ₹4.55/kWh (FY2011), ₹4.35/kWh (FY2012), ₹4.30/kWh (FY2013), ₹3.75/kWh (FY2014) • NVNL-NEA PPA (80 MW) ₹3.44/kwh ($0.05/kWh)

kWh = kilowatt-hour, MW = megawatt, NVNL = National Thermal Power Corporation Vidyut Vyapar Nigam, NEA = Nepal Electricity Authority, PTC = Power Trading Corporation of India, PPA = power purchase agreement.

Note: 'FY' before a calendar year denotes the year in which the fiscal year ends, e.g., FY2018 ends on 30 September 2018.

Source: Panda, R.R. (2016), 'Accelerating Cross Border Electricity Trade and Hydro Power Development between Myanmar and South Asia: Opportunities and Challenges', August. United States Agency for International Development–South Asia Regional Initiative for Energy Integration–Integrated Research and Action for Development.

India's Draft CERC (Cross Border Trade of Electricity) Regulations, 2017 (presented in Annex B) puts forward possible avenues for tariff determination. One such avenue would be government negotiations, like those undertaken for the Chukha Hydro Power Project between India and Bhutan. The draft also proposes that the tariff for the Cross-Border Transmission Lines and Associated Systems policy (from the pooling station in India to the Indian border) shall be determined as per the CERC (Terms and Conditions of Tariff) Regulations, 2014. The tariff for transmission within India shall be established based on the prevailing laws under Sections 62 or 63 of the Electricity Act.

The NER's three-dimensional role as power producer, exporter, and transit provider is only possible if a quadrangular approach to build energy linkages and promote integration is consciously put in place. This quadrangular perspective – (i) within a state, (ii) amongst the NER states, (iii) with the rest of India, and (iv) cross-border interactions – will bring openness, reoriented thinking, and varied opportunities for the NER. In such a situation, besides enabling the region to conserve its own energy resources significantly and earn substantial revenue from wheeling charges, the participation of a variety of development actors will bring knowledge, more choices in terms of production and generation techniques, a fresh work culture, and modern institutional practices. In turn, this will build new skills and capabilities, modern technologies, and efficient management and governance practices; and will inject a strong sense of human security, ultimately ensuring national security.

4. Key Messages

This study has far-reaching implications as an instrument in India's Act East Policy, including repositioning the NER as a subregion with a view to make it a robust economic growth pole in India; promoting project-based subregional cooperation and ventures with a subregions like the BBIN, Greater Mekong Subregion, and Mekong–Ganga Cooperation in Southeast Asia; and encouraging the participation of multilateral agencies, private investors, and other institutional investors such as the Japan International Cooperation Agency and AIIB.

Based on the findings of this study, its key policy messages are as follows:

(i) Build institutional and human capacities in the region by connecting critical stakeholders, including policymakers, technical and professional institutions, investors, civil society, and community leaders.
(ii) Construct various CBET scenarios, a menu of benefits, and models of cooperation, and provide choices and alternative pathways to policymakers and other stakeholders.
(iii) Coordinate and harmonise, in a regional document, national priorities and emerging policy frameworks as reflected in each member country's Energy Sector Strategy.
(iv) Reposition the NER to utilise its rich and unharnessed renewable sources effectively. Another relevant context is the BBIN countries' NDC commitments to comply with the provisions of the Paris Agreement and fulfill Goal 7 of the Sustainable Development Goals.
(v) Initiate multilayer interdisciplinary dialogues and consultations amongst various stakeholders and development partners, both within and outside the country.
(vi) Prepare the enabling documents, legal framework, and stepping-stone details on all critical areas of CBET in the NER at both national and regional levels (e.g., grid harmonisation, grid code and security, investment and finance, reforms and regulatory framework, and tariff considerations).
(vii) Bring together both conventionally accessed and new multilateral financial and investing institutions including the World Bank, ADB, United Nations agencies, the Japan International Cooperation Agency, AIIB, and the private and public sectors as facilitating actors.
(viii) Sensitise local and provincial communities and borderland regions to support CBET ventures that promote and propagate provincial, national, and regional wellbeing.
(ix) Create a common energy platform and strategic planning and management committee exclusively for the NER where the Ministry of Development of North Eastern Region, North Eastern Council, North Eastern Electric Power Corporation, North Eastern Development Finance Corporation, Ministry of Power, independent power producers, multilateral institutions, the national grid, private power exchange distributors, and other stakeholders could negotiate and firm up CBET.
(x) Assess the capacities of neighbouring countries to absorb electricity exports from the NER and other regions in terms

of markets, transmission capacities, regulatory frameworks, investment destinations, and other institutional capacities.

These key findings should be studied further to generate more information and knowledge, create critical space for cross-border energy exchanges, generate adequate alternatives for policy interventions, and highlight the scope for cooperation and integration with Southeast Asian countries. A deeper and wider assessment of all of the crucial findings could attract significant interest from regional, global, and multilateral investors.

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Ministry of Power
Guidelines on Cross Border Trade of Electricity

No. 14/1/2016-Trans (Vol.-II)

1.0 INTRODUCTION

1.1 The exchange of electricity across the South Asian Region will promote economic growth and improve the quality of life for all the nations and shall balance the diversity of primary energy sources and differences in seasonal patterns of supply and demand. A regulatory framework is required to accelerate the development of the cross-border trade of electricity.

1.2 The South Asian Association for Regional Cooperation (SAARC) countries envisaging the need for cross-border electricity cooperation signed the SAARC Framework Agreement for Energy Cooperation (electricity) on 27/11/2014 recognizing the importance of electricity in promoting economic growth and improving the quality of life in the region. The cross border trade of electricity also complements the electricity demand and resource endowments among the neighbouring and SAARC countries.

1.3 While each country is sovereign by itself, governed by its own policies and laws, there is a need to harmonise the laws/ rules/ regulations governing trade in electricity in order to facilitate the cross-border trade. It is therefore necessary to frame guidelines on cross border trade in electricity across and with the neighboring countries by India. The guidelines have been framed with this objective in view and aligned with the existing laws and requirement of the physical infrastructure development, system operation with reliability and stability, economic and commercial aspects, system demand, settlements and reconciliation of the obligations.

1.4 Notwithstanding anything done or any action taken or purported to have been done or taken for cross border trade of electricity with neighbouring countries shall be deemed to have been done or taken under provisions of these guidelines and shall continue to be in place till the expiry of the existing contract.

1.5 Keeping the above background in view, Ministry of Power in consultation with Ministry of External Affairs hereby issues the 'Guidelines on Cross Border Trade of Electricity'.

2.0 OBJECTIVE

2.1 The objectives of these guidelines are to:

(a) Facilitate cross border trade of electricity between India and neighbouring countries;

(b) Promote transparency, consistency and predictability in regulatory approaches across jurisdictions and minimise perceptions of regulatory risks;

(c) Meet the demand of the participating countries by utilising the available resources in the region;

(d) Reliable grid operation and transmission of electricity across the borders;

(e) Evolve a dynamic and robust electricity infrastructure for cross border transactions.

3.0 AGREEMENTS FOR TRADE:

3.1 Any cross border transactions between India and neighbouring country shall be allowed through bilateral agreements between Indian entity and an entity of that country under the overall framework of agreements signed between the countries.

4.0 INSTITUTIONAL FRAMEWORK

4.1 Ministry of Power, Government of India shall designate an Authority (Designated Authority) for facilitating the process of approval and laying down the procedure for cross border transaction and trade in electricity.

4.2 The cross border trade of electricity shall be regulated by the Rules and Regulations framed or to be framed for the purpose of its implementation.

4.3 The Central Electricity Regulatory Commission (CERC) of India shall frame appropriate regulation for facilitating cross border trade of electricity with neighbouring countries in accordance with these guidelines. The regulation so framed by CERC shall be binding on all the participating entities.

5.0 COOPERATION WITH NEIGHBOURING COUNTRIES

5.1 The Designated Authority shall coordinate with the nodal agency of the neighboring country for all purposes as stated in the Rules or Regulations. These would include, inter-alia,

(a) facilitating the process of approval and laying down the procedure for cross border trade;

(b) planning, monitoring and coordinating the commissioning of cross border transmission lines for cross border transactions;
(c) the grid security, safety and operation;
(d) any other function as assigned by Government of India, Ministry of Power.

5.2 The cross border trade of electricity transactions shall be governed by the policies of the respective countries.

5.2.1 Considering that electricity trade shall be involving issues of strategic, national and economic importance, participating entities (Participating Entity(ies)) complying with following conditions shall be eligible to participate in cross border trade of electricity after obtaining one-time approval from the Designated Authority :

(a) Import of electricity by Indian entities from Generation projects located outside India and owned or funded by Government of India or by Indian Public Sector Units or by private companies with 51% or more Indian entity (entities) ownership;
(b) Import of electricity by Indian entities from projects having 100% equity by Indian entity and/ or the Government / Government owned or controlled company(ies) of neighbouring country.
(c) Import of electricity by Indian entities from licenced traders of neighbouring countries having more than 51% Indian entity(ies) ownership, from the sources as indicated in para 5.2.1(a) and 5.2.1(b) above.
(d) Export of electricity by distribution licensees / Public Sector Undertakings (PSUs), if surplus capacity is available and certified by the concerned distribution licensee or the PSU as the case may be.

5.2.2 Any other participating entity shall be eligible to participate in cross border trade of electricity after obtaining approval of the Designated Authority on case to case basis.

5.2.3 Any change in the equity pattern of the participating entities after the date of approval shall be duly intimated to Designated Authority and fresh approval shall be obtained by the participating entities under para 5.2.1 and 5.2.2 above.

5.2.4 Any coal based Indian thermal power projects other than Public Sector Undertakings shall be eligible for export of electricity to neighbouring countries only if surplus capacity is certified by the Designated Authority.

5.3 Ministry of Power may also identify the sources from which power can be exported to neighbouring countries.

5.4 The Project Developer of the neighboring countries participating under cross-border trade shall submit the technical information to the Central Electricity Authority (CEA). Also, if required by the Designated Authority, the developer shall submit the commercial and financial information to the Central Electricity Authority.

6.0 TARIFF

6.1 Cross border transaction of electricity through Government to Government negotiations.

Where import/ export of electricity is agreed between the Government of India and the Government of neighbouring country involving the participating entities of the two countries, the tariff for such transaction shall be determined through Government to Government negotiations, which shall be adopted by the Appropriate Commission.

Provided that tariff of participating entity of the neighbouring country already determined through Government to Government negotiations shall continue to be determined through Government to Government negotiations.

6.2 Cross border transaction of electricity through arrangements other than Government to Government negotiations.

(i) Tariff for import of electricity by Indian entities (including traders, distribution licensees) from generating stations (directly or through trader) located outside India may be determined, under long term/medium term/short term agreement, through a process of competitive bidding, which shall be adopted by the Appropriate Commission under Section 63 of the Electricity Act, 2003. Provided that in case of hydro projects, the tariff may be determined by the Central Electricity Regulatory Commission as per its Regulations, if approached by the generator through the Government of the neighbouring country and agreed by the Indian entities, including Public Utilities/Di scom(s).

(ii) Tariff for export of electricity to entities of neighbouring countries by Indian entities through long term/medium term/short term agreements may be as mutually agreed or through competitive bidding, subject to payment of the charges as applicable for transmission/wheeling of electricity through the Indian grid.

7.0 TRADE THROUGH INDIAN POWER EXCHANGES

7.1 Any Participating entity, with approval from the Designated Authority under para 5.2.1, after complying with the relevant regulations of CERC, shall be eligible for cross border trade of electricity through Indian Power Exchanges under the categories of Term Ahead Contracts, Intra Day Contracts/Contingency Contracts as defined in the Power Market Regulations of CERC. Provided that other entities shall be eligible to participate in the Indian Power Exchanges through the eligible licensees under the aforesaid Regulations of CERC.

7.2 Further, the quantum of electricity that can be traded under cross border trade for electricity in Indian Power Exchanges shall be prescribed from time to time by the Designated Authority.

7.3 Cross border trade of electricity can be extended to other categories of contracts based on review by Ministry of Power in consultation with CERC.

8.0 TRANSMISSION SYSTEM, SCHEDULING & ACCOUNTING

8.1 Transmission systems developed for cross border trade would normally be part of the integrated transmission system on the Indian side.

8.1.1 The transmission interconnection between India and its neighbouring country shall be planned jointly by transmission planning agencies of the two countries with approval of the respective Governments. These interconnections would be planned based on the need for electricity trade in foreseeable future and sharing of information required for analysis and studies for such planning. The generator located outside the country may, if required keeping technical and strategic considerations in view, develop transmission lines to supply electricity to the pooling station at their cost. However, the associated transmission system in India shall be planned by CEA and Central Transmission Utility (CTU) with approval of Ministry of Power.

8.1.2 The cross border transmission lines may be constructed between the pooling stations of one country to the pooling stations of the other country for secure, safe and controlled operation of the grid.

8.1.3 The interconnection between two pooling substations of different countries shall be monitored and controlled by the respective system operators of the two countries, with proper coordination.

8.1.4 Pooling station will be the sub-station which shall be monitored by the system operator of the respective countries. Transmission line from pooling station of one country to the pooling station of the other country will be planned jointly by the nodal transmission agencies of the participating countries.

8.1.5 Transmission Access priority for Cross Border trade of electricity is to be determined by CTU as per the CERC regulation on Cross Border Trade of Electricity.

8.1.6 The transmission charges, scheduling, accounting, deviation settlement involving Indian Grid and any other related operational mechanism and matters involving inter connected grids of electricity shall be governed in accordance with the applicable CERC Regulations.

8.1.7 Ministry of Power shall notify Indian Nodal agency for each neighbouring country which shall be responsible for settlement of grid operation related charges as per CERC regulations.

8.2 Indian Generating Stations supplying electricity exclusively to neighbouring countries may be allowed to build independent transmission system for connecting to the neighbouring country transmission system keeping technical and strategic considerations in view and with the approval of the competent authority at the cost inbuilt in the contract agreement signed between Indian entity and the neighbouring countries. Such approval will be under applicable section(s) of the Electricity Act, 2003, subject to complying the technical and safety standards notified under various section of the electricity Act, 2003.

9.0 GRID OPERATION, SAFETY & SECURITY

9.1 Grid security is paramount, therefore, cross border electricity trade would be undertaken in a manner that does not jeopardize grid security at any point.

10.0 DISPUTE RESOLUTION

10.1 The disputes within Indian territory shall be settled as per the provisions of Electricity Act, 2003.

10.2 The disputes involving entities of separate countries may be settled through Singapore International Arbitration Centre or as may be mutually agreed by the participating entities.

ANNEXURE B

Central Electricity Regulatory Commision New Delhi

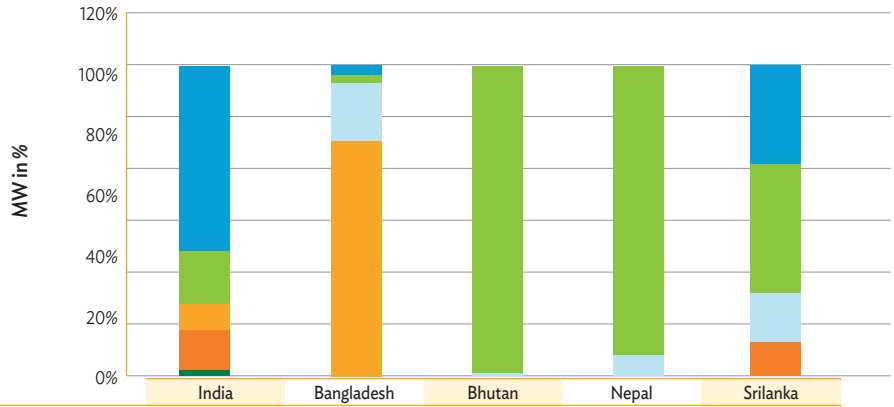
Draft Central Electricity Regulatory Commission (Cross Border Trade of Electricity) Regulations, 2017

Explanatory Memorandum

1. Background

1.1. The power sector in India and its neighbouring countries in South Asian Region must grow rapidly in order to sustain the high level of economic growth in the region. In this backdrop, strengthening of cross-border electricity cooperation can prove beneficial for all in terms of providing adequate and reliable electricity supply. As shown in the Figure B-1 & Figure B-2 below, there are complementarities in electricity demand and resource endowments among these countries which can be leveraged upon to meet the growing energy requirements of the region while optimally utilizing the resources.

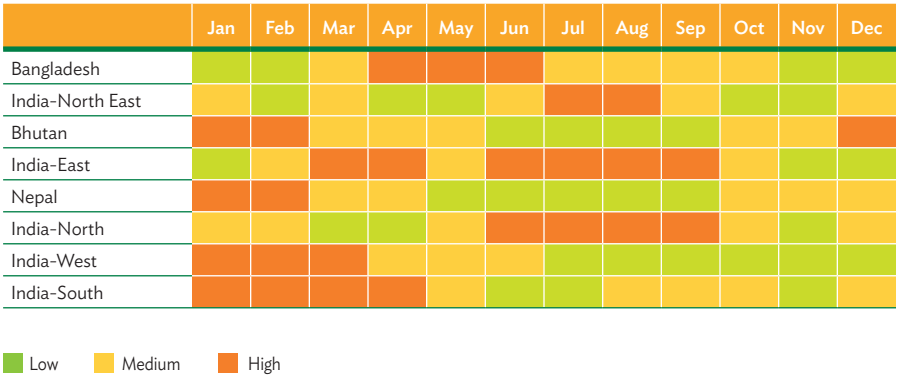
Figure B-1 Energy Mix of Neighbouring countries



	India	Bangladesh	Bhutan	Nepal	Srilanka
Coal	60%	3%	0%	0%	32%
Hydro	16%	2%	99%	93%	41%
Oil	0%	19%	1%	7%	16%
Gas	9%	76%	0%	0%	0%
Renewable	13%	0%	0%	0%	11%
Nuclear	2%	0%	0%	0%	0%

Source: World Bank Reports, 2015.

Figure B-2 Seasonal Demand of Neighbouring countries



Source: World Bank Reports, 2015.

1.2. Furthermore, increased electricity cooperation and trade among these countries can also bring economies of scale in investments, strengthen electricity sector financing capability, enhance competition, improve sector efficiency, and enable more cost-effective renewable energy penetration.

1.3. Recognizing the importance of electricity in promoting economic growth & improving the quality of life in the region and envisaging the need for a stronger cross-border electricity cooperation, the South Asian Association for Regional Cooperation(SAARC)[1] countries have signed the SAARC Framework Agreement Energy Cooperation (Electricity) on 27th November, 2014. The Framework allows the member states to carry out Cross Border Trade of Electricity subject to laws, rules, and regulations of the respective member states.

1.4. Government of India has also initiated measures in the direction of strengthening the cross border cooperation in electricity with its neighbouring countries. In order to facilitate and promote Cross Border Trade of Electricity with greater transparency, consistency and predictability in regulatory approaches across jurisdictions and minimise perception of regulatory risks, the Ministry of Power in consultation with the Ministry of External Affairs has issued Guidelines on Cross Border Trade of Electricity (herein after referred as "Guidelines") vide OM No. 14/1/2016-Trans dated 5th December, 2016. The Guidelines issued by Ministry of Power are attached at Annexure-A. The objectives of these Guidelines are to:

[1] SAARC Member States - Afghanistan, Bangladesh, Bhutan, India, the Maldives, Nepal, Pakistan and Sri Lanka

(a) Facilitate cross border trade of electricity between India and neighbouring countries;
(b) Promote transparency, consistency and predictability in regulatory approaches across jurisdictions and minimise perceptions of regulatory risks;
(c) Meet the demand of the participating countries by utilising the available resources in the region;
(d) Ensure reliable grid operation and transmission of electricity across the borders;
(e) Evolve a dynamic and robust electricity infrastructure for cross border transactions.

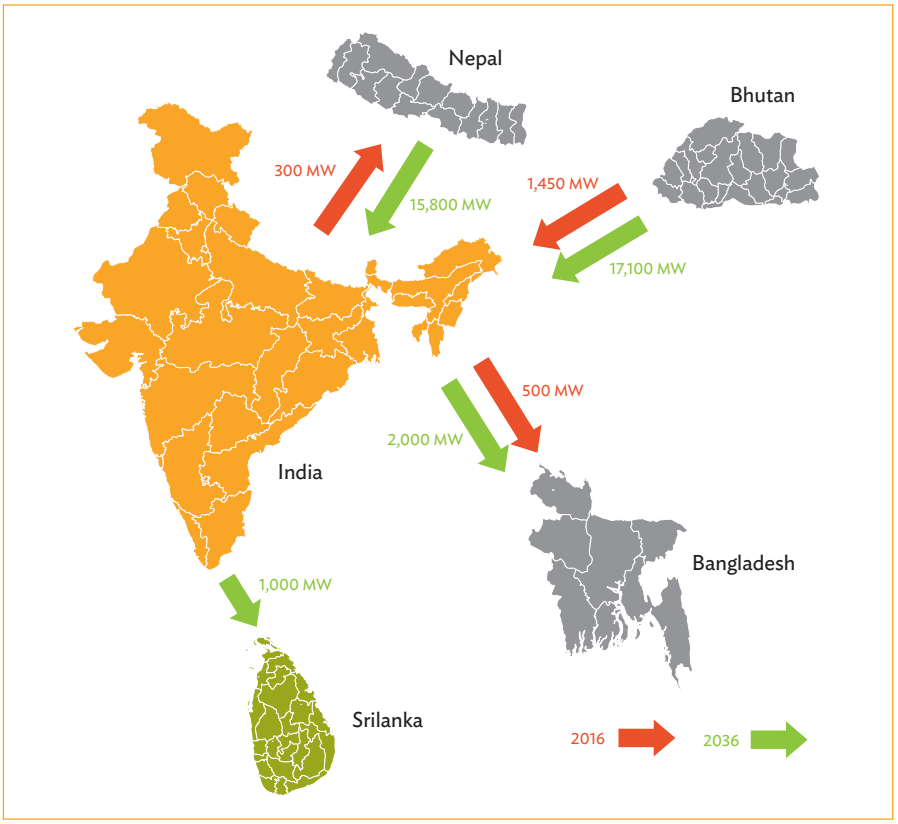
1.5. The Central Electricity Regulatory Commission (CERC) (herein after referred as "the Commission") has been mandated to frame appropriate regulation for facilitating Cross Border Trade of Electricity with neighbouring countries in accordance with the above-mentioned Guidelines issued by Ministry of Power.

1.6. Presently, India imports around 1450 MW from Bhutan and exports around 500 MW to Bangladesh & 300 MW to Nepal.[2] Going forward, the cross border transactions are expected to increase in the coming years. As per an estimate of Ministry of Power, by the end of 2036, India would have been importing around 17100 MW from Bhutan, 15800 MW from Nepal, and exporting around 2000 MW to Bangladesh & 1000 MW to Srilanka[3]. This can further be bolstered if a uniform framework is created for undertaking cross border trading of electricity. Currently the cross border transactions in electricity between India and neighbouring countries of Bhutan, Bangladesh, Nepal and Myanmar is taking place essentially through Long-term, Medium term and Short term contracts under bilateral Memorandum of Understanding (MoU) / Power Trade Agreement (PTA) and it is envisaged that the new regulations to be framed by the Commission will further harmonize the extant laws/rules/regulations governing Cross Border Trade in Electricity and create a common platform for all the stakeholders. The import & export of power during 2016 and the import of power estimated to take place by the end 2036 is shown in the next Figure B-3.

[2] CEA Notes on Cooperation with Nepal, Bhutan, Bangladesh, October 2016

[3] 20 (2016-2036) Year Transmission Perspective Plan Report

Figure B-3 Import & Export of Power from India



1.7. In this backdrop, the Commission proposes to notify the Cross Border Trade of Electricity Regulations, 2017 (short as "Draft Regulations") to facilitate the cross border trade of electricity between India and its neighbouring countries. While framing the

Draft Regulations, various planning and operational issues related to cross border trade of electricity have been considered. The salient features of the Draft Regulations are deliberated in the Section 2 below.

2. Salient Features of Draft Regulations

2.1. Objectives & Scope

2.1.1. The Draft Regulations have been framed with the objective to enable and facilitate Cross Border Trade of Electricity between India and its neighbouring countries. The Cross Border Trade of Electricity between India and any of its neighbouring country shall be bilateral in nature and these regulations shall be binding on all the participating entities undertaking such cross border transactions.

2.1.2. An applicant located within India may be using the same connectivity for both inter-state and cross border transmission purpose. Therefore, in view of consistency, it is proposed that for the participating entities located in India and seeking connectivity for long term or medium term open access for Cross Border Trade of Electricity, the existing CERC (Grant of Connectivity, Long-term Access and Medium-term Open Access in inter-State Transmission and related matters) Regulations, 2009 shall be applicable.

2.1.3. It is proposed that if the cross border trade of electricity between India and the neighbouring countries is taking place on the basis of Agreements made prior to these Regulations, then these Agreements shall continue to prevail till their expiry including any extension thereof.. For example, the PTC is importing power from Chukha, Tala, and Kiruchu Hydro Electric Projects in Bhutan based on the power Purchase Agreements signed with Royal Govt. of Bhutan under the umbrella Agreement signed between the two countries. As proposed, the above Agreements shall be deemed to have been done under these Regulations.

2.1.4. The Draft Regulations, on several instances, have invoked the provisions already existing as a part of some other Regulations or Act. Wherever such references have been made to the Regulations or Act, it is clarified that amendments thereto or subsequent enactment thereof shall apply.

2.2. Institutional Framework

2.2.1. The institutional mechanism, rules & regulations, technical procedures etc. may vary significantly across the neighbouring countries. In view of this, the institutional framework proposed has given a lot of emphasis to the planning and coordination activities associated with Cross Border Trade of Electricity.

2.2.2. The Ministry of Power in its Guidelines issued on 5th December, 2016 stipulated that the Ministry shall designate an Authority for facilitating the process of approval and laying down the procedure for cross border transaction and trade in electricity. Subsequently, in pursuance of the aforesaid Guidelines, the Ministry of Power vide OM No. 14/1/2016-Trans dated 14th December 2016 notified Member (Power System), CEA as the Designated Authority (DA).

2.2.3. According to the above mentioned notification, the DA shall carry out the following functions:

(a) Co-ordinating with the respective nodal agency of the neighbouring countries on Cross Border Trade of Electricity.

(b) Planning, monitoring, co-ordinating and commissioning of cross border transmission lines for cross border transaction in consultation with Central Electricity Authority (CEA) & Central Transmission Utility (CTU).
(c) The grid security, safety & operations with respect to Cross Border Trade of Electricity in consultation with CEA, POSOCO and CTU
(d) Examining and certifying surplus capacity of electricity in India for the purpose of Cross Border Trade of Electricity for export by coal based Indian Thermal Power Projects other than Public Sector Undertakings (PSUs) projects.
(e) Accord the approval for Participating Entity(ies) for cross border trade between India and the neighbouring country and/or through Indian Power Exchanges
(f) Notifying the quantum of electricity from time to time that can be traded under Cross Border Trade of Electricity through Indian Power Exchanges and any other function as may be specified by Ministry of Power.

Further, as notified, the DA shall also be framing its own rules for Conduct of Business (CBR) for facilitating the process of approval and laying down the procedure for Cross Border Trade of Electricity between India and neighbouring countries. The Draft Regulations have incorporated the provisions related to Designated Authority provided in the Guidelines.

2.2.4. A detailed institutional mechanism has been proposed in the Draft Regulations with the following agencies carrying out the designated functions as mentioned below:

(a) Transmission Planning Agency (TPA) - Akin to the DA in India, the neighbouring country shall designate a Transmission Planning Agency (TPA) for its country. The TPA shall coordinate with the DA in India and carry out the Transmission System planning for the Cross Border Trade of Electricity between the two countries.
(b) **Settlement Nodal Agency (SNA)** - As provided in the Guidelines, the Ministry of Power shall notify a SNA for each of the neighbouring country who shall be responsible for settling all cross border payments pertaining to grid operations including operating charges, charges for deviation and other charges related to transactions with a particular neighbouring country. SNA will be a member of the deviation pool, reactive energy pool and other regulatory pools for payment and settlement of the corresponding charges in the pool accounts of the region having connectivity with any other

neighbouring country. This practice is already being followed in India. For instance, NVVN has been assigned the role of Nodal Agency for trading of power with Bangladesh.

(c) **Central Transmission Utility (CTU)** - As per the CERC (Grant of Connectivity, Long Term Access, and Medium Term Open Access) Regulations, 2009, the CTU is the nodal agency for granting connectivity, long-term and medium term open access to the inter-state transmission systems in India. It is proposed that for cross border transactions also, the CTU shall be responsible for granting connectivity, long term & medium term open access to the Indian grid. It shall also be responsible for billing, collection and disbursement of the related transmission charges in accordance with the CERC (Sharing of Inter State Transmission Charges and Losses) Regulations, 2010.

National Load Dispatch Centre (NLDC) - As per the CERC (Open Access in inter-state Transmission) Regulations, 2008 the concerned RLDC is the nodal agency for all the bilateral short term open access transactions in India. It is proposed that for cross border transactions involving two countries, the NLDC shall be responsible for granting short-term open access to the Indian grid. It shall also be responsible for billing, collection and disbursement of the related transmission charges in accordance with the CERC (Sharing of Inter State Transmission Charges and Losses) Regulations, 2010.
In addition, the NLDC shall also act as the System Operator for India and be responsible for scheduling and dispatch of electricity related to cross border transactions. It shall also carry out other monitoring and supervision activities required for maintaining the security and stability of the international transmission link.

2.3. Eligibility Conditions for participating Applicant

2.3.1. The cross border trading of electricity with a neighbouring country can have significant implications on the economic and strategic interests of the country. Considering this, the Guidelines issued by Ministry of Power under Sub Clause 5.2.1 have specified the conditions based on which an applicant can either seek one time approval or case to case basis approval from the DA. The applicant shall become eligible to participate in the cross border trade of electricity only after obtaining the suitable approval from the DA. The Draft Regulations have incorporated the provisions related to eligibility conditions of the participating entities provided in the Guidelines.

2.3.2. Besides, the Draft Regulations in Clause 2(e) in the Definition section have specified that any one of the following entities from the neighbouring country can be an Applicant for seeking grant of connectivity for Cross Border Trade of Electricity:

(a) A Hydro Generating station or generating station using renewable source of energy for a installed capacity of 50 MW and above, or

(b) A generating station (not covered under (a) above) with installed capacity of 250 MW and above, including a captive generating plant of exportable capacity of 250 MW and above, or

(c) Hydro Generating stations or generating stations using renewable source of energy individually having less than 50 MW installed capacity, but collectively having an aggregate installed capacity of 50 MW and above, and acting on behalf of all these generating stations, and seeking connection from CTU at a single connection at the pooling sub-station under CTU, termed as the lead generator, or

(d) A consumer who intends to avail supply of a minimum load of 100 MW through the inter-State Transmission System of India

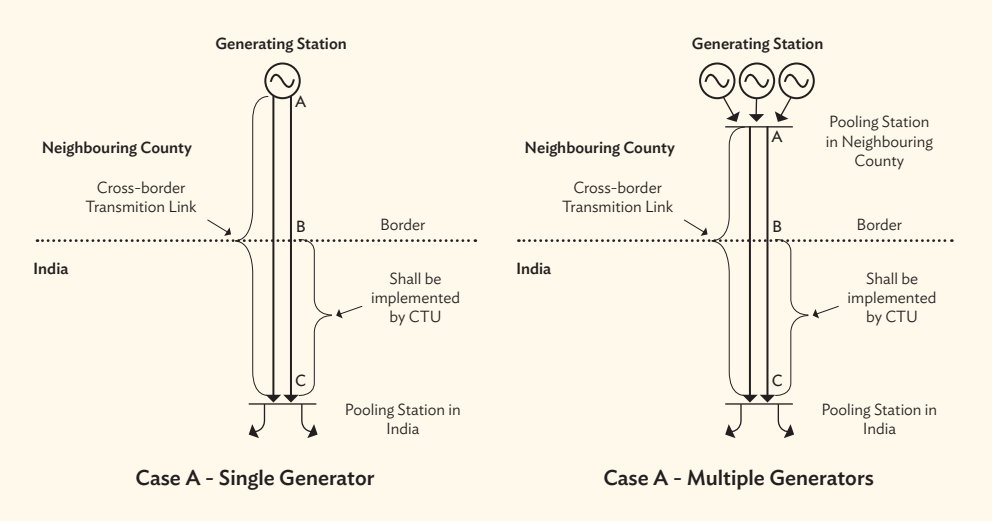
The above conditions are in alignment with the eligibility conditions required for the applicant seeking connectivity in India under CERC (Grant of Connectivity, Long Term Access, and Medium Term Open Access) Regulations, 2009.

2.4. Transmission Planning and Implementation of Cross Border Transmission Link

2.4.1. The transmission interconnection between India and a neighbouring country shall be planned jointly by the DA in India and the TPA of the neighbouring country with the approval of their respective Governments.

2.4.2. The cross border transmission link shall consist of lines (including associated transmission system) from the pooling station within India till the Indian border and lines from Indian border till the pooling station of the neighbouring country. The CTU shall be responsible for the implementation of cross border transmission link between the pooling station within India till the Indian border. Beyond the Indian border the responsibility of the implementation shall be that of the Applicant(s) or the TPA of the neighbouring country. An illustrative example may be seen Figure B-4.

Figure B-4 Cross Border Transmission Link



As shown in the above figure, the transmission lines (including associated transmission systems) from Point A to Point C shall be considered as cross border transmission link. The cross border transmission link shall be planned by the DA in India and the TPA of the neighbouring country in a coordinated manner. The transmission lines from Point B to Point C shall be the responsibility of CTU whereas the transmission lines from Point A to Point B shall be the responsibility of either the TPA or the Applicant of the neighbouring country.

2.4.3. The cross border transmission link between the pooling station within India to the Indian border shall be treated similar to other inter-state transmission lines in India. Further, considering the strategic nature of cross border transactions, it is desirable that the cross border transmission link from the pooling station within India to the Indian border be implemented based on cost plus basis and not on tariff based competitive bidding basis. It is based on the rationale that in case there is a delay in construction of generating station/ associated portion of cross border transmission link in the neighbouring country, then the additional costs incurred on account of the delay can be recovered through tariff as per the extant Regulations.

The Central Government may consider allowing the construction of cross border transmission link on a cost plus basis under strategic considerations. The National Tariff Policy, 2016 has also provided for such exemptions under clause 7.1 (7) as reproduced below:

'While all future inter-state transmission projects shall, ordinarily, be developed through competitive bidding process, the Central Government may give exemption from competitive bidding for (a) specific category of projects of strategic importance, technical up -gradation etc. or (b) works required to be done to cater to an urgent situation on a case to case basis'

Accordingly, as provided under the Article 62 of the Electricity Act, the tariff for the Indian part of the cross border transmission lines (including the associated transmission systems) shall be determined by the Commission in accordance with CERC (Terms and Conditions of Tariff) Regulations, 2014 payable by the applicant (s) using these facilities for Cross Border Trade of Electricity.

2.4.4. It is important that both the sides of cross border transmission link i.e. from pooling station within India to the Indian border and pooling station within the neighbouring country to Indian Border should be implemented in a coordinated manner so that these can come up in a similar time frame. In case the CTU has implemented the transmission links, but the matching lines or the generating station in the neighbouring country could not come up within the agreed timelines, then the tariff as determined by the Commission shall be charged to the applicant even though no actual transmission of power takes place.

2.4.5. In this regard it is proposed that the DA shall make a detailed procedure specifying inter-alia the modalities for creating the transmission link, mechanism for sharing and recovery of transmission charges, contingencies in case of delays etc.

2.4.6. The mode of interconnection between neighbouring country and India will preferably be through DC links. It can help increase system stability, by preventing the cascading failures propagating from one part of a power transmission grid to another. Construction and maintenance of the transmission lines & associated systems shall be in accordance with the Indian technical standards specified by CEA from time to time.

2.5. Grid Connectivity Long Term Access or Medium Term Open Access or Short Term Open Access

2.5.1. As already mentioned in the Objective & Scope section, the existing CERC (Grant of Connectivity, Long Term Access, and Medium Term Open Access) Regulations, 2009 shall be applicable in entirety for granting connectivity, long term or medium term open access for the purpose of Cross Border Trade of Electricity to the participating entities located in India.

2.5.2. The Draft Regulations have proposed some additional requirements for granting connectivity, long term or medium term open access to the participating entities located in neighbouring country. The additional conditions are proposed keeping in view the specific requirements of Cross Border Trade of Electricity. Besides, it has also incorporated some of the amendments that the Commission is contemplating to bring in the existing CERC (Grant of Connectivity, Long Term Access, and Medium Term Open Access) Regulations, 2009. The important ones proposed are discussed below.

(a) **Definition of Long Term and Medium Term Open Access:** As per CERC Grant of Connectivity Regulations, 2009 long term access implies the right to use the inter-state transmission system between 12-25 years whereas the medium term access implies usage for 3 months - 3 years. It is proposed that long term access be defined as right to use the inter-state transmission system for 7 or more years whereas the medium term access should be the right to use between 1 - 5 years. This is in alignment with the trends observed with respect to duration in recently signed PPAs.

(b) **Application Fees:** The applicant located in neighbouring country seeking grant of connectivity and long term or medium term open access for cross border trade of electricity shall, along with the application, have to pay a non refundable application fee in Indian Rupees as mentioned below:

No.	Quantum of Power to be injected/off taken into/from ISTS	Application fee (Rs. in Lakh)	
		For Connectivity/ Long term Access	Medium-term open access
1	Up to 100MW	4	1
2	More than 100 MW and up to 500 MW	6	2
3	More than 500 MW and up to 1000 MW	12	3
4	More than 1000 MW	18	4

The Draft Regulations have proposed to do away with Application Bank Guarantee provided under the sub clause 3 of clause 12 in CERC (Grant of Connectivity, Long Term Access, and Medium Term Open Access) Regulations, 2009. Instead, it has proposed to double the application fee for grant of connectivity and long term access.

(c) **Access Bank Guarantee for Long Term Cross Border Access:** Besides, the application fees as discussed above, the applicant located in neighbouring country shall be required to furnish to the CTU the Access Bank Guarantee along with the application for long term access for an amount of Rs. 1 cr/MW of the long term cross border transmission access quantum. The applicant has to furnish the Access Bank Guarantee regardless of whether the augmentation of transmission system has to be taken up or not. In case any of the developers fail to construct the generating station/dedicated transmission system or makes an exit and abandon its project, then the CTU shall have the right to encash the Access Bank Guarantee. However, the long term customer can approach the CTU and seek permission to exit prior to the award of contract for execution of Transmission system. In such case, considering that the CTU may have already carried out the necessary studies and the associated preparatory work, it shall encash Rs. 20 lakhs from the Access Bank Guarantee and return the balance amount to the long term customer. After operationalization of Long Term Access the Access Bank Guarantee shall be discharged to the concerned applicant in 5 years with one fifth of the Access Bank Guarantee amount to be refunded every year.

(d) **Provisional Grant of Connectivity:** As also provided under CERC (Grant of Connectivity, Long Term Access, Medium Term Open Access) Regulations, 2009 it is proposed that the grant of connectivity shall be considered provisional till the cross border long term or medium term or short term access is filed by the Applicant. Further, it is proposed that the application seeking long term access has to be mandatorily filed within 2 year of date of grant of Connectivity for a minimum of 50% of the installed capacity (minus auxiliary consumption) failing which Connectivity granted shall be withdrawn and application fees shall be forfeited.

(e) **Condition for Augmentation of Transmission Line:** It is proposed that the augmentation of Transmission system shall be undertaken only

after signing up of the Long Term PPA for at least fifty(50) percent of the installed capacity of the generating station. This has been included considering the risks associated with transmission infrastructure creation for cross border trade of electricity.

(f) **Time frame for processing:** It is proposed that the CTU shall process the Long term access applications requiring augmentation of transmission system in Indian grid within 90 days and in case the augmentation is not required the applications shall be processed within 60 days. It is further proposed that the CTU shall process the medium term open access applications within 30 days. It is proposed that the CTU shall process the application for cross border trading of electricity within the above timelines notwithstanding the existing procedures followed for processing the long term access or medium term open applications from India.

2.5.3. It is proposed that applications for grant of connectivity for short term open access shall be made to NLDC as per CERC (Open Access in inter-state Transmission) Regulations, 2008. The fees for short term open access shall be as per the procedure for scheduling for Bilateral Transactions specified in CERC (Open Access in inter-State Transmission) Regulations, 2008.

2.5.4. Unless otherwise specified in these Regulations, the provisions contained in the CERC (Open Access in inter-State Transmission) Regulations, 2008 and CERC (Grant of Connectivity, Long Term Access, Medium Term Open Access) Regulations, 2009 shall be applicable to the participating entities located in neighbouring countries seeking grant of connectivity or long term or medium term open access or short term open access for the purpose of Cross Border Trade of Electricity.

2.6. Trade Through Indian Power Exchanges

2.6.1. The Guidelines under Clause 7.0 have clearly specified the conditions based on which the participating entities can carry out trade in Indian Power Exchanges. The Draft Regulations have incorporated these provisions without any changes.

2.6.2. The entities eligible to undertake cross border trade of electricity in Indian Power Exchanges are initially allowed to trade under the categories of Term Ahead Contract, Intra Day Contracts or Contingency Contracts. However, as provided

in the Guidelines, the same can subsequently be extended to other categories of contracts based on review by Ministry of Power in consultation with CERC.

2.7. Tariff Determination

2.7.1. The Guidelines under Clause 6.0 have specified the conditions for determination of generation tariff for cross border transactions. The Draft Regulations have incorporated these provisions without any changes.

2.7.2. Considering the strategic nature of the cross border trade of electricity, the Guidelines have provided for determination of tariff through Government to Government negotiations. It is further provided that in case there is an Agreement already in existence and the tariff is determined as per the terms and conditions laid down in the Agreement, then the tariff shall be deemed to have been adopted by the Appropriate Commission as and when the same is received.

For example, the tariff for 336 MW Chukha Hydro Power Project in Bhutan is determined based on the Agreements signed between Government of India and Government of Bhutan in the year 1974. According to the protocol agreed between the two countries, the tariff shall be determined at the time of commissioning of the project and thereafter be reviewed by the two Governments at the end of each 4 year period. As provided in the Draft Regulations, the tariff so determined by the Govt. of India & Govt. of Bhutan for Chukha Hydro Power Project shall be deemed to have been adopted by the Appropriate Commission.

2.7.3. Besides, it is proposed that the tariff for the Cross Border Transmission Lines & associated Systems from pooling station within India till the Indian border (which shall be the responsibility of CTU), shall be determined as per CERC (Terms and Conditions of Tariff) Regulations, 2014. The Cross Border Transmission Lines & System has already been explained the section 2.4 above.

2.7.4. The tariff for transmission system within India shall be as per the prevailing laws under Section 62 or Section 63 of the Electricity Act.

2.8. System Operations

2.8.1. While facilitating the cross border trading of electricity it is important to ensure that the interconnected grid is also operated in a stable and secure manner. Besides, there should be in place an efficient energy accounting and settlement

mechanism for settlement of charges arising out of cross border transactions between India and its neighbouring countries.

2.8.2. In view of the above, the Draft Regulations have made provisions for system operations related activities for cross border trade of electricity in alignment with the procedures laid down in the existing CEA and CERC Regulations. All related provisions under CERC (Indian Electricity Grid Code) Regulations, 2010 shall also be applicable.

Declaration of Available Margins for facilitating Cross Border Transactions.

2.8.3. In India, the CTU assesses the Total Transfer Capability (TTC)/Available Transfer Capability (ATC) for long term/medium term open access in inter-regional links based on the Detailed Procedure prepared under the CERC (Grant of Connectivity, Long term Access and Medium term Open Access) Regulations, 2009. Similarly, the System Operator (NLDC) assesses the TTC/ATC for short term transactions in inter-regional links based on CERC (Measures to relieve congestion in real time operations) Regulations, 2009.

2.8.4. It is proposed that the TTC/ATC for the international link should also be assessed in advance by the System Operators identified in the respective countries based on their prevailing procedures and the lower of the two values of ATC assessed by the two countries should be considered for allowing the cross border transactions.

Scheduling and Dispatch

2.8.5. It is proposed that the scheduling of Cross Border Trade of Electricity be carried out in accordance with the procedure specified in the Part 6 of CERC (Indian Electricity Grid Code) Regulations, 2010. The proposed procedure is briefly outlined below.

- The selling/buying entity shall inform their requisitions to the SNA who in turn shall coordinate with the System Operators of the respective countries for scheduling of cross border transactions.
- System Operator shall declare the quantum of power to be scheduled over the cross border link on a day-ahead basis for the next day at the interconnection point.
- The scheduling of power shall then be carried out as per agreed quantum in the contracts for each 15-minute time period in a day. The transmission system losses shall be borne in kind by the utilities as per

the quantum declared by the concerned System Operator of India or the neighbouring country.

Congestion Management and Priority of Curtailment

2.8.6. It is proposed that the NLDC being the designated System Operator for Cross Border Trade of Electricity may decide to curtail already scheduled transactions in case of tripping of cross border link, congestion over the cross border inter-connection, or any other considerations in India.

2.8.7. Further, similar to the provisions under CERC (Indian Electricity Grid Code) Regulations, 2010 the curtailment priority shall be first short term transactions followed by medium term transactions and then, long term transactions. Amongst the customers of a particular category the curtailment shall be carried out on a pro rata basis.

Meter Reading, Accounting, Deviations and Settlement

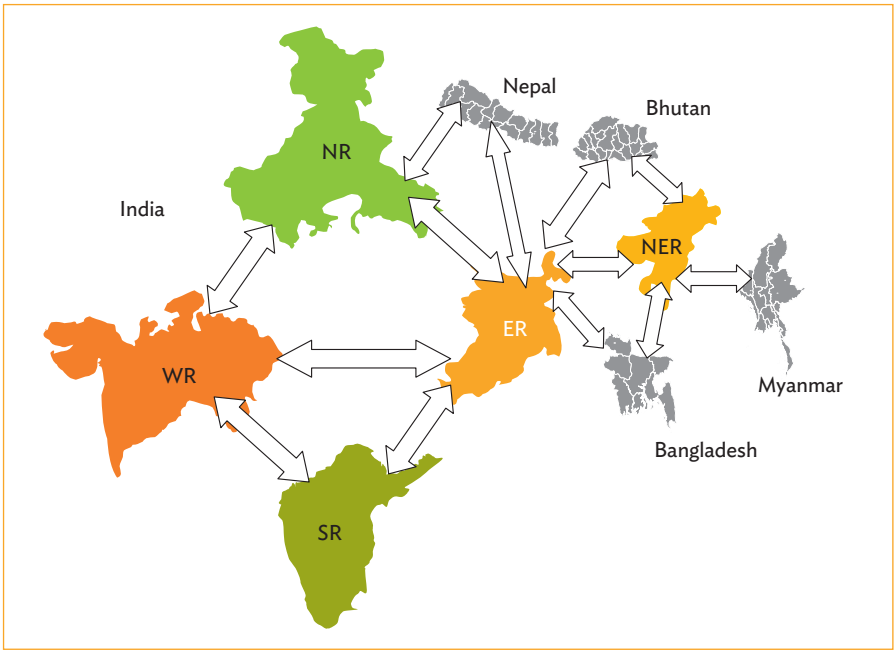
2.8.8. Special Energy Meters constituting of Main Meter, Check Meter and Standby Meter should be installed at both the ends of the cross border transmission link for recording of actual net MWh interchanges on a 15-minute basis and MVArh drawals. Further, Meters should also be installed at Generating stations located outside India. All the metering arrangements shall be carried out in accordance with CEA (Installation and Operation of Meters) Regulations, 2006.

Going forward, it is envisaged that the CERC (Indian Electricity Grid Code) Regulations, 2010 may be amended to provide that the energy meters may record transactions in 5 minute time block instead of 15 minute time block at present. The cross border metering system shall be aligned to the provisions of CERC (Indian Electricity Grid Code) Regulations, 2010.

2.8.9. Before the flow of electricity on cross border transmission line, TPAs of both the countries should confirm the availability of Main Meter, Check Meter and Standby Meter to System Operator of respective country. Further, the Special Energy Meters should be open for inspection by any person authorized by the TPAs or System Operators of the respective countries.

2.8.10. It is proposed that the Settlement of accounts of all electricity imported or exported from or to the neighbouring country should be at the interconnection

Figure B-5 Grid Connectivity with neighbouring country



point and carried out by the SNA in accordance with the CERC (Indian Electricity Grid Code) Regulations, 2010.

2.8.11. The SNA, who is responsible for settlement of charges arising out of cross border transactions, shall be a member of the Regional DSM pool acting on behalf of the selling entity/buying entity of the neighbouring country. As shown in the Figure B-5 below, some of the neighbouring countries may be connected to more than one region in India. In such cases the SNA shall also be a member of respective Regional DSM Pool.

2.8.12. It is proposed that the following procedure be adopted for energy accounting and settlement purposes:

- Weekly meter readings by the selling and buying entity shall be taken and transmitted by the TPAs to the SNA which in turn shall provide the same to System Operator i.e. NLDC by Tuesday noon for the previous week so as to facilitate energy accounting.
- Net import /export MWh and MVArh shall be computed by NLDC and shared with System operator of the neighbouring country for matching purpose

- Deviation from schedule on the Cross Border Link for each 15 minute time interval and the Charges for deviation from schedule (imbalance) at the point of inter-connection with the Indian Grid shall be calculated by the NLDC in accordance with the CERC (Deviation Settlement Mechanism) Regulations, 2014.

2.8.13. The SNA shall pay/receive charges on account of deviation to/from Regional DSM pool maintained by the System Operator as per DSM account issued by Regional Power Committee. It is the responsibility of the SNA to settle the same with the selling entity/buying entity of the neighbouring country.

2.8.14. Besides, as envisaged in the institutional framework, the SNA shall be responsible for settling scheduling charges (SOC & MOC Charges), Reactive Energy charges, Regional Power Committee (RPC) charges etc. etc. on behalf of the Selling/Buying entity with the System Operator and RPC which is in turn has to be settled by the SNA with the concerned parties. The Settlement Nodal Agency may sign an Agreement with Parties to the Cross Border trades for the required activities to be performed by the Settlement Nodal Agency. The SNA shall be paid service charges for carrying out functions under these Regulations which shall be separately notified by the Commission.

Real time SCADA Data, Communication Facilities Safety and Cyber Security

2.8.15. A reliable and efficient speech and data communication systems, with adequate redundancy of communication links, should be provided to facilitate necessary communication and data exchange, and supervision/control of the cross border interconnection by the respective System Operators in each of the country, under normal and abnormal conditions.

2.8.16. For safety, the CTU and the concerned Users shall be responsible in accordance with Central Electricity Authority (Technical Standards for connectivity to the Grid) Regulations, 2007, Central Electricity Regulatory Commission (Grant of Connectivity, Long-term Access and Medium-term Open Access in inter-state Transmission and related matters) Regulations, 2009 and CEA (Safety Requirements for construction, operation and maintenance of electrical and electric lines) Regulations, 2008.

2.8.17. It is proposed that a cyber-security framework identifying the critical cyber assets and protecting them should be put in place at both ends so as to support reliable operation of the cross border interconnection.

System Security Outage Planning & Recovery Procedures

2.8.18. The interconnection between two pooling substations of different countries should be monitored and controlled by the respective System Operators of the two countries, with proper coordination.

2.8.19. Detailed plans and procedures related to system security outage, planning and recovery should be finalized after the discussion between the System Operators of both the countries. While preparing the procedure the provisions related to system outage and recovery procedures under CERC (Indian Electricity Grid Code), Regulations 2010 should be followed.

2.9. Transmission Charges & Payment Security Mechanism

2.9.1. The PoC Injection and Withdrawal charges so determined under CERC (Sharing of ISTS Charges & Losses) Regulations, 2010 shall be applicable to the entities injecting or withdrawing power from the Indian Grid for cross border transactions. Besides, the applicant has to bear the transmission charges for using the Cross Border Transmission Link from the pooling station in India to the Indian border as determined by the Commission from time to time under the provisions of CERC (Tariff Regulations), 2014

2.9.2. In line with the provisions of Regulation 6.5 of Scheduling and Despatch procedure of Central Electricity Regulatory Commission (Indian Electricity Grid Code) Regulations, 2010 and Regulation 6 on Application of losses while scheduling of contracts of the Procedure for sharing of ISTS losses, the transmission losses shall be shared as per the following methodology:

(a) Withdrawal PoC losses as applicable would be applied at the interface.
(b) Injection PoC losses of respective injection grid would be applied at the interface.
(c) Net schedule at Indian end of the cross border transmission line would be arrived at after applying injection PoC loss of the concerned injection zone and withdrawal PoC loss.

2.9.3. Cross Border Transmission Access Customer shall establish payment security towards transmission charges at least ninety days prior to the intimated date of commencement of Cross Border Transmission which inter-alia shall include following for Long term access and medium term open access:

(a) A confirmed irrevocable, unconditional and revolving Letter of Credit in favour of the CTU through bank as specified in 2.10 equivalent to two point five (2.5) times the average Bill amount towards transmission charge for 3 months of the Application Period with a validity of 1 year;

(b) A confirmed irrevocable, unconditional and revolving Letter of Credit in favour of the SNA of India through bank as specified in Regulation 2.10 equivalent to two point five (2.5) times the average Bill amount towards grid related charge for 3 months with a validity of 1 year as informed by SNA of India.

2.10. Bank details

2.10.1. Bank guarantees, Letter of credit or any other payment security or payment required to be provided under these regulations shall be furnished by the Cross Border Transmission Access Applicant/Customer in Indian Rupees from a bank in their Country which shall be counter guaranteed by Nationalized Bank of India.

2.10.2. In case such Bank guarantees, Letter of credit or any other payment security is established by entities of neighbouring country the same shall be duly secured by the Sovereign Guarantee of the government of the neighbouring country.

2.11. Responsibilities of DA

2.11.1. The DA shall be playing a pivotal role in smooth implementation of the cross border trade of electricity in India. As discussed in Clause 2.2.3, the notification issued by Ministry of Power has specified the broad functions of the DA.

2.11.2. Within this broad contour of activities identified by the Ministry of Power, it is proposed that the DA shall inter-alia carry out the following activities:

(a) Coordinate with CEA, CTU and TPAs of the neighbouring country and plan for the Cross Border Transmission Link. It shall prepare procedures for creating cross border transmission link in different scenarios viz. dedicated lines, shared lines etc. The procedure may address how the transmission charges have to be recovered from the applicants using the cross border transmission link.

(b) Coordinate with CTU, TPAs, Developers (Joint co-ordination group) for ensuring that the Cross Border Transmission Lines from pooling station within India to the Indian Border and from Indian border to the neighbouring country pooling station comes up in a similar time frame. The procedure may include measures for addressing the delays in the implementation of generator or associated cross border transmission link.

(c) Coordinate with the System Operators and TPAs of neighbouring countries to look into various aspects associated with the operation of cross border transmission link including the protection related issues. It may consider constituting Operation Co-ordination and Protection Groups for overseeing the operations of cross border transmission link. The group may also periodically review the provisions related to protection and relay settings etc. It shall make procedures for outages, scheduled maintenance activities with mutual consent from the System Operators and TPAs of the neighbouring countries etc.

(d) Prepare the modalities for collecting the technical, financial and commercial information from the entities of the neighbouring countries.

2.12. Dispute Settlement Mechanism

2.12.1. The Draft Regulations have proposed a time bound multi-tiered dispute settlement mechanism for resolving any disputes arising on account of cross border trade of electricity.

2.12.2. Initially, the participating entities involved shall try to resolve and settle the disputes shall resolve and settle the dispute mutually within 60 days from the raising of the dispute.

2.12.3. In case the disputes can't be resolved mutually then the same shall be escalated to Secretary (Power), Govt. India and the concerned Secretary of Govt. of neighbouring country to be resolved at Government to Government level. If it still can't be resolved within the 30 days of escalation, then it shall be referred to Singapore International Arbitration Centre and finally settled through by its arbitration in accordance with the Rules of Arbitration of Singapore International Arbitration Centre ("SIAC Rules").