

Regional Power Cooperation and Trade

Lessons for South Asia

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Contents

Executive Summary	i
1.0 Introduction	1
2.0 Energy (Power) Profile and Power Cooperation in the Sub-Region.....	3
2.14	
2.2 Bilateral Power Cooperation in the Sub-Region	6
2.2.1 Bhutan and India	6
2.2.2 Nepal and India	7
2.2.3 Bangladesh and India	8
2.3. Regional Energy (Power) Cooperation	9
3.0 International Cases on Regional Energy (Power) Cooperation.....	11
3.1 The Greater Mekong Sub-region Energy Program (GMS)	11
3.1.1 Background.....	11
3.1.2 Development of Institutions for Regional Power Trade.....	11
3.1.3 Physical Infrastructure in the GMS Power Market	12
3.1.4 Role of Outsiders	13
3.1.5 Lessons from the GMS Regional Power Market Development Process	14
3.215	
3.2.1 Background.....	14
3.2.2 Development of Institutions for Regional Power Trade.....	14
3.2.3 Physical Infrastructure in the SAPP.....	16
3.2.4 Role of Outsiders	17
3.2.6 Lessons from SAPP	17
3.319	
3.3.1 Background.....	17
3.3.2 Development of Institutions for Regional Power Trade.....	18
3.3.3 Physical Infrastructure in SIEPAC	19
3.3.4 Role of Outsiders	20
3.3.6 Lessons from SIEPAC.....	20
3.4 The Nordic Power Market	20
3.4.1. Background.....	20
3.4.2 Development of Regional Institutions for Power Trade.....	21
3.4.3 Physical infrastructures	23
3.4.4 Role of Outsiders	23
3.4.6 Lessons from the Nordic Power Market.....	23
4.0 Lessons from International Cases for the South Asia Sub-Region	24
5.0 Conclusion	34
References	36
Appendix.....	40

Executive Summary

Regional power cooperation and trade in South Asia has been minimal so far, with power trade limited to a few bilateral arrangements. Given that the region is endowed with a mix of diverse energy resources, exploiting their combined potential to suit the power production and consumption patterns across the region creates a favorable landscape for regional power cooperation.

Recently a number of studies has been prepared on electric power cooperation in South Asia. The World Bank and USAID's SARI/EI program have developed system optimization models whose analyses and results would be valuable for promoting regional cooperation and trade on electricity in the region. This study complements those of the Bank and SARI/EI by focusing on the pre-requisites for a successful execution of power trading arrangements. It analyzes the regional power pools in Central America, South Africa, Southeast Asia and the Nordic, drawing lessons for the BBIN region, especially for developing infrastructure for transmission interconnections and for making institutional arrangements for trading and governance. The key messages of the study follow.

All bilateral trading arrangements need to be building blocks to build the foundation for regional ones in the future. Basic physical infrastructures that allow inter-connectivity between the countries are pre-requisites to power trade. Similarly, as shown by the case studies, investments in power generation must be made a priority in order to increase the capacity that can facilitate the initiation of power trade while creating a short-term electricity trading market. The role of external actors can be useful for financing technical studies, training and capacity building as well as for investments in physical infrastructure. Outsiders such as international finance institutions and donors have been actively supporting the sub-region's power cooperation process and such support is crucial particularly in building transmission infrastructure.

Similarly, a certain degree of domestic institutional and regulatory reforms in the power sector is required for creating effective regional power cooperation. Such reforms should be expedited—and harmonized between the countries to the extent possible. Country-specific legislations must accommodate provisions for cross-border power trade and open access to transmission infrastructure. Furthermore, the creation of regional institutions with legal authority to manage, implement and enforce action plans and decisions agreed upon by the national governments is essential for the success of power trade projects. Moreover, the presence of regional cooperation in multiple areas and a liberal regional trading environment can complement and enhance efforts for regional power cooperation. And finally, political will and trust is central to regional cooperation

The recent bilateral power cooperation between India and Bangladesh, the power trade agreement between India and Nepal, the sub-regional cooperation between Bangladesh, Bhutan, India and Nepal for possible power trade and grid connectivity and the SAARC framework agreement for Energy Cooperation are certainly positive developments towards regional power cooperation in South Asia. It is expected that the lessons drawn from the international cases will be useful in the region's path towards creating a power market to ensure energy security and economic development.

1.0 Introduction

The acute shortage of electric power in South Asia has taken a severe toll on regional economic growth. In spite of its rich endowment of diverse energy resources, the region has been unable to take full advantage of its energy potential resulting not just in economic and social costs but environmental costs too. Cross-border electricity trade among the nations of South Asia, especially the BBIN region consisting of Bangladesh, Bhutan, India and Nepal is attractive for a number of reasons.

First, the region has the potential to benefit from the seasonal complementarity in demand from the power systems of its countries. For example, monthly electric load profiles show high complementarity between the Bhutan and Nepal grids (low demand) and the India-East and India-North grids (high demand) from June through September, and that between the Bhutan and Nepal grids (high demand) and the India-East grid (low demand) from December through February (Timilsina and Toman, 2016). In addition, throughout the year, cross-border trade may help to increase the capacity utilization of power plants, especially those in the relatively less industrialized nations, during non-peak hour period. In the absence of power trade, the flux in both energy demand and supply across times of the day and different seasons implies extremely high costs for establishing electricity production capacity which meets demand during peak-hour period. Likewise, periods of significantly low demand relative to high supply results in wastage.

Second, the region has a tremendous potential for hydropower, which could be harnessed and transmitted as clean energy across the borders, after meeting domestic needs. The hydro energy potential of the Hindu Kush Himalayan region exceeds 500 gigawatts (Vaidya, 2012), most of which is yet to be developed. Currently, India and Bangladesh excessively depend on fossil fuels for power generation and are expected to have the largest demand for power in the sub-region. The environment cost associated with fossil fuels can be mitigated by power generated from hydro sources leading to a reduction in carbon emissions in the region.¹ In the case of Bhutan and Nepal, the sole dependence on hydro at all seasons may have harmful environmental impact; it is yet to be assessed how much of the technically feasible potential would be environmentally sustainable. The option of importing electricity generated by thermal power plants in India can reduce the pressure upon fragile upland ecosystems caused by excessive hydropower development.

Third, because of the recent advances made in direct-current transmission technology, the cost of transporting electricity across long distances is expected to come down. The adoption of “super-grids” using ultra-high-voltage-direct-current (UHVDC), running at 600,000 volts and higher, would facilitate the flow of electricity across long distances more efficiently in the years to come. For example, India is building a 1700 km UHVDC link to carry hydroelectric power from Assam to Uttar Pradesh and a 1400 km one to carry coal-based thermal power from Chhatisgarh to Haryana, with a peak capacity of 6000 MW each (The Economist, 2017).

Finally, cross-border electricity trade could be a catalyst for strengthening intra-regional trade in goods and services in a region that is least integrated in the world—paving the way towards

¹ A study by Wijayatunga et al. (2015) shows that the potential carbon dioxide reduction due to hydropower use from Bhutan to India is forecasted to range from 10 million tons per year in 2016/17 to 40 million tons per year by 2020/21.

regional economic integration. Presently, the SAARC region is one of the least integrated regions in the world; in 2005 its intra-regional trade flows was 4.7%, in terms of exports to own region, and 3.1% in terms of imports from own region. For Sub-Saharan Africa, these numbers are 6.8% for both exports and imports and, for lower and middle-income countries in East Asia and the Pacific, they are and 9.6% for exports and 18.4% for imports (COMTRADE cited in CII, 2008). Increased integration and interdependence fostered through regional power trade can yield peace dividends in the region.

To analyze cross-border electricity trade in South Asia, the World Bank and USAID's SARI/EI program have recently developed system optimization models whose analyses and results could be valuable for promoting power trade in the region (Timilsina and Toman, 2016; SARI/EI, 2017). Our study complements these studies by focusing on a study of the pre-requisites for a successful execution of power trading arrangements. It analyzes regional power cooperation arrangements around the world selecting four initiatives in Central America, South Africa, Southeast Asia, and the Nordic region. The objective is to draw lessons from these power pools for cooperation initiatives in the BBIN region of Bhutan, Bangladesh, India and Nepal. Given that the South Asian initiatives, such as the *SAARC Framework Agreement for Energy Cooperation* signed in November 2014 and the meetings of the Joint Working Group on Sub-Regional Cooperation between Bangladesh, Bhutan, India and Nepal held in New Delhi on January 30-31 2015, are still at a very early stage, we believe our findings will be timely for providing valuable inputs to the BBIN sub-regional cooperation process. Section 2 presents a brief overview of the reform initiatives of the domestic power sector and the initiatives towards bilateral and regional cooperation in Bangladesh, Bhutan, India and Nepal. Section 3 analyzes the cases of regional power cooperation in Central America, the Nordic region, South Africa and Southeast Asia, drawing key lessons from each of them. Lessons learned from the analysis of these four cases for the BBIN region are presented in Section 4. The report closes with a list of key messages of the study in Section 5.

2.0 Energy (Power) Profile and Power Cooperation in the Sub-Region

A large share of the population in the sub-region is still dependent on traditional fuels. For example, 29% of final energy consumption and 90% of rural cooking in India is met through traditional fuels. Similarly, the use of traditional energy sources is as high as 91% in Bhutan, 87% in Nepal and 53% in Bangladesh (ADB, 2014a; SAARC, 2010). In terms of non-traditional fuels, there is a significant dependence on fossil fuels. Oil accounts for 78% of energy use in Nepal while 74% of energy use in Bangladesh is met through natural gas (SAARC, 2010). Despite the immense potential of hydro, fossil fuels and natural gas are still the most used sources in the region as shown in Table 1.

Table 1. Energy Reserves/ Endowment of the Sub-region

Country	Oil (million barrels)	Natural Gas (trillion cubic feet)	Coal (million tons)	Hydropower (megawatts)*	Biomass (million tons)
Bangladesh	12	8	884	1897	0.08
Bhutan	0	0	2	30,000	26.60

India	5,700	39	90,085	148,701	139
Nepal	0	0	NA	42,130	27.04
Total	5,712	47	90,971	209,008	192.72

Source: Table 3 in ADB (2012a); *IMF (2013)

Moreover, the slow pace of growth in power generation and transmission infrastructures have led to crippling power shortages across the region. About 59.6% of the population has access to electricity in Bangladesh, 75.6% in Bhutan, 78.7% in India and 76.3% in Nepal (World Bank, 2012). However, even those with access to electricity face chronic power shortages, erratic supply and low electric power consumption. As shown in Table 2, Bhutan's electric power consumption per capita is the highest at 2,420 kWh while Nepal's consumption is the lowest at 103 kWh per capita. For the purpose of comparison, China's electricity consumption per capita is 2,944 kWh and the average global per capita electricity consumption is about 2,977 kWh (IRADe, 2014). However, Nepal experienced a shortage of 44% between 2011 and 2012 (IRADe, 2014). Enterprise surveys show that the economic value lost due to electricity cuts were the highest in Nepal and inadequate power supply has been cited as a major constraint for growth.

Table 2. Electricity Consumption and Access

Country	Access to electricity (% of population)*	Electric Power Consumption (kWh per capita)#	Economic value lost by enterprises due to electrical outages (as a % of sales)*	Percentages of firms citing electricity availability or reliability as a major or severe constraint for growth (%) +
Bangladesh	59.6	274	10.6	78
Bhutan	75.6	2420	4.3	6
India	78.7	879	6.6	32
Nepal	76.3	103	27.0	76

Source: * World Bank (2012); # Table 2 in IRADe (2014); +Singh et.al. (2015): Compiled from Enterprise Survey Data. Figures are from 2007 for Bangladesh, 2009 for Bhutan and Nepal and 2006 for India.

Furthermore, as illustrated by the table below, all countries in the sub-region depend on a single source of fuel for electricity generation. Over the last three decades, the use of fossil fuel in electricity production has increased steadily in Bangladesh and India while use of hydro sources has declined. On the contrary, hydroelectric sources account for 99.5% and 100% of electricity production in Nepal and Bhutan respectively. The utilization rate of the economically feasible hydropower potential in India and Bhutan are relatively higher at 17.2% and 12.1% respectively while the figures for Bhutan and Nepal are only 1.4% and 1.2% respectively, indicating a large unexploited potential (IMF, 2013).

Table 3. Sources of Electricity Production (in GWh)

Fuel	Bangladesh	Bhutan	India	Nepal
Coal	883 (1.8%)	0	801,341 (71.1%)	0
Oil	5,652 (11.5%)	0	22,716 (2%)	19 (0.5%)
Gas	41,727 (85.1%)	0	93,908 (8.3%)	0
Biofuels	0	0	19,339 (1.7%)	0

Waste	0	0	1,194 (0.10%)	0
Nuclear	0	0	32,871 (2.9%)	0
Hydro	777 (1.6%)	6,746 (100%)	125,827 (11.2%)	3,533 (99.5%)
Geothermal	0	NA	0	0
Solar PV	0	NA	2099 (0.2%)	0
Solar thermal	0	NA	0	0
Wind	0	NA	28,279 (2.5%)	0
Tide	0	NA	0	0
Other sources	0	NA	0	0
Total Production	49,039	6,746	1,127,574	3,552
Imports	0	2	4794	793
Exports	0	4,924	-5	-4
Domestic Supply	49,039	1,642	1,132,363	4,341

Source: IEA (2014)

2.1 Domestic Power Sector

Domestic power sector reforms were initiated in the early 1990s in South Asian countries to improve financial conditions of state-owned utilities and to attract more private sector investments. The power sector in the sub-region is still a highly regulated sector. Government institutions and recent reforms reflect a larger emphasis on improving operational performance rather than increasing free market competition (Singh et al., 2015). As shown by the table below, the existing regulatory bodies, level of private sector participation, market structures, and the state of transmission and cross border energy trade across the four countries present many similarities that may go on to explain the current status of joint energy trade in the region.

Table 4. Organization of the Power Sector

	Bangladesh	Bhutan	India	Nepal
Unbundling of Utilities	Partially implemented	Partially implemented	Most large states have unbundled their State Electricity Boards	No
General Market Structure	Multiple sellers, single buyer	Multiple sellers, single buyer	Competition with organized trading but includes SOEs	Multiple sellers, single buyer

Independent Regulatory Commission	BERC is the common regulator for oil & gas and electricity sector	Bhutan Electricity Authority is the regulator for electricity sector	Both Central (CERC) and State (SERC) regulators for electricity sector	In the process of establishing NERC
Private sector participation	Present in electricity generation only	Present in electricity generation only	Present in most segments of energy chains but dominant in electricity generation	Present in electricity generation only
Transmission Arrangement	Vertically integrated	Unbundled transmission owner	Unbundled transmission and independent system operator	Vertically integrated
Provisions on cross-border electricity trade	Recognized as a strategy for increasing energy security in the National Energy Policy	No mention in policy	No provisions in legislative framework	Hydro policy 2001 recognizes potential of regional energy trade for developing hydro potential in the country and recognizes electricity as an

				exportable commodity
Nodal Agency for Power Trade	None	None	Power Trade Corporation	None

Source: compiled from ADB (2012a), SAARC (2013), Singh et al. (2015)

India has introduced a higher degree of reform and competition in the power sector compared to others. The Electricity Act of 2003 and other provisions for reforms in the National Electricity Policy 2005, and the National Tariff Policy 2006, have brought significant changes to the Indian Power sector. One of the reasons for lack of progress in power cooperation in the past can be attributed to the absence of adequate power sector reforms in India, which is a key player in driving power trade in the region. While India has implemented major reforms, Nepal lags significantly behind as it has not yet implemented the unbundling of the power sector and does not have an independent regulatory commission. Even though private sector participation is present in the generation sector in all countries, these are mostly small IPPs, while majority of power generation units are state-owned. Only Bhutan and Nepal have explicit provisions for cross-border electricity trade in national legislations. All countries require licenses for electricity generation, transmission, and trade, however, the conditions and rules for acquiring licenses vary. Licensing is not required for electricity generation in India, except for hydropower projects, which need to be approved by the Central Electricity Authority.

The competitive bidding process for hydropower projects also differs across countries. Hydropower projects in India are exempted from tariff-based bidding. The high risks and uncertainties associated with hydro projects make it difficult to arrive at a set tariff, which makes tariff-based bidding unattractive for the private sector. According to India's hydropower policy, a minimum of 12% free supply of power to the state government and additional supply of 1% to the local population is a requirement under competitive bidding (GoI, 2008). Bhutan has a similar competitive bidding policy for hydropower projects where a minimum of 12% free power to the state during the first 12 years and a minimum of 18% thereafter is required (GoB, 2008).

Nepal's Hydropower Development Policy of 2001 provisions competitive bidding for awarding hydropower licenses. However, in practice, up until 2008, all hydropower licenses were awarded indiscriminately. Since the formulation of the Directives on Licensing of Hydropower Projects in 2008², licenses have been handed out on a competitive basis. A license is awarded to the firm proposing the highest upfront charge (revenue). Bids for projects however are required to be above the pre-determined base value determined by the government for each project listed. Other requirements for participation, qualification and selection of bids is determined by the government

² Successive revisions in 2009 and 2015

of Nepal and communicated to bidders through a Request for Proposal (RFP). Specific to export oriented projects, such requirements are negotiated through the Project Development Agreement (PDA).

Only India has established a nodal agency for electricity trade and has a separate authority specifically for electricity related dispute resolution (SAARC, 2013). The countries also differ in terms of the structure of their electricity regulatory commission where India has a dual regulatory framework (federal and state level), while Nepal is still in the process of establishing a regulatory body. This makes it challenging to establish a platform with power sector regulators from the sub-region and create regional guidelines for power trade. The lack of cost-reflective power pricing also creates difficulties in negotiating power trade deals, which can be a long and drawn out process when a market determined reference price is absent. The spot market in India could provide solutions. If regulatory restrictions are removed, Nepal, Bangladesh and Bhutan could trade power in the Indian spot market even at small quantities for a start due to the low capacity of existing interconnection grids. Continued power sector reforms towards harmonizing regulatory and legal framework would facilitate power cooperation and trade in the sub-region.

2.2 Bilateral Power Cooperation in the Sub-Region

The existing nature of power trade in the sub-region is limited to bilateral agreements between India and Bhutan, India and Nepal and very recently between India and Bangladesh. As of 2014, the amount of electricity traded is 1,416 MW between Bhutan and India, 500 MW between Bangladesh and India, and only 150MW between Nepal and India (IRADe, 2014).

2.2.1 Bhutan and India

The first agreement for hydropower trade between Bhutan and India was signed in 1961 with the Jaldhaka Hydroelectric project located in West Bengal which supplied electricity to the border towns of Bhutan. The Chukha project of 1974 was the first joint venture that made Bhutan a net exporter of power to India (Tamang, 2007). In 2006, Bhutan and India signed a framework agreement on hydropower development and trade with provisions for public and private sector participation. In 2009, a protocol for the 2006 Agreement was signed with plans to develop 10,000 MW of power generation capacity from 10 mega hydropower projects by the year 2020 (ADB, 2013a; IPPAI, 2014). A recent development was the signing of an Inter-Governmental Agreement on Joint Venture Hydropower Projects through Public Sector Undertakings which includes four HEPs with a total capacity of 2020 MW.³

Power is exported from Bhutan to India via three major transmission links of 400 kV, 220kV and 132 kV. Surplus power from the Tala HEP is exported to West Bengal in India via the 400 kV Tala (Bhutan) – Binnaguri/New Siliguri (India) transmission links. The 220 kV Chukha (Bhutan) – Birpara (India) grid supplies power from the Chukha HEP to West Bengal. These high voltage networks are dedicated transmission links specifically associated with the Tala and Chukha HEP. Surplus power is exported to Assam in India from the Kurichhu HEP via the 132 kV Kurichhu

³http://www.mea.gov.in/press-releases.htm?51/Press_Releases - Press Releases, Media Center, Ministry of External Affairs

(Bhutan) - Salakai/ Rangia (India) transmission links. Several 400kV transmission links are also under development for the future (IPPAI, 2014; Tshering, 2012).

The current 1,488 MW of hydropower in Bhutan is largely generated from three key projects - Chhukha, Kurichhu and Tala - which are based on long term power trade agreements with India. About 80% of the total generated hydropower is exported to India after meeting domestic needs. Net power exports to India have increased from 1,460.48 GWh in 2000 to 5,556 GWh in 2013-14 (ADB, 2013a; Singh et al., 2015). However, during the dry winter season, Bhutan is a net importer of power from India (ADB, 2014a; World Bank 2014).

The success and motivation behind India-Bhutan cooperation has been attributed to various factors such as Bhutan's streamlined institutions for power development and trade, supply of royalty energy for the domestic market, India's financial support and technology, and rising demand from India's Northern grid which consumes 20% of total energy supply in India (Bisht, 2011). Power exports generate about 30% to 40% of government revenue in the form of taxes and dividends and contribute to 25% of the GDP. In addition to the direct benefits from hydropower projects, the indirect benefits include employment generation and industrial development due to low cost of electricity. These realized benefits from mutual power cooperation for both Bhutan and India have contributed to the political will towards developing new hydropower projects (ADB, 2014a; World Bank 2014).

In the past, concessionary financing from the Government of India (60% grant and 40% loan model) along with higher prices in the Indian power market helped cover hydropower generation costs and brought surplus revenue to Bhutan (ADB, 2010). In recent years, the share of loan component in hydropower sector financing from India has gone up (30% grant and 70% loan), which has affected development of some mega projects. In addition, there are some concerns in Bhutan about excessive dependence on one source of energy and one export market. But despite concerns, bilateral cooperation and electricity exchange between Bhutan and India have grown and strengthened significantly over the years. So far, this is the most successful power cooperation endeavor in South Asia.

2.2.2 Nepal and India

The first cooperation in hydropower between Nepal and India started with the Koshi project in 1954, and the construction of a 6.8 MW power plant in Kataiya (Nepal-India border) along with a transmission line for power imports to Nepal. The 1959 Gandak project was a 15 MW capacity power plant constructed in Nepal under with financing from the Government of India. This was the first project to export power from Nepal to India (Dhungel, 2008; IPPAN/CII, 2006).

Several other hydropower projects such as Trishuli, Phewa and Devighat HEP were built in Nepal with Indian support on a grant-aid basis during the 1970s and 1980s. However, many other hydropower projects initiated under Nepal-India cooperation such as Chisapani, Budhi Gandaki and Sapta Koshi have not moved ahead due to various political, financial and implementation problems. Since the construction and handover of the Devighat HEP in the early 1980s, there have been no other hydropower projects developed under bilateral cooperation between India and Nepal.

In 1996, Nepal and India signed the Mahakali Treaty with plans for the integrated development of the Mahakali River. However, provisions to develop the Pancheshwar multipurpose project on the Nepal-India border under this treaty has not materialized due to problems with water-sharing issues and lack of consensus on a rehabilitation policy, among other things (IPPAN/CII, 2006). The Indo-Nepal Power Trade Agreement signed in February 1996 was a major step towards promoting private sector participation in power trade. The agreement has provisions for any private-public or private parties to enter into an agreement for power trade between the two nations. The parties are also given the flexibility to negotiate the conditions of the agreements such as points of delivery, price and other supply parameters (IPPAN/CII, 2006).

In 2014, a project development agreement was signed between the Nepal Investment Board and GMR of India for developing the 900 MW Upper Karnali as an export oriented project (Kumar, 2014). On October 2014, an agreement on electric power trade, cross-border transmission interconnection and grid connectivity was signed between the two nations. The power trade agreement aimed to facilitate cooperation for power generation and transfer, national grid connectivity, renewable energy and had provisions for creating joint working groups to plan and conduct relevant research. However, most of the articles under the PTA appear to be lacking adequate detail and are formulated as broad clauses that could be open to interpretation though the agreement did indicate the broader goal of moving towards a common electricity market in the sub-region (GoN/ GoI, 2014).

Currently there are 21 power exchange points through 11kV, 33kV and 132kV transmission lines between Nepal and India. However, these transmission lines fall short of delivering surplus power from Nepal to India during the summer season. There are only three large power carriers of 132 kV lines while the rest are medium voltage levels of 11kV and 33 kV. The first 132 kV line was constructed to export power from the Gandak power house to Bihar under the Gandak Treaty. At present this transmission facility is being re-developed to import power from India as well (Mishra, 2009). The Duhabi (Nepal) - Bhandabari (border) – Kataiya (India) 132 kV link was commissioned in January 1999 to trade/exchange up to 50 MW of power, mostly as imports to Nepal from the Bihar grid (Mishra, 2009; IPPAN/CII, 2006). The third 132 kV transmission link was established to import about 70 million units of free power from India under the Mahakali Treaty (IPPAN/CII, 2006; IPPAI, 2014). The 400 kV Muzaffarpur (India) - Dhalkebar (Nepal) double circuit transmission line aims to synchronize grids between India and Nepal and is expected to transmit 800 MW power (IPPAI, 2014).

At present, power trade occurs only via radial mode due to the absence of infrastructure for transmitting large volumes of electricity. Currently, Nepal is able to import 120-150 MW of power from India via existing transmission lines. Except for the year 2003, Nepal has been a net importer of electricity from India and the trade deficit in electricity has increased over time. The significant shortfall of generation capacity in Nepal has turned it into a net importer of electricity. In 2013, Nepal's electricity imports from India amounted to 793 GWh (Singh et al., 2015).

Any kind of cooperation requires a high degree of communication through various platforms and demands a certain level of political commitment. The third meeting of the Indo-Nepal Joint Commission, responsible for planning and executing hydropower projects, took place in July 2014 after a long gap of 23 years. The Pancheshwar multipurpose project under the Mahakali Treaty which had been stalled for 18 years was re-initiated in September 2014 (Kumar, 2014). Such long

gaps reduce the momentum built towards bilateral cooperation and leads to wastage of political capital. The difficulties arising from the water-power nexus, environmental issues and any potentially contentious benefit sharing issues have all added to the complexities related to power development and cooperation between Nepal and India.

2.2.3 Bangladesh and India

The power cooperation initiatives between Bangladesh and India are relatively recent. The increasing shortage of gas and rising power generation costs have been the key factors that have motivated Bangladesh to pursue bilateral power trade arrangements with India. A bilateral agreement to set up the first cross-border power interconnection to supply 500 MW of power to Bangladesh was initiated in 2009. This grid connection between Baharampur (Eastern India) and Bheramara (Western Bangladesh) was commissioned in October 2013 (IPPAI, 2014). This is South Asia's first high voltage direct current (HVDC) interconnection. HVDC allows better control over power flows and provides stability to the two grids. This allows Bangladesh to buy electricity from India at a cheaper cost compared to sourcing it internally from rental plants and small IPPs.

Power purchase agreements between the Bangladesh Power Development Board and NRVN Ltd. in India are covered by two PPAs lasting a duration of 3 years. According to the agreement, 250 MW is to be supplied from the central generating stations of India based on electricity price indexed to power plant generating costs, or the CERC tariff rate. The remaining 250 MW will be procured from the Indian Power market (IPPAI, 2014). This venture is expected to reduce energy shortage and cost of electricity for Bangladesh while Indian suppliers benefit from selling power to a new market.

Bangladesh is an important neighbor when it comes to India's focus on developing its landlocked North-Eastern region and in building its 'Look East Policy' of strengthening economic ties with South-East and East Asia. As India is developing hydropower plants in its North-Eastern region, it is expected that Bangladeshi territory will be necessary for electricity transmission to the power deficient Northern states of India. With rising power demand in Bangladesh, the country is keen on importing electricity from India. Such mutually beneficial interests have accelerated the initiatives for trading power in the last few years.

Bilateral talks have taken place at the highest political level followed by the signing and execution of power trade agreements. The joint deal is said to have received relatively less media coverage and therefore less exposure to vested interest groups who may try and sabotage such efforts. ADB has played a key role in financing transmission interconnection on the Bangladeshi side while the Power Grid Corporation of India financed the infrastructure on the Indian side. In December 2014, a deal was made for providing transit facilities to Indian goods through ports of Eastern Bangladesh in exchange for India supplying Bangladesh with 100 MW of power (IDCR, 2015). The India-Bangladesh power deals show how bilateral agreements can be fast-tracked with political will and an understanding of clear mutual benefits.

On reflection, certain aspects of the current bilateral power trade agreements in the sub-region are possible road blocks for regional power cooperation. Bhutan's pre-existing commitments towards power generation and export to India have a tenure of 15 to 25 years. Such long term PPAs can limit Bhutan from seeking other avenues for partnership and financing. India holds the right to import any surplus power that Bhutan may have after meeting domestic needs. Since

Bhutan's major power generation capacity is already tied up to these bilateral agreements with India, a more regional approach can be challenging.

Since countries from the region only have bilateral arrangements with India, these agreements do not include any clauses on third party (country) access to transmission infrastructure. The lack of standard rules for formulating bilateral agreements makes it challenging to harmonize them seamlessly towards a regional agreement.

2.3. Regional Energy (Power) Cooperation

There are four key mechanisms currently in place for regional energy cooperation in the sub-region. Two of these are State-led initiatives - the South Asia Association for Regional Cooperation (SAARC) and the Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC). The other two, led by non-governmental actors are the South Asia Sub-regional Economic Cooperation (SASEC) led by ADB and the South Asia Regional Initiative for Energy (SARI/E) led by USAID. The latter are project-based partnership initiatives focused on promoting regional cooperation in the South Asian sub-region.

The four regional power cooperation initiatives have provided a platform for networking and among the member states. Both SAARC and BIMSTEC have established energy centers that are active in producing studies on energy cooperation but there appears to be a substantial overlap in the activities. Moreover, State-led initiatives like SAARC and BIMSTEC have secretariats which are not empowered to make decisions. The SAARC secretariat is staffed by mid-level diplomats who lack technical expertise and are at the risk of favoring individual country interests over regional interests (Ghate, 2011). After a very long period of stagnation, the signing of the 2014 SAARC Agreement and the 2015 BIMSTEC MOU on electricity cooperation are hopeful developments. The BIMSTEC MOU is similar to the SAARC Framework Agreement and it is expected that the BIMSTEC deal would accelerate the implementation of the SAARC deal.

Regional initiatives such as SASEC and cross-regional initiatives like BIMSTEC may have better chances of promoting regional cooperation rather than SAARC. The North-East region of India is more dependent on Bangladesh and Myanmar and India's 'Look East Policy' sits well with integrating the North-East sub-region. In addition, India already has bilateral power interconnections with Bhutan, Nepal and Bangladesh. Therefore, strengthening these bilateral interconnections and moving them towards a sub-regional market may be a pragmatic first step towards creating a broader regional power market.

3.0 International Cases on Regional Energy (Power) Cooperation

In this section we examine four cases of regional power cooperation efforts from South-East Asia, Southern Africa, Central America and Scandinavia. These joint regional efforts are at varying stages of maturity and also represent regional blocs that are largely different in terms of their economic and technological state. However, a review of these individual case studies offer a lot of insight into the challenges of creating regional power markets and the successes or failures attached to them.

3.1 The Greater Mekong Sub-region Energy Program (GMS)

3.1.1 Background

The Greater Mekong Sub region (GMS) program is a regional partnership between Cambodia, Laos PDR, Myanmar, Thailand, Vietnam and the Yunnan Province and Guangxi Zhuang Autonomous region of the People's Republic of China (PRC). It was launched in 1992 with the support of the Asian Development Bank to promote economic growth, reduce poverty and develop an integrated harmonious sub-region, with energy being a key focus (ADB, 2014b).

The GMS members are endowed with a diverse mix of resources. Oil is the key fuel source for Cambodia, natural gas for Thailand, hydro for Laos and Myanmar, while Vietnam has a more diversified mix of coal, gas and hydro (ADB, 2012b; ADB, 2013b; Hasnie, 2014). The larger GMS countries mostly depend on thermal energy sources and are looking towards complementing their energy mix with imported hydropower. China is expected to be mostly self-sufficient but Thailand and Vietnam will have to rely on imported power. Myanmar, Laos and Cambodia are the potential exporters (World Bank, 2010b; ADB, 2013b).

Thailand's high economic growth and demand for cheaper sources of power has been a key driver for developing the regional power trade agenda. Before the creation of GMS the region already had bilateral arrangements between Thailand and other member states which worked as building blocks for the creation of regional power trade agreements. The development of the regional power market in GMS has been gradual as the supporting institutional and physical infrastructures have evolved slowly. The current focus is geared towards strengthening bilateral power projects and trade, using existing transmission infrastructures. Technical studies and action plans for regional projects, and regulatory arrangements have been formulated but not yet implemented. There has not been any power trade under the GMS program yet, however energy trade has been taking place through existing bilateral agreements outside of the program.

3.1.2 Development of Institutions for Regional Power Trade

The Sub-regional Electric Power Forum (EPF) was formed in April 1995 as a platform for power sector coordination, knowledge sharing and collaboration among GMS members and donors (ADB, 2008; ADB, 2012b). The Experts Group on Power Interconnection and Trade (EGP) was established in 1998 for transmission development. The EPF also helped in the adoption and endorsement of a Policy Statement on Regional Power Trade in the GMS in January 2000. This led to the development of an Inter-Governmental Agreement on Regional Power Trade (IGA) in 2002 which gave legal authority to implement power trade among GMS members. Following the signing of the IGA, a Regional Power Trade Coordination Committee (RPTCC) was established with the responsibility of preparing the Regional Power Trade Operating Agreement (RPTOA) that

would lay out technical guidelines and commercial rules for regional power trade (ADB 2012b; World Bank, 2010b). The RPTOA is the only regional contract in place while the details of operating procedures fall within the scope of bilateral agreements outside of the RPTOA (ADB 2012b; World Bank, 2010b). A process for resolving disputes in a phased manner has also been established whereby any disagreements between the parties are resolved by sending them to concerned transmission system operators with selected representatives for formal discussions. Any dispute concerning a technical matter is referred to an independent expert. Failure to reach an agreeable solution leads to settlement via creation of a three-member panel based on the rules of the United Nations Commission on International Trade Law (UNCITRAL) and the decision made by the panel is final (World Bank, 2010b).

The first MOU of the RPTOA (MOU #1) was signed in July 2005, which established guidelines and an institutional framework for power trade in the first stage of the program, with a view to execute the project in four stages. The first stage would involve power trade based on cross-border transmission lines through bilateral power purchase agreements. The second stage would involve development of some transit trade, that is, use of transmission facilities of third GMS members, allowing power trade between any pair of GMS countries (ADB 2012b). In March 2008, a MOU on the road map for implementing the GMS Cross-Border Power Trading (MOU # 2) was signed. This outlined actions with timelines required to implement stage 1 of the RPTOA by 2012, and prepared for transitioning into stage 2. The two MOUs signed in 2005 and 2008 have served as guiding tools for the process of creating a regional power market in the absence of a coordinating regional institution in the GMS (ADB, 2012b; ADB, 2013b). It is worth noting that the GMS power market institutions are also limited to working groups and committees with representation from member countries. A permanent secretariat without a legal identity has posed challenges to the development of the regional power market. The role of the secretariat has been taken up by ADB and the member states' governments on a rotating basis. However, the lack of permanent staff and changing representation in the RPTCC has reduced the effectiveness of the action plans (SIDA, 2011). Moreover, the coordinating bodies in the GMS also suffer from a lack of consistency in their commitment to creating a regional power market. It is believed that even though political will is present at the highest ministerial levels, such commitment is weak among the national utility bodies (SIDA, 2011).

The GMS members have a vertically integrated power utility set-up owned by the State. Corporatization and some degree of power sector unbundling have been introduced in Cambodia, Laos, China and Vietnam. Similar reforms were initiated in Thailand but were reversed making it problematic since Thailand is one of the largest power markets in the sub-region (SIDA, 2011; World Bank, 2010b). Moreover, GMS members vary in terms of the nature of their domestic regulatory agencies. Cambodia, China, Thailand and Vietnam have national regulatory agencies while Laos and Myanmar are yet to establish such an agency. But even in the case of countries with regulatory agencies, they are all fairly new. Therefore, they are still weak institutions with a dearth of skilled personnel, experience and a lack of autonomy. Being relatively new with weak institutional capacity, they have very little involvement in the GMS regional power market development process (SIDA, 2011; World Bank, 2010b).

Without a common level of liberalization and reforms in national power markets, actions identified in the MOUs for completing stage 1 and moving towards stage 2 are difficult to implement.

3.1.3 Physical Infrastructure in the GMS Power Market

Coinciding with the signing of the high level IGA in 2002, the second decade of the GMS program saw a large number of interconnection projects and power plants being constructed in the sub-region. The planning and financing of these projects was supported by ADB and other donors. Currently, eight high voltage power interconnections above 220 kVs are in operation in the GMS sub-region. In addition, there are many medium and low voltage interconnectors between Laos and Cambodia, Vietnam and Yunnan, PRC; and Thailand and Cambodia. These interconnections either transmit electricity produced from export oriented power plants or send power to cross-border areas which are distant from the national networks (ADB, 2013b).

The construction of these physical infrastructures and the system of power trade that currently exists has been a result of bilateral agreements instead of being a product of a comprehensive regional planning endeavor. The assets developed have been an extension of national infrastructure into territories of power producers and are owned by transmission utilities in the country in which they are located. Hence, there are no regional assets and true interconnections of systems with synchronous operations in the GMS power market and no physical infrastructure has been developed for third party use for the purpose of transit power trade yet (ADB, 2013b; World Bank, 2010b).

Only the larger GMS members like China, Thailand and Vietnam have established national grids based on 500 kV transmission voltage levels, which are required for effective power trade. The significant costs and risks associated with constructing large backbone grids have made private investors shy away from such projects (SIDA, 2011). The private sector participates largely in joint ventures with the governments based on Build-Operate-Transfer (BOT) models where the Independent Power Producers (IPPs) operating power plants sell power to neighboring importer countries via dedicated transmission lines. These transmission lines are merely an extension of the importer country's power system into the territories of the exporter country's single power plant. For example, the hydropower plant and transmission lines located in Laos are shown as being part of Thailand's power system (ADB, 2012b; ADB, 2013b; SIDA, 2011). Under this model, the IPPs have locked in deals on power generation and sales via long-term Power Purchase Agreements (PPAs) lasting up to thirty years. Such long-term binding agreements create an obstacle for third party access to the transmission lines, even when the lines have additional capacity beyond what is needed by the IPPs under the specific PPAs (SIDA, 2011). Many new power projects in Laos and Cambodia are following this type of BOT-IPP model which can slow down the transition towards stage 2 of the regional power market. In this context, the private sector's role in developing new power generation capacity is creating an obstacle towards regional power integration due to lack of legislative mechanisms in the host countries to accommodate third party access to transmission lines.

Bilateral power trade between most GMS countries is relatively recent and is based on PPAs outside of the regional power program. Bilateral cross-border trade pricing is negotiated under the PPAs, however the presence of subsidized power tariffs in the sub-region leads to price distortions. According to the RPTOA, contracting parties are at liberty to set any mutually acceptable transit tariff schedule, but in practice these agreements do not have transit or wheeling charges in place (World Bank, 2010b). Moreover, larger power importers tend to be key investors in smaller less developed power producing countries giving them more influence to negotiate

power trade for their own benefit. There is also evidence of larger importers extending their grids into territories of smaller exporters in order to avoid relying on foreign grids, putting national interests ahead of regional interests. Hydropower sites in Laos are divided among monopoly buyers from larger importers like Thailand, China and Vietnam, thereby reducing export tariffs for the power producer (SIDA, 2011). Such practices run the risk of creating a non-equitable regional power market.

3.1.4 Role of Outsiders

ADB has been a key driver of the GMS Program as compared to other regional integration efforts which have solely been driven by member countries. The utility representatives from member states with heavy support from donors have produced the actual design of the power trading framework for the GMS power market. It is believed that outside consultants and experts have taken the lead on drafting necessary documentations and action plans in many cases (World Bank, 2010b). While consultative and technical support provided by external experts are instrumental in transferring knowledge, the lack of understanding on the outside experts' of the realities on the ground has sometimes led to less effective outcomes. There have been instances where the objectives and timelines for implementation set out by external consultants have been too ambitious. For these reasons, much of the knowledge generated has not been adequately applied (SIDA, 2011). While regional integration supported by an international institution like ADB certainly helps member countries, it also runs the risks of undermining the ownership of the process by the member countries. Therefore, the political will and commitment to execute the action plans have to be member driven to ensure long term commitment within the region.

3.1.5 Lessons from the GMS Regional Power Market Development Process

- Need for a permanent secretariat (such as the RPCC which is currently under evaluation) to increase ownership and commitment towards facilitating power cooperation executing action plans
- A minimum level of domestic power sector reform and market liberalization required to move towards an integrated regional power market
- Expertise and knowledge from external consultants are useful, however, substantial local consultation and input is necessary to generate effective applicable output
- Independent Power Producers with long term PPAs can limit third party transit trade and hinder regional power integration process

3.2 The Southern African Power Pool

3.2.1 Background

The Southern African Power Pool (SAPP) includes DR Congo, Angola, Tanzania, Malawi, Zambia, Zimbabwe, Mozambique, Botswana, Namibia, Swaziland, South Africa and Lesotho. These countries are all members of the Southern African Development Community (SADC). SAPP is the result of an effort towards regional integration that began a decade before its existence. The gradual evolution of the regional bloc has helped SAPP push its mandate of promoting electricity trade among the member states. This particular power pool has a diverse mix of resources with countries rich in hydro such as Tanzania and Angola, and countries rich in thermal power such as Namibia, Botswana, and South Africa. The interconnection of the Northern

and the Southern part of the continent with varying energy sources has helped the regional power market (World Bank, 2009). At present coal generates 70% of the power as South Africa is the biggest supplier coal in the power pool. The other large power markets are DRC, Mozambique, and Zambia which have large hydropower resources making hydro the second biggest energy source that generates 21% of the power in the region. Similarly nuclear power and diesel and gas produce 3% and 6% of power respectively. (SAPP, 2014).

A long legacy of regional cooperation, the presence of basic transmission grids, surplus generation capacity, and the presence of several bilateral and tripartite agreements for power trade have created an optimum environment for SAPP to be a promising regional energy market. Within a short period of time, SAPP has been able to transition to the second stage of a regional energy market that reflects a certain level of market integration.

3.2.2 Development of Institutions for Regional Power Trade

Major Initiatives towards regional cooperation in the energy sector started with the Southern African Development Coordination Conference and the establishment of the Electricity Subcommittee in 1990 with representatives from national utilities of the member states. This unit functioned as a technical advisory body on electricity cooperation. SAPP, however, came into force after the signing of the Inter-Governmental Memorandum of Understanding (MOU) in 1995, which provided authority to the national utilities of member states to participate in SAPP. Several legal documents covering operating guidelines and obligations of the SAPP members were agreed upon. Guidelines related to asset ownership and rights, rules of operation and pricing, and standard procedures for plant operation, maintenance and cost sharing were all included in the document (World Bank, 2009; Hammons, 2011). Similarly, the SADC Protocol on Energy was signed in August 1996 with the objective of advancing regional energy cooperation in line with the broader policies and programs of SADC. This included promotion of pooling power and electricity trading, integrated resource planning for the electricity sector, formulation of common regional rules, procedures for electricity generation, transmission and distribution (ICA, 2011).

All SAPP agreements are required to be consistent with the SADC treaty have to follow the SADC Energy Protocol. All disputes are deferred to the SADC dispute resolution tribunal, which acts as the binding dispute resolution body for SAPP (O'Leary, et al., 1998). The SADC's dispute resolution process is similar to that of WTO's dispute settlement protocol. The revised contractual documents have also included agreements for a separate dispute resolution mechanism for the electricity sector, however there is little clarity regarding any disputes between member states under this provision (World Bank, 2009). Furthermore, there is a lack of clear and detailed statements regarding provisions for foreign investment protection mechanisms in the SADC treaty which questions the level of commitment on the part of governments to invite foreign and private sector participation (World Bank, 2009).

Coordinating Institutions of SAPP

In 2000, a permanent SAPP Coordination Center was established in Zimbabwe to function as a focal point for all activities. The center, which acts as a secretariat, has a permanent staff and though it is funded by the SAPP member countries, it operates as an independent institution. Participation fees imposed on regional electricity trade transactions under the short-term energy market also bring some revenue for running the SAPP activities (World Bank, 2009). The center

is responsible for conducting technical studies, guiding their implementation, monitoring transactions, training staff members, collecting and maintaining a power pool database, facilitating meetings and resolving disputes among members. Its establishment has been a key milestone in developing a power pool in the region (ICA, 2011, Hammons, 2011). However, it is yet to become a supranational institution and the ultimate decisions remain with the national governments instead of SAPP. The Regional Electricity Regulators Association (RERA) of Southern Africa was established in 2002 to aid the harmonization of electricity sector policies and regulations among the members and to ultimately attract more investment in the region's power sector. The body acts as a platform for cooperation, dialogue and capacity building among energy regulators in SADC, however, it does not have mandate over regional regulatory matters (Sithole and Sichone, 2012).

Energy or electricity regulators have been established in most countries since the 2000s. DRC and Swaziland do not have regulatory agencies yet and hence are not members of RERA. While some degree of vertical unbundling has occurred among the members, such reforms are still absent in Tanzania, Mozambique and Swaziland (UNIDO, 2006). The power sector is not fully deregulated and utilities in the region are vertically integrated, mostly as single buyers, leading to a state of monopsony. Harmonization of regulatory frameworks is a challenge when all members do not have an independent regulatory agency and are at different stages of reform. In order for SAPP to transition into a full power pool with a competitive power market, RERA would have to develop into a regional regulatory body with the mandate to enforce power trading rules while the Coordination Center would also have to evolve into a supranational institution with more influence.

Electricity Trade

Electricity trade in SAPP occurs through two channels: long term bilateral arrangements and a short-term competitive market. The co-existence of both a cooperative and competitive power trading structure is characteristic of the second stage of a regional power market development process. However, only about 5-10% of electricity trade occurs through the competitive market. Southern Africa had bilateral and tripartite agreements in place before the creation of SAPP which have worked as building blocks for creating a regional power pool. The provisions of transit trade and third party access in these agreements have facilitated the inclusion of other countries. Currently, there are around 30 bilateral agreements in place among SAPP members lasting a period of 1-5 years, or longer. While bilateral contracts ensure some form of power security, they are generally inflexible to changing demands and price patterns. Compared to other regional power markets, the bilateral contracts in SAPP appear weak due to inadequate provisions for contract defaults (World Bank, 2009). Not all bilateral contracts were active between 2013 and 2014. About 85% of energy was traded bilaterally while 15% of the power requested could not go through due to capacity constraints (SAPP, 2014).

The Short-Term Energy Market (STEM) was introduced in April 2001. STEM allowed any pair of SAPP members to buy and sell surplus electricity outside of bilateral contracts through the existing transmission infrastructure, facilitating a real-time regional electricity market. An internet platform was used to make bids, matching buyers and sellers and allowing for power trade to occur at the sellers' offer price (World Bank, 2009). The Coordination Center was responsible for managing this process and confirming contracts. Under this system, energy trade occurred on a

daily basis with delivery made on the following day. However, the fall in surplus power capacity and the existing power trade under bilateral contracts led to limited energy trading under STEM.

The Day-Ahead-Market (DAM) system was introduced in 2009. It operates as an auction market for utilities, IPPs, transmitters and distributors and the SAPP Coordination Center acts as the market operator. This system is modeled after the Nordic market pool pricing model where total bids and offers are matched to create a common market clearing price for power transactions (World Bank, 2009; Theron, 2007). This system is more competitive and is expected to attract more players, however, surplus power capacity is still crucial to its success.

3.2.3 Physical Infrastructure in the SAPP

The first major grid interconnection in the region was a 666 MW power station under the Kariba scheme and construction of a 330kV line connecting present day Zambia and Zimbabwe during 1955-1959. Under the Inga hydropower scheme, a 220kV interconnection was built in 1956 to link the Belgian Congo (present day DRC) with Zambia (World Bank, 2009). This grid also served Zimbabwe when the first tripartite agreement with provisions for third party transmission access was signed in 1992 for a power purchase agreement between Congo and Zimbabwe with Zambia, wheeling power for a fee. Another tripartite agreement was signed between Mozambique, South Africa and Zimbabwe under the 400kV Cahora Bassa interconnector in 1997 to export power from South Africa to Zimbabwe through Mozambique. During the same period, Botswana, South Africa and Zimbabwe also signed a tripartite agreement and built the 400 kV Matimba interconnector. In 1998, a 400 kV interconnector was constructed to link South Africa, Swaziland and Mozambique (World Bank, 2009). These interconnectors have provided the necessary transmission grid infrastructure for establishing a regional power market. In particular, the interconnection of two key networks through a 400kV grid - the Thermal Southern network and the Hydro Northern network - created the basis for establishing regional power trade (Maupin, 2013).

Eskom of South Africa is the dominant system operator among the three control areas in SAPP and has led to other systems replicating its operational model. Grids of countries such as Botswana, Lesotho, Swaziland and Namibia have developed as extensions of the South African grid. South Africa's well-developed transmission grids extending across the region, along with its excess capacity, provided for the necessary ingredients for the growth of SAPP in the first decade. This surplus generation capacity also helped in the operation of STEM just six years after the launch of the SAPP. While the existing SAPP grid system has carried forward the regional power trade, strengthening and expansion of central transmission corridors are required to reduce current bottlenecks, transmit power at a larger scale and link non-operating members to the grid. The lack of adequate investments in the first decade of its existence along with a strong rise in demand for power has led to substantial power shortages in the region (Madakufamba, 2010).

Investment financing for physical infrastructure is undertaken by utilities or by special purpose companies set up to implement joint projects. Funding is channeled by international finance institutions. In recent years Chinese financial institutions have been active in the region (World Bank, 2009; SAPP, 2014). However, power tariffs in the region are below costs of production and distribution, which adversely affects the supply industry and discourages investments. The need for cost-based power tariffs has been recognized by policy makers but implementation is a challenge due to political resistance (Madakufamba, 2010).

3.2.4 Role of Outsiders

The creation and development of SAPP has been a regional effort, however, during the early years, the operation of the SADC Energy Sector Technical and Administrative Unit and the initial meetings of energy officials were financed by the government of Norway. International finance institutions and donors such as USAID, DFID, DANIDA, SIDA, the government of Norway and the EU have provided assistance for carrying out feasibility studies, technical assistance projects and capacity building projects (World Bank, 2009). The government of Norway and SIDA were key donors for aiding the development and implementation of the DAM competitive electricity trade market (SAPP, 2013). Outside funding has also helped in the construction of power generation and transmission infrastructure.

3.2.6 Lessons from SAPP

- Presence of basic transmission grids and surplus generation capacity can accelerate the regional power integration process in the early stages
- Bilateral and Tripartite agreements with provisions for third party access to transmission infrastructure can work as building blocks for developing a regional power pool
- Active involvement of national utilities in the early stages of the program and the financing of regional institutions through members' contributions can help increase ownership and commitment to the process of power integration
- A permanent Coordination Center acting as a secretariat is necessary to manage the decision making process, but the center could benefit from a more participatory decision making process and greater authority in implementing action plans
- Challenges faced by SAPP indicate the need for well drafted power trade contracts with firm enforcement mechanisms along with an emphasis on foreign investment protection to attract and retain investment for the regional power pool

3.3 Central American Electricity Interconnection System (SEIPAC)

3.3.1 Background

The Central American Electricity Interconnection System (SEIPAC⁴) is a regional market for electricity exchange between Panama, Costa Rica, Honduras, El Salvador, Guatemala and Nicaragua. SEIPAC is the first major regional power transmission system in Latin America connecting 37 million consumers in the region. The countries in the region differ widely, with Costa Rica being the most developed with near universal access to electricity, making it the largest producer and consumer of electricity. Whereas, Nicaragua is the least developed and the smallest power consumer. Panama and Guatemala are also one of the key power exporters of the region. The energy mix in the region is dominated by hydropower but in recent years, there has been a strong growth of thermo-electricity generation using diesel and fuel oil. The region's electricity generation comes from 41% hydropower, 47% thermal and 13% renewable sources (Martin and Posadas, 2012). The motivation for regional cooperation in power has been driven by factors such as limited resource endowment, dependence on imported energy sources, unreliable energy services, volatile prices, and high costs of production due to small fragmented markets. The

⁴ Spanish Acronym – Sistema de Interconexion Electrica para Los Paises de America Central

efforts for regional cooperation were aimed at achieving reliable, efficient, and sustainable supply of electricity for all member countries through optimal use of collective resources.

SIEPAC has been supported by the development of two complementary projects: the institutional infrastructure of a regional electricity market⁵ (MER) enjoying supranational power and the physical infrastructure including a 1,800 km international transmission line (World Bank, 2010c). A long history of regional economic cooperation, supporting role of the government of Spain and institutions such as Inter-American Development Bank (IADB) along with political will on the part of national utilities have been key pre-conditions for establishing SIEPAC.

3.3.2 Development of Institutions for Regional Power Trade

The creation of the Central American Electrification Council (CAEC) in 1989 was an effort to institutionalize regional power cooperation. This body was a forum for discussion, coordination and regional planning among national utilities and now plays an advisory role to the regional and national bodies. SIEPAC was formally established by the signing of the Marco Treaty of the Electrical Market of Central America by the six states in 1996 which came into effect in 1999. This inter-governmental framework agreement provided the legal foundation for creating various permanent institutions to govern and regulate the regional power market.

The Treaty is based on three key principles: opening up competition in the electricity market, which would include non-discriminatory access to transmission system infrastructure; gradual market growth to support varied stages of development of each country while encouraging inclusion of new members; and reciprocity between countries based on mutually agreed rules. As per the treaty, the six members agreed to form a competitive MER that came into operation in 2002. MER functions within a market design with carefully developed rules and transmission codes and its operation is supported by a regional operator and a regional regulator. Under the aegis of the Marco Treaty, the three core regional institutions are (World Bank, 2010; CASTALIA, 2009):

1. La Empresa Propietaria de la Red (EPR) - International Transmission Line Company
2. Ente Operador Regional (EOR) – The Regional Market Operator
3. Comisión Regional de Interconexión Eléctrica (CRIE) – The Regional Regulator

The EPR, established in 1999, is a consortium of private and public companies from Central America and was tasked with operating and constructing the SIEPAC regional transmission network. The ownership of the transmission line also lies with EPR. Similarly, EOR, the regional market operator, was established in 2001 and has the mandate to operate the regional transmission network alongside the national system operators of each member state. EOR is largely responsible for the functioning of the MER. In this capacity, it prepares technical rules for MER, enables market transactions, ensures security of the system and plans the expansion of the regional transmission network. CRIE, the regional regulator, was established in 2002 to regulate MER with the objective of developing the regional market and promoting competition. This body enjoys supranational status with independent legal power. Since it is governed by international laws, it is a strong regional institution with a uniform legal structure that is above

⁵Mercado Eléctrico Regional

domestic laws (World Bank, 2010c). Its responsibilities include formulating tariffs, enforcing market rules, levying penalties for non-compliance, regulating competition and anti-trust issues and resolving disputes. It is run by a board of commissioners with representation from each of the member state. The board composition is intended to minimize the scope for inconsistency between national and regional regulatory approaches and encourage the standardization of technical and operating standards (CASTALIA, 2009).

Disputes are settled through negotiation, conciliation and if needed binding arbitration (World Bank, 2010). Disputes related to agents participating in the market are resolved by CRIE via binding resolutions and disputes related to the countries that are signatories to the treaty are resolved by the Central-American Court of International Justice. However, should countries choose, their disputes may also be handled by CRIE. The decision making process in SIEPAC follows logical steps, whereby EOR makes proposals which are reviewed by CRIE and an independent expert panel. Based on regional interests, the CRIE has the authority to make the final decision which is binding and legally enforceable in all six states. MER and its core supporting institutions enjoy supranational status with clearly assigned roles. This very setup provides strong legitimacy to SIEPAC and helps it function as the backbone of this regional power market.

By the mid-1990s all six countries moved towards a single-buyer utility model from the old state-owned vertically integrated model and also established their national regulatory bodies. However, additional reforms in each country have progressed at different rates. Guatemala, El Salvador, Nicaragua and Panama have implemented wholesale competition with strong private sector participation in generation and distribution segments. On the other hand, Honduras and Costa Rica are yet to introduce many reforms and have limited private sector participation.

MER, which is governed by regional institutions and supported by the regional transmission grid can operate independently, in parallel to the national power systems. This allows countries to undertake gradual domestic reforms. However, as the ultimate goal is to merge national markets and create a single regional electricity market, consistent domestic power sector reforms are required. It has been stated that wide differences in the structure of domestic power sector will pose a challenge in coordinating and harmonizing policies as SIEPAC moves towards further integration (Arnson, 2008).

Electricity Trade

Electricity trade occurs via two channels in the region: bilateral contracts and spot market trading. About 80% of power trade occurs through medium and long term bilateral arrangements. However, the regulation of cross-border exchanges including pricing rules and technical trading requirements are overseen by EOR and CRIE (CASTALIA, 2009). Spot market trading occurs through day-ahead financial contracts and real-time spot market transactions, with prices set at physical trading points which helps in managing any disruptions and meeting peak demands in the region.

3.3.3 Physical Infrastructure in SIEPAC

Electricity interconnections between the countries started in 1976 with a line connecting Honduras to Nicaragua. Over the years, connections between Nicaragua and Costa Rica and between Costa Rica, Panama, Guatemala and El Salvador were also established. Building physical

infrastructure to connect each member state was a key component of the SIEPAC project. Between 1992 and 1997, several feasibility studies were conducted for an international transmission line and as per the Marco Treaty, EPR, the international transmission line company was created to build the SIEPAC transmission line.

The 1,793 km international transmission line passes through each of the six member states. It consists of a 230 KV electricity transmission line with capacity to transport up to 300MW of power among the member countries (IDB, 2013). The Marco Treaty allowed for regional and national transmission systems to have non-discriminatory access to the SIEPAC grid. Third parties have also been allowed to develop feeder and regional transmission lines in order to supplement the capacity of the SIEPAC grid. The Treaty further limits the scope for market discrimination by disallowing the member governments from maintaining direct or indirect control over the SIEPAC transmission system (CASTALIA, 2009).

3.3.4 Role of Outsiders

The Spanish government and international financial institutions, namely the IADB and the Central American Bank for Economic Integration (CABEI), played important roles in establishing SIEPAC. The six governments floated the idea of creating a regional market in 1987, with encouragement from the government of Spain that funded a feasibility study for the physical interconnection in 1987. The construction of the transmission line cost US\$ 494million, of which IADB debt-financed 59.3% of the cost followed by CABEI which covered 24.7% of the cost (World Bank, 2010c).

3.3.6 Lessons from SIEPAC

- Existence of basic power sector reforms and domestic regulatory bodies can be a major contribution towards setting up a regional energy market
- The Marco Treaty, which sets down clear rules for creating a regional power market and its supporting institutions, has been the key guiding document for SIEPAC building a case for a regionally-binding agreement
- MER works as the seventh market to complement the domestic power market of the six member states and should be seen as a model
- Creation of supranational regional institutions for governing the regional electricity market with legal authority has been a major strength of SIEPAC and has helped promote regional interests over national interests
- Construction of the SIEPAC line that connects all six member states providing non-discriminatory access to the transmission system infrastructure has been a crucial component of the project and is a compelling alternative to other regional markets
- Medium and long-term bilateral arrangements in SIEPAC are required to follow pricing rules and technical trading rules set by regional institutions which ensures consistency in bilateral arrangements and promotes regional interests over national interests.

3.4 The Nordic Power Market

3.4.1. Background

The Nordic pool, which is one of the world's most advanced electricity markets, consists of four Scandinavian countries: Sweden, Norway, Finland and Denmark. As a fully market driven

arrangement, the pool is considered to be a benchmark for regional power cooperation. The institutions, market operations and regulations are designed to promote energy security, efficiency and sustainability through a competitive market system.

The region is endowed with a complementary mix of energy resources. In the power pool, about half of the overall generation capacity comes from hydro which is a dominant resource in Norway, while Denmark relies on thermal power mostly generated from imported coal. Sweden depends on an equal mix of hydro and nuclear power while Finland has a mix of hydro, nuclear and thermal plants (Carlsson, 1999). The use of cost-effective hydro and nuclear power have resulted in low electricity prices in the Nordic region and high power consumption in the region compared to other countries in continental Europe. Sweden is the largest electricity consumer followed by Norway, Finland and Denmark. Finland has mostly been a net importer of electrical power while Norway, Sweden and Denmark are either net exporters or importers in any given year, depending on hydro inflows and other climatic conditions. This variation in energy resource mix and demand for electricity within the member states has provided an opportunity for power trade (NordReg, 2014; Mundaca, et al., 2013).

The Nordic Pool, developed over a period of 45 years followed two phases of regional cooperation: NORDEL and the Nord Pool. The transition from the first phase of cooperation to the second phase was initiated by Norway through deregulation of its domestic power market in 1991 and the establishment of the spot market in 1992. Other states followed by introducing their own power sector reforms and by joining the power pool based on Norway's design. The transition to an international electricity market was also aided by the long history of bilateral energy trade and cooperation between the countries along with the presence of interconnection transmission infrastructures.

3.4.2 Development of Regional Institutions for Power Trade

First Phase of Cooperation (1963 -1996)

Nordel was created in 1963 as an association for cooperation between Nordic Transmission System Operators (TSOs) in the region. It was tasked to enable the region to create efficient electricity generation and transmission systems, primarily by functioning as an advisory body for cooperation and a forum for the system operators and market participants. Nordel had an executive board (EB) responsible for initiating and making decisions on operational issues, and for implementing decisions approved by Nordel's annual meetings. Three planning committees—Planning, Operations, and Market—under EB supervised Nordel's work. Nordel provided a formal institutional framework which enabled each member country to trade electricity (Carlsson, 1999). The Nordel members deregulated their power sector in the 1990s, paving the way for market-based trading in the region. Norway was the first to implement domestic reforms through introduction of a new Energy Act in 1990 which resulted in the unbundling of several vertically integrated utilities and the introduction of competition in the domestic electricity market leading to a fall in power cost differences across region. Sweden followed in 1992 where reforms were focused on opening up the national grid to smaller companies. By 1996, all member states had introduced new reforms that allowed corporatization and unbundling in different areas of the power sector. Denmark implemented power sector reforms at a slower pace, introducing third party access to the national grid only in 1998, hence delaying its integration into the Nord Pool.

Second Phase of Cooperation (1996 - Present)

Despite Norway introducing the spot market in 1992, price volatility still persisted due to its dominant reliance on hydropower plants. This was remedied by combining the Norwegian and Swedish markets to create a joint electricity trading exchange in 1996, called the Nord Pool Spot. The design for this market was largely based on the Norwegian framework. The creation of this pool marked the beginning of the second phase of cooperation. Finland joined the Nord Pool in 1998 and Denmark in 2000 by making the Nord Pool Spot a fully integrated power market. During this period, Nordel slowly conceded its mandates to the private sector TSOs; and eventually, in 2000, it was formally reconstituted as an organization of Nordic TSOs. In 2009, this institution was replaced by the European Network of Transmission Operators, which became the official medium for advancing transmission grids and developing an integrated electricity market (Mundaca et al., 2013). National rules were amended in 2000 to conform to EU Electricity Directives of 2003 and 2009. In addition to the rules on supply competition and unbundling, the EU Directives required infrastructure operators to grant third parties non-discriminated access to all transmission and distribution systems.

At present, the Nord Pool Spot operates a trading market place based on licensing from the Norwegian Water Resources and Energy Directorate (NVE). Enabled by the Norwegian Energy Act, NVE is the primary regulator of the Nord Pool and works closely with the national energy market authorities of the member states. It issues market place licenses to the Nord Pool Spot which is renewed every three years. As per the guidelines set out under the EU's monitoring scheme, the Regulation on Energy Market Integrity and Transparency (REMIT), which is the market surveillance unit, is responsible for informing national regulators of any activities related to market manipulation or insider trading (NordREG, 2014).

The Nord Pool Spot Regulatory Council is a platform for information exchange on wholesale energy market monitoring as per REMIT, with experts from the Nordic national regulatory agencies. National energy regulators from the Nordic states cooperate through NordREG which is a forum of Nordic Energy Regulators. The objective of this initiative is to harmonize rules and regulation in the Nordic electricity market (Mundaca et al., 2013; NordREG, 2014). Additionally, there are several channels of communication and cooperation among the Nordic states, such as the Action Plan for Nordic Energy Cooperation, Electricity Market Group under the Nordic Council of Ministers, the Nordic Energy Research, and the Cross-border Regulatory Council Dialogue for improvement of regulatory aspects of the system.

It should be noted that as the Nordic power system moved from the first to the second phase of regional cooperation, the power market transitioned from a cooperative to a competitive structure. As a result, the role of regional institutions also changed as market forces took over the running of the power system. However, due to the existence of local, national, regional and supranational institutions, extensive coordination and dialogue has been essential to the smooth functioning of the power market.

Electricity Trade

The Nord Pool Spot is owned and operated by the Nordic and Baltic TSOs and offers guaranteed contract settlements and delivery of power. Guidelines outlined in a detailed rulebook govern and regulate electricity trading in the Nord Pool Spot (Mundaca et al, 2013). This is a fully competitive

market that is open to all parties that have signed agreements with the Nord Pool. Pricing and quantity for trade is determined by transmission capacity, supply and demand. Based on all the bids and offers for the region, aggregate supply and demand curves are constructed to estimate the market clearing price which is then used as the reference price for majority of the financial trading contracts. Hourly contracts are traded for the following day. Future contracts of various lengths from one week to six months for price hedging are also offered by liaising with various brokering companies. Direct power trading through bilateral contracts also exists and the prices generated in the spot market are used as reference price for these bilateral contracts. There are various mechanisms in place to manage transmission grid congestion in the Nordic power system. A system of area price model is practiced by dividing the Nordic region into 12 different price areas to handle transmission bottlenecks. Prices are influenced by several economic and non-economic factors such as weather conditions, generation and transmission capacity, economic activity, carbon emissions and fuel prices. Inadequate transmission capacity due to congestion in two areas in the region are key drivers of price differences in the Nordic power market. The prices in turn affect investment decisions in generation units and transmission infrastructure. Various market monitoring frameworks are implemented by the Nordic National regulatory agencies to ensure correct functioning of price signals in the wholesale electricity market (NordReg, 2014).

The power market is further split into two separate markets: the Nord Pool ASA and the Nord Pool Spot. In the Nord Pool Spot, participants are able to conduct physical trade in electricity while in the Nord Pool ASA they are able to conduct financial transactions to secure electricity prices for future purchase and sale. In 2010, all shares of Nord Pool ASA were acquired by NASDAQ OMX, which is a market for financial trading of electrical power. There are no transmission border fees between the countries. This ensures that each trader only pays the tariff corresponding to their national system. The operators in each level charge the producer and consumer on point-of-connection basis, whose basic principle is that a payment in one point at the point of connection provides access to the whole network. This system facilitates one market participant to trade with any other participant in the whole of the national network system (Pignon, 2001; Mundaca et al., 2013).

3.4.3 Physical infrastructures

The generation capacity of all Nordic countries has been increasing in recent years due to growth in installed capacity of wind, solar and nuclear power. As of 2013, the total electricity generation from the Nordic countries amounted to 380 TWh and power consumption during this period was 380.5 TWh (NordReg, 2014). The Nordic transmission grid connects all Nordic states by combining the national grids into one synchronous power system. However, the grid system is decentralized as each state's transmission companies operate and invest in their national network. The transmission interconnectors also connect various countries from continental Europe to the Nordic market. Moreover, there are three types of transmission line providers: the Nord Pool Spot AS, the National TSOs and the Local level TSOs that own and operate the regional, national and local systems respectively.

The highest voltage level in the electricity transmission grid connecting all Nordic states is 400kV. Norway and Sweden are joined through four DC connections of 400kV and 220kV cables, while Denmark and Sweden via four AC connections of 400kV and 132kV cables and two DC connections of 285kV cables. Denmark and Norway are connected by three DC connections of

250kV and 350kV cables. The Finnish grid connects Norway and Sweden through 220kV AC connections. Sweden and Finland are also joined via two 400kV AC cables. Moreover, the Nordic states are also connected to Germany, Poland, Netherlands, Estonia and Russia through high-voltage DC networks.⁶ Since border tariffs have already been abolished, the transmission capacity of interconnected grids are the key impediments for trading. In the presence of inadequate transmission capacity, the area price increases and this affects cross-border trade, inhibiting full market integration. However, there are provisions for reducing transmission grid congestion by using the above mentioned area price model or by using the practice of market splitting. Also, transmission tariffs or the pricing system for grid access are standardized across all Nordic countries and rates are not dependent on distance.

Developing adequate infrastructure and managing electricity pool is a capital-intensive scheme. Nordic countries have liberalized, open capital markets which enable the region to raise necessary capital by attracting investments at competitive rates.

3.4.4 Role of Outsiders

The initiative as well as capital for creating both institutional and physical infrastructure for the Nordic Power Market came from the Nordic States themselves with Norway leading the way. However, later developments have been largely driven by the EU regulations. The bylaws set out in the EU electricity directives have played an important role in shaping the Nordic Power Market.

3.4.6 Lessons from the Nordic Power Market

- Presence of strong political will and commitment among the Nordic states for creating an electricity market was key to the regional market
- Nordic states have been able to cooperate on several fundamental common elements even though each country has maintained their own energy policy and variations on the structures of their domestic electricity market
- Creation of an independent market surveillance unit has helped in avoiding any discrepancies related to trading regulations, transparency, inaccurate price signals or transmission congestion
- Successful co-existence of local, national, regional and supranational institutions in the Nordic power implies a high degree of coordination, cooperation and dialogue among various agencies, which can easily be replicated by other regions in the short run
- Open trade regimes, deregulated electricity markets, and well-developed financial markets have been key to establishing a successful electricity trading system. While these may not be easy to develop in other regions, building institutions for “coordination, cooperation, and dialogue” may be attainable in the short-run.

4.0 Lessons from International Cases for the South Asia Sub-Region

Nine key lessons relevant to the South Asia Sub-Region can be derived from the four international case studies:

1. Strong Regional Institutions

The coordinating institutions in the GMS are limited to loose working groups only which have mostly been useful as a platform for networking and information exchange. The lack of a

⁶ Information compiled from the following sites: <http://viavasterbotten.se> ; <http://www.energinet.dk>; <http://www.fingrid.fi>

permanent secretariat and staff has resulted in frequent personal change, hence undermining productivity of meetings and continuity in moving discussions forward effectively. The commitment and degree of engagement at the utility level is weak both due to lack of progress in domestic regulatory reforms and due to absence of proper regional institutions with legal authority. Hence, the current form of institutional bodies in the GMS power program has been ineffective in implementing and managing the regional power cooperation process.

Given that the SAPP is at a more advanced stage of a regional power market, it has an independent permanent secretariat with legal authority. The SAPP has membership based on utilities of SADC countries and their active involvement since the early stages of developing the power pool has been crucial. The SAPP regional institutions have become empowered over the years, however they are not supranational institutions and have limited decision making power. The RERA (of SAPP) is also an association of regulators that functions as a platform for cooperation to harmonize electricity sector policies, legislation and regulations among the members. However, it is not a regional regulator and not all SAPP states are its members since not all of them have established a domestic regulatory body.

Building strong regional institutions have been a key component of SIEPAC and its associated Marco Treaty. In fact, SIEPAC is the only developing country regional power bloc that has established strong supranational regional institutions. The regional electricity market has been designed as the seventh market with its own supporting institutions that are add-on bodies to complement the domestic power market and institutions of the six member states. These are supranational regional institutions with an independent identity and legal authority to enforce agreed upon market rules and impose penalties for non-compliance on the participants. The Marco treaty provides CRIE a status as supranational entity with powers under public international law. It has a critical role in making final, binding decisions to promote regional over national interests. In this sense, by signing the treaty, the national governments have ceded significant portion of their regulatory authority to CRIE.

The creation of strong regional institutions such as NORDEL and NordREG at various stages of cooperation have helped in the development of a harmonized Nordic power market. The Nordic institutions are in general considered effective, transparent, and professionally run. They are carefully designed with sole focus to promote energy security, efficiency and sustainability through competitive market system for trading electricity within the pool.

The well-functioning power exchange system is supported by clear rules, independent market surveillance unit to maintain transparency and effective mechanisms for reducing transmission congestion. In the later stages, the Nordic states have had to conform to regulations set in the EU electricity directives. As markets integrate and advance, the rules also become increasingly complex as policy making takes place at several different levels, such as the EU level, Nordic/regional level, national level and municipal/ local level. Therefore, local, national, regional and supranational institutions have been co-existing with each other in the Nordic power market and this requires a very high degree of coordination and dialogue among the authorities.

These regional cases suggest the importance of having an independent and permanent secretariat with legal authority responsible to manage decisions and action plans. The process of strengthening such regional institutions is difficult as they may encroach into national sovereignty

and policy space, but are crucial for countries to progress in their regional power market development path.

Unlike the reviewed four international cases, regional power cooperation among Bangladesh, Bhutan, India and Nepal is occurring through multiple regional and sub-regional platforms. SASEC and SARI/EI follow project-based approaches to regional power integration with heavy financing and involvement from the ADB and USAID respectively. These organizations have provided platforms for networking, information sharing, training and capacity building for the member states. These tasks are necessary for developing human resource capacity of officials and leveling the playing field for countries with unequal personnel capacity. However, the frequent changes in governments in Nepal, for example, makes the task less effective.

On the other hand, initiatives through SAARC and BIMSTEC are state driven regional efforts with the objective of strengthening integration and cooperation on multiple issues with energy being one of them. Both organizations have a permanent secretariat and staff, however, they are quite limited in their decision making power. SAARC has a weak institutional design and insufficient resources to operate effectively. Instead of having an institutional head on a rotating basis, it needs a more permanent head with a longer fixed year term with more decision making powers and funds. Both also have a separate Energy Center and their functions are limited to preparing and coordinating meetings for various working groups, maintain energy database, facilitate networking and knowledge sharing among national level institutions, conduct feasibility studies, policy studies and facilitate capacity building and training programs. The institutional mechanisms for energy (power) cooperation largely takes place via loose working groups on energy, Ministerial level energy forums and the Energy centers.

Experiences from SAPP institutions suggest that regional institutions like the Energy Centers need to be strengthened with more power to make decisions and enforce agreed upon action plans. Also, there is a need to create a regional regulatory institution at least one along the lines of RERA (from SAPP) for a start. Creation of such an institution is necessary to initiate the process of harmonizing and streamlining legal, regulatory and technical aspects of the power sector in member states. It would also be necessary to create a forum of Transmission System Operators for harmonizing rules on grid codes and transmission infrastructure (SAARC, 2013).

2. Regional Cooperation and Free Movement of Goods and Services

The GMS energy cooperation program is part of a broader GMS regional economic cooperation initiative. The SAPP is also a product of SADC regional organization that works in several other regional cooperation issues. The Central American Common Market was established decades prior to creating the SIEPAC in Central America. Moreover, SIEPAC is one component of a broader vision towards trade and integration of Central American countries with their neighbors.

Being part of a larger cooperation initiative with other focus areas may facilitate in the timely moving of the power sector agenda forward. The meetings and associated achievements of various other area-specific working groups could possibly pressure the energy sector working group to make their own timely breakthroughs in meeting the sector goals. Under a larger economic cooperation framework, various summits, ministerial meetings, and working group meetings are held regularly which provides a de facto platform for power sector representatives

to engage and make gradual progress. The political will and commitment in organizing timely meetings and delivering outcomes under stand-alone sector initiatives may be weaker.

SAARC and BIMSTEC are larger regional cooperation initiatives, which provide a platform for sub-regional cooperation. Both SAARC and BIMSTEC established Energy Centers within a year apart. The SAARC Framework Agreement for Energy (Power) Cooperation was signed in November 27, 2014 which included plans to establish a South Asian regional grid. In March 16, 2015, BIMSTEC members also presented an MOU to establish a power grid for electricity trade. These initiatives are seen as products of competition between the two regional groupings. The BIMSTEC MOU is expected to be signed during the third energy minister's meeting, which may quicken the implementation of the SAARC agreement.

Nordic pool was borne out of one of the most open trade regimes in Northern Europe. The region has a long history of political and economic cooperation within the region. In this sense, the cooperation is unhindered by trade protectionism and other irritants, which helped create a conducive environment for establishing an electricity trading system.

A regional block with liberal free trade agreements on goods and services suggests the presence of strong political will and domestic support for free trade regimes. This also implies that various barriers in the form of physical infrastructure, border and customs, regulatory and bureaucratic impediments have decreased. Hence, strong regional integration and trade in goods and services can facilitate regional integration in the power sector as well.

South Asia is the least integrated regional block in the world with less than 5% of South Asian trade being intraregional. The presence of high tariffs and non-tariff barriers, exclusion of several items via negative lists and long time frames for tariff liberalization in its free trade agreements are to blame. Regional integration in the power sector may also be influenced by how quickly and comprehensively trade barriers are reduced to promote overall goods and services trade.

3. Bilateral Trading Arrangements as Building Blocks

The prior existence of bilateral agreements between Thailand and many other GMS members was useful for initiating a regional power market in GMS. However, since the bilateral trading model has been based on IPPs with long term PPAs (20- 30 years) selling power to importing countries through dedicated transmission lines, this is proving to be an obstacle for third party access to those private transmission lines. This practice is hindering the regional power integration process in the GMS. While long term PPAs ensure a certain degree of security in power agreements incentivizing large scale investments; without clauses for flexibility and with a lack of long term vision towards moving to a regional market, such IPP-long term PPA models can be problematic.

The long legacy of bilateral and tripartite arrangements for power trade in the SAPP have been utilized as building blocks for the regional power pool. In particular, the existence of tripartite agreements have provided mechanisms for facilitating third party access to transmission lines and rules on wheeling charges in the region. These practices of including multiple countries in power trade arrangements have helped in moving towards the regional power pool in Southern Africa. However, a key problem with bilateral contracts in SAPP is that, they are poorly drafted, and appear weak with insufficient provisions to compensate for contract defaults. Rising power

shortages and inadequate power transmission capacity has lowered the rate of contract fulfillment in recent years. Weak contract enforcement mechanisms within the SADC Energy Protocol along with the absence of clear and strong bilateral contracts are raising questions of security of power supply in the region.

About 80% of electricity trade occurs through medium and long-term bilateral arrangements in SIEPAC. While cross-border power deals are negotiated on a bilateral basis, they are required to follow pricing rules and technical trading requirements set forth by regional institutions such as EOR and CRIE. Cross-border exchanges are also overseen and regulated by the regional regulator- CRIE. This system ensures consistency in bilateral arrangements and safeguards regional interests over narrow national/ bilateral interests.

Since each country in the sub-region only trades with India, the existing bilateral agreements in the sub-region by default have no provisions for open access to third parties (country). Surplus power generated in Bhutan are already locked in for exports to India via dedicated transmission lines. Also, given that majority of power plants in Bhutan have been developed with India's assistance, the surplus power produced need to be exported to India according to the specific provisions in their bilateral agreements. This makes it difficult for Bhutan to export its surplus power to a third country. A different type of financing model (with private participation or with other country collaboration) is required to build power plants in Bhutan for promoting power trade with third countries.

Similar to the case of GMS where Thailand functions as a monopsony buyer of power from the smaller members and as in the SAPP where Eskom of South Africa is the major buyer of power from other state utilities, India plays a similar role in the region. Bilateral power trade deals can relegate smaller states into becoming 'captive' suppliers of power.

Some recent developments towards power sector cooperation suggest that these countries will soon be in the process of drawing up several bilateral and possibly tripartite agreements for power generation and trade; these aforementioned lessons from the international cases need to be kept in mind. On one hand, long-term PPAs provide a degree of assurance and certainty for the contractual parties, but it can lock in the use of power plants, transmission lines and fix tariffs- all of which may become roadblocks for expanding into a regional power market. If new power generation from IPPs are tied up through long term PPAs, then creating a short-term real time power trading system in the region can also be difficult. For this reason, flexibility clauses are necessary in long-term contracts, should the need for amendments arise.

The recently signed SAARC Framework Agreement on Energy Cooperation is expected to enable the smaller states to diversify their electricity buyers. However, several issues on the SAARC Framework Agreement defer to bilateral trade agreements. For example, *Article 12* on Transmission Access states that "Member States shall, for the purpose of electricity trade, enable non-discriminatory access to the respective transmission grids as per the applicable laws, rules, regulations and applicable inter-governmental bilateral trade agreements" (SAARC, 2014).

The existing bilateral arrangements for power trade in South Asia has treated electricity as a general commodity, thereby deferring to normal laws and regulations governing cross-border commodity trade. Trading of electricity is inherently different from trading any other commodity due to the need for working out regional power transit and open access mechanisms, establish

technical and operational norms such as transmission and grid codes, safety standards, harmonize laws and regulations of trading states and make commercial arrangements for generation, transmission and distribution among other parameters. These very rules and requirements set electricity trade apart from general commodity trade.

In the absence of adequate provisions for power trade in the domestic electricity laws and regulations, cross-border power trade has been conducted under bilateral agreements which treat electricity as a general commodity. By not separating electricity trade from general commodities trade, states are able to avoid amending their domestic electricity legislations to incorporate cross-border power trade provisions.

4. Physical Infrastructure for Interconnections

Decades prior to SAPP's existence, several transmission lines with third party access provisions had already been created in the Southern African region. The interconnection of two major grids- the Southern thermal network and the Northern hydro network- helped to create the basis for establishing the SAPP. The presence of this SAPP grid system helped the region move quickly from the first to the second stage of forming a regional power market.

The construction of a regional transmission line, the SIEPAC line, has been a major component of the power market integration process. As per the Marco Treaty, an International Transmission Line Company, EPR, was specifically created to construct and operate the SIEPAC transmission line. EPR which is a consortium of private and public companies from Central America has ownership of the interconnection infrastructure. The construction of this interconnection infrastructure was finally completed in 2014 after 8 years. Hence, the power market in Central America has a proper regional asset connecting each member state.

Nordic pool's operations are highly dependent on high quality physical infrastructure in the member states and the interconnection infrastructure across the border and the region. The Nordic transmission grid connects all Nordic states combining the national grids into one synchronous power system. In addition, the transmission interconnectors also reach several countries in mainland Europe. A high degree of openness in the financial market and capital mobility within the region has played a key role in raising private investment capital for physical infrastructures. The practice of market splitting to ease transmission grid congestion also leads to price differences between zones which in turn has motivated the building of new transmission capacity. Moreover, Nordic governments also have stellar track record in allocating public investments in infrastructure to advance their individual and regional interests. As such, physical infrastructures for facilitating interconnection in the region are highly responsive to the needs of the cooperation.

On the other hand, GMS members do not have such regional assets yet and rely on dedicated transmission lines and interconnector facilities which are merely extensions of national grids into territories of power exporting countries. In fact, the absence of a regional power grid has led to the construction of private transmission lines for power exchange. These practices are less efficient and an obstacle towards creating a regional power market.

The South Asian sub-region shares these issues with the GMS members. Power exchange between India and all three members occurs largely through dedicated transmission lines. Even

when new power plants have invested for power generation, inefficient grids create a hurdle in transmitting power to the source of demand resulting in wasted power. At present transmission interconnections exist between Bhutan and India; Nepal and India and Bangladesh and India. The recently operationalized interconnection between Bangladesh and India is the only HVDC interconnection in the region which is able to support large volumes of power transmission over longer distances. India was able to connect all of its five regional grids into a common national grid only in 2014 which has positive implications for developing a regional grid.

Given the locations of power supply and demand in the sub-region, expansion and construction of interconnection infrastructure is crucial. Both increased private sector participation and large scale investments are needed in the transmission and distribution segments of the power chain. There has been a good amount of private sector involvement in the power generation sector while this involvement is severely lacking in the transmission and distribution chains. In the sub-region, only India has opened up the transmission and distribution segments to the private sector. However, the high cost and high risks associated with investments in large backbone grids have discouraged private investments in transmission segments. Governments and international finance institutions will have to play an active role for undertaking these large scale investments.

5. Investments in Power Generation

The presence of surplus power capacity due to past investments in power generation in Southern Africa helped in pushing SAPP forward. It also helped create a competitive short-term electricity market shortly after the establishment of the SAPP. However, the lack of sustained investments in power generation along with rising electricity demands have exhausted the excess power capacity in the power pool. As a result, both security of power supply and development of the power pool into a more integrated stage has been stalled.

Likewise, regional electricity trade in SIEPAC has declined in recent years owing to a shortfall in additional power generation capacity. Major power exporters are diverting generated electricity to meet their own rising domestic demands. Despite the presence of strong regional institutions, decrease in power generation capacity has hindered power exchange in SIEPAC. It is argued that SIEPAC's full potential will only be realized once the region invests in large scale power generation units.

Only Bhutan has surplus power capacity in the sub-region. The existing power plants are also locked-in with long term contracts which does not leave the sub-region with any additional capacity. The slow rate of investments in generation capacity has led to significant power shortages in the region. Without further investments to generate surplus power, it is difficult to envision developing a regional power market. However, the Nordic model has benefited from open trade regimes, deregulated electricity markets, and well-developed financial markets making it more successful in power generation.

6. The Role of Outsiders

The role of the ADB has been instrumental in aiding the development of a regional power market in GMS. In its role as a de-facto secretariat, the ADB has provided technical, financial and administrative support to the GMS energy cooperation program. However, adopting such a project-based approach to regional cooperation can increase dependency on the outsider and

reduce the ownership of the program among the member states. For this reason, despite the production of extensive documentation and action plans since the inception of the GMS program, implementation has been very slow. Also, some of the GMS technical studies have not been effective due to inadequate understanding by external consultants on ground realities and lack of sufficient input from local experts.

In the conventional sense, outsiders did not play a role in the formation of the Nordic power market. The initiative and support for creating the market came from the states themselves. However, in the latter stages, as these countries adopted EU electricity directives, EU regulations played an important role in shaping the Nordic power market.

Donor financing played an important role during the early stages of creating a regional power market in the SAPP. While financing of energy working group meetings during the initial years were supported by donors, the national utilities of the member states decided on self-financing various committee meetings quite early on. At present, member state's contribution makes up about 80-90 % of SAPP revenue which is used to finance its institutions.

Outside support in the form of imparting technical knowledge for capacity building and training of various government officials and stakeholders to understand the process of creating regional power markets has existed for both the GMS and SAPP. Such programs are useful for creating a level playing field among the member states to establish an equitable regional power market.

In the case of SIEPAC, the Government of Spain's initial technical and financial support provided a constructive prod for the countries to start the conversation in regional power cooperation. Investment financing from IFIs for the construction of transmission interconnections are particularly necessary due to the difficulty of attracting private sector finance in this segment. IADB and the CABEL have played key roles in providing technical and financial assistance during various stages of the cooperation in SIEPAC. They also provided debt financing to construct the physical transmission infrastructure which has been the backbone of SIEPAC. These loans were released by the IADB contingent on the creation of supporting regional institutions such as CRIE and EOR and after finalization of rules for MER, the regional power market. In this manner, IFIs played a very crucial role in contributing to SIEPAC's development by creating effective incentives through loan conditionality.

These lessons are useful for the sub-region since there are project-based initiatives for regional energy cooperation such as the ADB led SASEC program and the USAID led SARI/EI program. The ADB financed HVDC interconnection between India and Bangladesh on the Bangladesh side is a good example of outsiders' contribution in successful power cooperation in recent years.

7. Domestic Institutional and Regulatory Reforms

The goal of regional cooperation in the power sector is to further national goals of development and achieve national energy security. However, national reform efforts in the sector are necessary for moving towards building effective regional institutions and achieving regional integration in power. Not all GMS states have introduced corporatization into their power sectors or have national regulatory agencies. For countries with regulatory bodies, they are weak with inadequate capacity and lack the necessary independence. As a result of this, regulatory bodies and utilities are not actively involved in the GMS regional power market creation process.

There have been some form of power sector reforms implemented in all Southern African countries. However, the sector is still not fully deregulated and unbundling of utilities have not yet taken place in all the member states. Also, the degree of private sector participation in the power sector varies widely. Not all countries have regulatory agencies which makes harmonization of regulatory framework a challenge. These shortcomings have, however, not prevented the members from creating a regional power pool. The national utilities were actively involved in the process of creating the power pool from the beginning. But the absence of further deregulation of the sector and lack of regulatory bodies in some members is becoming an obstacle for the region to progress towards further integration in their power pool.

On the contrary, all members from SIEPAC introduced reforms in their power sector during the 1990s. By the mid-1990s, all states moved towards a single-buyer model and established a domestic electricity regulatory body. Unlike the cases of GMS and SAPP, each member had created a domestic electricity regulator when SIEPAC came into existence. Therefore, the country level regulators were able to work closely with CRIE, the regional regulator in coordinating their regulatory regimes with the regional regulations. Similarly, the Nordic states' initiative to implement market liberalization in their domestic power sectors was crucial in helping the Nordic power market transition from the first phase of cooperation to the second phase of creating a competitive electricity market. Norway led the reform initiative in 1990 while Sweden, Finland and Denmark followed with their respective power sector reforms by 1996 to introduce competition as well as provisions for third party access to their grid infrastructure. These collective reforms facilitated each Nordic state to join the Nord Pool Spot and participate in real-time competitive electricity trade. Continued reforms in the latter stages were largely driven by EU policies and regulations.

In a broad sense, the design of economic regulations is similar across Nordic states. However, there are differences in the details of the setup of their regulatory model and structure of the power sector to suit their domestic context. The EU's electricity directives are based on similar principles where its member states are required to meet certain goals or targets, but flexibility is allowed for the members to choose their own suitable paths that best fits their existing regulatory and organizational structures to reach the set targets. This case shows the importance of achieving an adequate balance between harmonization and flexibility.

In the case of the sub-region, the power sector of Bangladesh, Bhutan and Nepal is dominated by the single-buyer model while India has introduced more competition among the market participants. Most of the States in India have unbundled their State Electricity Boards into separate units for generation, transmission and distribution. Both Bangladesh and Bhutan have implemented partial unbundling while initiatives to unbundle the Nepal Electricity Authority have been proposed through a draft bill which has not yet been passed. The countries vary significantly in terms of their regulatory commissions, with India having separate Central and State regulators while Nepal is still in the process of establishing a regulator. Nepal has provisions for cross-border power exchange with procedures on licensing for electricity trade, export duties, permit approvals, etc. However, due to the absence of an Electricity Regulatory Commission with the mandate to regulate the sector, the above mentioned provisions do not hold much ground.

The countries also differ in terms of the degree of private sector participation in the power sector. Private sector participation is present in the generation segment for all countries in the form of

IPPs. However, majority of the power generation is state-owned. Only India has opened its distribution and transmission chains to the private sector, but in a limited form. Licenses are needed for participation in transmission and distribution but there are still substantial bureaucratic hurdles in the forms of multiple licenses and permits that need to be acquired from various uncoordinated agencies and these practices discourage private investments.

The significantly low electricity tariffs maintained by utilities in Southern Africa, especially Eskom (South Africa) was one of the reasons for their weak financial status and low levels of investments in the power sector. Power tariffs are also subsidized in the GMS countries, which has led to distorted power prices in power purchase agreements. In addition, large single buyers in the GMS have been able to set reduced export tariffs for the power producers from smaller less developed countries. Similar concerns regarding non-equitable power pricing deals are present in the South Asia sub-region as well. Energy is subsidized in some form among all countries in South Asia. Such skewed price signals have created a low incentive for investments in power supply and have also contributed to the weak financial position of utilities in the member states.

Implementing broad-based domestic reforms in the power sector will certainly create winners and losers as more competition is introduced. There will always be resistance to reforms from various stakeholders that stand to lose from the process. A strong government commitment to see the reforms through without bowing to pressures of policy reversals is required. This kind of commitment is clearly demonstrated by the Nordic case. Even when prices increased and power supply decreased during the reform period, the governments continued with the reforms (Mundaca, et al., 2013). However, in the face of strong public pressure, measures to provide short-term support for the most vulnerable consumer groups can be designed.

8. Provisions for Cross-Border Power Trade

Open and non-discriminatory access to transmission grid is a key requirement for creating a competitive electricity market. Due to the long legacy of power sector cooperation among SAPP members, majority of them, have provisions and guidelines for cross-border electricity trade incorporated into their National Electricity Acts. The governing documents of SAPP also emphasize on fair open access to transmission systems and rules on transmission system pricing, referred to as wheeling charges. The operating members of SAPP are obligated to wheel power unless there are technical problems, which need to be disclosed and are open to investigation.

One of the key principles of the Marco Treaty that formally established SIEPAC was to promote competition in the electricity market, which includes non-discriminatory access to transmission system infrastructure. Regional and national transmission systems are granted non-discriminatory access to the SIEPAC grid while individual states are not allowed direct control over the SIEPAC transmission system. Private sector transmission developers are allowed to enter the market and in case of transmission pricing disagreements, CRIE is able to set the pricing.

Similarly in the case of the Nordic model the power sector reforms in the mid-1990s, regulated third party access to national transmission infrastructure. As Nordic states adopted the EU Electricity Directives in 2003 and 2009, they agreed to non-discriminatory third party access to transmission infrastructure. The Nordic Power market has moved beyond this basic requirement to a more sophisticated transmission and grid management system. The elimination of

transmission border fees between countries has ensured that electricity buyers and sellers pay tariffs only at the point of connection. Moreover, these transmission prices are independent of distance between the traders. Such provisions and rules on transmission grid usage have played an important role in expanding electricity trade in the region.

In the case of South Asia, most of the laws and regulations were formulated with an inward looking perspective. Only Nepal and Bhutan have included power trade provisions in their laws and regulations as part of their power sector reform program (SAARC, 2013). Electricity laws and regulations of both India and Bangladesh are silent on cross-border power trade (SAARC, 2013). In India, trading has been recognized as a distinct activity and licenses are required, however, it has been clarified that “trade” refers to inter-state trading and not cross-country trading. Any issues related to cross-border trade falls under the purview of the Ministry of External Affairs. Since India-Bhutan and India-Nepal bilateral cooperation in power trade falls under India’s aid assistance program, it is kept separate from its domestic electricity regulations (SAARC, 2013).

Since all countries share borders with India in the sub-region, India is able to carry out power trade without requiring territorial access from a third party. On the contrary, all other countries require transit access from India to trade with one another. Hence, India will have to make provisions for non-discriminatory open access to its transmission systems if the sub-region is to create a power market. While such provisions are only present for the domestic context, actual application of this law on the ground is still not fully enforced. State governments are reluctant to grant such access fearing power shortages in their home states.

Even though Bhutan’s domestic electricity act has provisions for facilitating cross-border power trade, power exports to any other country besides India requires India’s consent. Bangladesh has shown interest in importing electricity from Bhutan and Nepal. For this, India has to grant access of transit for power flows through Indian transmission facilities. There is a need for domestic power sector legislation to incorporate provisions for cross-border power trade, assure transit and open access to transmission lines. Without these amendments to permit and facilitate power exchange and transit, developing a regional power market will remain a challenge. On a positive note, harnessing the hydro power potential of Nepal and Bhutan to achieve energy security has been acknowledged in the power sector plans from the Government of India’s 12th Five Year Plan (2012-17). The possibility of integrating the Indian Power Grid with Nepal and Bhutan for cross-border electricity exchange via Inter Governmental framework agreements has been mentioned in the document (Gol, 2012).

9. Political Will and Trust

The high degree of political will and commitment among governments of the Nordic states played a key role in establishing their regional power market. This commitment translated into each state implementing economic reforms in their domestic power sector. Throughout various stages, governments have come together through several platforms for effective dialogue and information exchange. The development and co-existence of local, national, regional and supranational institutions governing the Nordic Power Market indicates the presence of extensive coordination and cooperation among the Nordic states. Similarly, the strong commitment among governments of Central America to create a regional power market is clearly evidenced by the Marco Treaty and its supporting supranational regional institutions. Since the regional institutions of SIEPAC

have the legal authority to make binding decisions, the institutions and physical infrastructure envisioned by the treaty have been created in a timely manner. It is commendable that governments have come together to allow their national policy space to be trumped for the greater good, that is, to achieve an integrated region.

However, other developing country regional blocs have not been able to make such level of progress on their power market integration process. While Thailand is said to have taken a lead role in pushing for the GMS energy program, there is lack of strong political will and commitment at the national utility level among some GMS member states as not all states/ utilities view regional power markets as a beneficial endeavor. Before establishing SAPP, there was political will on the part of national utilities to take the initiative of organizing regular meetings to discuss and prepare the groundwork for creating a power pool. South Africa's dominant position as the major supplier and consumer of power and its role in shaping the power pool has also been a key factor. However, governments have not been able to or are unwilling to make further binding commitments through strong protocols that are legally enforceable.

The political instability in countries like Nepal and Bangladesh lead to frequent change in the government, which breaks the momentum of bilateral and regional talks. This is problematic since these talks generally entail very lengthy political and technical negotiations. To deal with such issues, non-government stakeholders such as consumer groups, civil society organizations and business councils can be included to spread awareness about the benefits of regional power integration creating a pro-regional power integration constituency. Through the involvement and active lobbying of such non-state actors it is possible to create political will for regional cooperation at the governmental level.

Among the nine lessons, four lessons can be implemented in the short to medium term in the South Asian sub-region. Basic level of domestic power sector reforms and harmonization of legal and regulatory framework which is necessary for effective regional power cooperation can be implemented unilaterally in the short to medium term (Lesson 7). Without adequate reforms in the domestic market, regional power cooperation will be limited and will experience setbacks along the way. Similarly, making provisions for cross-border power trade and open access to transmission infrastructure in domestic electricity legislations (Lesson 8) is also a pre-requisite and can be carried out unilaterally in the short-term to medium-term. These provisions were present in the national legislations and governing documents of the SAPP, SIEPAC and Nordic power market prior to the creation of their respective power pools. As countries from the sub-region move forward by signing bilateral power trade agreements, they need to be drafted so that they are not roadblocks to regional power trade (Lesson 3). Long-term PPAs can tie up new power generation from IPPs and access to dedicated transmission lines under these agreements can be a challenge for third parties. It is necessary to develop any new bilateral agreements with clauses for flexibility and with a vision of seamlessly moving towards a regional power market. These provisions can be made in the short to medium term on a bilateral basis.

Construction of basic interconnection infrastructure is a necessity for creating a regional power market (Lesson 4). SAPP, SIEPAC and the Nordic case clearly show that the presence of a regional (international) transmission grid connecting member states is key for executing multi-country power trade. In recent years there have been some developments on constructing large scale bilateral transmission grids in the sub-region. India's recent completion of regional grid

integration into a national grid can provide the way forward for building regional interconnection infrastructure (ADB, 2013). Planning and execution of physical infrastructure is necessary in the short to medium run, given the long gestation period of these large scale projects. Both bilateral and sub-regional coordination is required for developing such interconnection infrastructure.

Other lessons such as creating strong regional institutions (Lesson 1) and regional cooperation in complementary areas (Lesson 2) are ongoing processes that require cooperation at the sub-regional and regional level. Investments in power generation (Lesson 4) is also a continuous process which can be undertaken at the unilateral, bilateral, sub-regional and regional levels. The role of outsiders (Lesson 6) is important for creating a platform for information exchange, networking and capacity building, which can be complementary to state-led initiatives. In addition, IFI's role in financing of regional transmission infrastructure will also be necessary since attracting private sector financing in the transmission segment is difficult than in the generation segment. Lastly and more importantly, political will and trust (Lesson 8) will be the key overarching factor for creating a sub-regional power market in the South Asian sub-region.

5.0 Conclusion

Sub-regional power sector cooperation in South Asia can contribute to energy security, environmental sustainability and economic development of the region. This report has looked at the existing state of bilateral and regional arrangements of electricity cooperation in Bangladesh, Bhutan, India and Nepal to identify key issues for sub-regional power cooperation. By reviewing four international case studies, the paper aims to draw lessons from their power market integration efforts for the South Asian sub-region.

The case studies show that regional power sector cooperation is a long term endeavor which can take decades. It has taken the Nordic Power Market 45 years to come into its current form. It has been about two decades since SIEPAC and SAPP created their respective power pools. SIEPAC and GMS energy programs have explicitly stated their intention of following a gradual approach to allow adequate time for their member states to prepare their domestic institutions for regional integration since they are at different stages of economic development.

However, majority of the issues faced by GMS, SAPP and SIEPAC appear to be more relevant to the sub-region since they are also developing country regional blocs. Since the Nordic Power Market is the most advanced power pool in the world, experiences from its early stages of cooperation are useful for the sub-region. The sub-region may not have the kind of financial markets, open trade regimes and de-regulated electricity markets of the Nordic states, but they can aim to build institutions for coordination and cooperation.

The South Asian sub-region will have to follow a sequential approach. For example, adequate domestic power sector reforms, provisions for power trade in domestic electricity legislations and building of physical interconnections are a must before creating an effective regional power market. However, all of these tasks along with drafting proper bilateral power trade agreements, strong regional institutions, economic cooperation and investment in power generation are all inter-related. A supportive legal and regulatory framework both at the domestic and regional level that allows free flow of electricity across borders can attract project developers and investors in the sector as they can maximize their revenues by reaching a larger market and mitigate risks associated with fluctuations in a smaller local market while minimizing costs.

Bilateral cooperation and trade in electricity among countries from the sub-region predates their power sector reform initiatives. This is one of the reasons why regional power cooperation has not been able to proceed at a more desirable pace. Many power trade agreements, especially those between Nepal and India, were signed prior to the introduction of India's Electricity Act of 2003, the National Electricity Policy of 2005 and the Tariff Policy of 2006, all of which have been instrumental in bringing proper market-based reforms and competition into the power sector. It takes time for institutions and economies to adapt to new changes as reforms generally show their impact after a long time. Given India's central position in the region, it is expected that their domestic power sector reforms will support the creation of a sub-regional power market.

Regional institutions are necessary to initiate the process of harmonizing and streamlining legal, regulatory and technical aspects of the power sector in member states, whenever necessary, and to create a forum of Transmission System Operators for harmonizing rules on grid codes and transmission infrastructure. Presently, efforts towards regional power cooperation among Bangladesh, Bhutan, India and Nepal is occurring through multiple regional and sub-regional platforms: SASEC and SARI/EI follow project-based approaches to regional power integration; and SAARC and BIMSTEC are state driven regional efforts for strengthening integration and cooperation on multiple issues, including energy. While these platforms have definitely helped in efforts towards regional cooperation and trade on power, a permanent coordination center is still needed to manage decision-making processes listed earlier.

Strong political will and commitment remains a central element which has been lacking in the region. It will be crucial for the countries to override their political differences and allow for economic interests to take priority. It is possible to create political will at the top level of national leadership through building an organized political constituency which stands to gain the most from such regional power cooperation. Bhutan and India's cordial relationship has been translated into a successful bilateral power trade and cooperation model. Similarly, a strong political will and the presence of strong mutual economic benefits from a power trade deal were key drivers of the recent power cooperation initiative between India and Bangladesh.

Cooperation in the electricity sector in the sub-region is expected to be more politically feasible than cooperation in the entire region. This would provide an opportunity to develop and test a smaller scale sub-regional trading platform which could be the building block for a larger regional cooperation—and ultimately regional economic integration. The five key messages of the study follow:

1. Use bilateral electric power trading arrangements to build the foundation for regional ones in the future.
2. Engage external support, when necessary, to finance technical studies, capacity building, and the development of physical infrastructure.
3. Make provisions in national legislation for cross-border power trade and open access to transmission grid networks.
4. Expedite—and harmonize to the extent possible—power sector reforms in countries of the region.
5. Establish a permanent coordination center to manage decision-making processes concerning cross-border power trade with active participation of member countries.

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Appendix

Table A.1. Major Power Transmission Links between Bhutan and India

Transmission Lines	Voltage Level	Notes
<i>In operation for power exchange</i>		
Chukha (Bhutan)- Birpara (India)	220 kV	Power export from Bhutan to India (West Bengal) via Phutsholing delivery point Power export from Bhutan to India (West Bengal) via Malbase delivery point
Kurichhu (Bhutan)- Salakati (India) Kurichhu (Bhutan)- Rangia (India)	132 kV	Surplus power export from Bhutan to India (Assam) via Gelephu delivery point Surplus power export from Bhutan to India (Assam) via Motanga/Samdrupjongkhar delivery point
Tala (Bhutan) – Binnaguri/New Siliguri (India)	400 kV	Surplus power export from Bhutan to India (West Bengal) via Khogla delivery point Surplus power export from Bhutan to India (West Bengal) via Pagli delivery point
<i>Transmissions Lines in Pipeline</i>		
Punatsangchhu-I (Bhutan) - Alipurduar (India)	400 kV	Surplus power export from Bhutan to India (West Bengal) via Lhamoizingkha
Mangdechhu (Bhutan)- Alipurduar (India)	400 kV	Surplus power export from Bhutan to India (West Bengal) via Jigmeling
Punatsangchhu-II (Bhutan)- Jigmeling Pooling Point (Bhutan)	400 kV	Surplus power export from Jigmeling Pooling Point to India (West Bengal)
Kholongchhu (Bhutan)- Bhutan-India border	400 kV	Options of pooling at Goling and Yangbari Power Pooling Points; By 2020
Sunkosh (Bhutan)- Alipurduar (India)	400 kV	Surplus power export from Bhutan to India (West Bengal) via Sunkosh HV DC Power Pooling point; By 2020
Chamkhar (Bhutan) - Goling Pooling point	400 kV	By 2020
Chamkhar (Bhutan) -Yangbari Power Pooling HV DC point (Bhutan)	400 kV	By 2020
Kuri-gongri (Bhutan)- Yangbari Pooling/HV DC (Bhutan)	400 kV	By 2020
Rangia/Rowta HV D/C Pool (India)	400 kV	By 2020
Wangchhu (Bhutan) – Tala-Khogla Feeder (Bhutan/India)	400 kV	Loop-in-loop out line; By 2020

Amochhu (Bhutan) -Tala-Pagli Feeder	400 kV	Loop-in-loop out line; By 2020
Bunakha (Bhutan) - Malbase/Khogla	220 kV	By 2020

Source: “Status of Bhutan cross border interconnection with India & Expected Benefits”, SARI/EI Workshop on “Competitive Electricity Markets- Design, Implementation & Benefits” 18-20 March 2014, Colombo, Sri Lanka

Table A.2. Nepal-India Treaties and Agreements on Power Development and Trade

Original: April 25, 1954 ; Amended: December 19, 1966	Agreement between HMG/N and GOI on the Koshi Project
Original: Dec 4, 1959; Amended: April 30, 1964	Agreement between HMG/N and GOI on Gandak Irrigation and power projects
Feb 17, 1996	Treaty between HMG/N and GOI concerning the Integrated Development of the Mahakali River- Sarda Barrage, Tanakpur Barrage and Pancheshwar Project.
Feb 17, 1996	Electric Power Trade Agreement between HMG/N and GOI
Oct 21, 2014	Agreement between GON and GOI on Electric Power Trade, Cross-border transmission interconnection and grid connectivity

Source: Compiled by the authors

Table A.7. Major Power Transmission Links between Nepal and India

Transmission Lines	Voltage Level	Notes
<i>In operation for power exchange</i>		
Gandak powerhouse (Nepal) - Ram Nagar (India)	132 kV (radial mode)	Power export from Nepal to India (Bihar)
Duhabi (Nepal) – Bhandabari (Border)- Kataiya (Bihar, India)	132 kV (radial mode)	Power import to Nepal (eastern region) from India (Bihar grid)
Mahendra Nagar (Nepal) – Tanakpur (India)	132 kV (radial mode)	For Nepal's internal use under Tanakpur agreement
Transmission Lines in Pipeline		
Butwal (Nepal) – Sonauli (Border) – Anandanagar (U.P., India)	132 kV	
Birgunj (Nepal) – Motihari (Bihar, India)	132 kV	
Dhalkebar (Nepal) – Sitamarhi (Bihar, India)	132 kV	
Kusaha (Nepal) – Kataiya (Bihar, India)	132 kV single circuit	
Parwanipur (Nepal)- Raxaul (Bihar, India)	132 kV single circuit	
Dhalkebar (Nepal) – Muzaffarpur (India)	400 kV double circuit	

Source: IPPAN/CII (2006) “Nepal India Cooperation on Hydropower”; IPPAI (2014) “State of the Indian Power Sector 2013-2014”

Table A.3. Key developments on energy cooperation under SAARC

Year	Key Developments
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January 2000	Technical Committee on Energy
January 2004	Working Group on Energy
October 2005	Expert Group on Energy
2006	SAARC Energy Center established
March 2007	South Asia Energy Dialog
January 2009	Concept of South Asia Energy Ring approved
November 2014	SAARC Inter-governmental Framework Agreement for Regional Cooperation in Energy (Electricity) signed

Source: http://www.saarc-sec.org/areaofcooperation/cat-detail.php?cat_id=55

Table A.4. Initiatives on Energy Cooperation under SASEC

Year	Key Developments
2001	First Energy & Power Working Group Meeting (Delhi)
2002	Second Energy & Power Working Group Meeting (Delhi)
2009	Energy Access & Efficiency Improvement Project (USD \$94 million)
2010	SASEC Bangladesh-India Electrical Grid Connection Project (USD \$ 159 million)
2011	Energy Access & Efficiency Improvement Project II (USD \$94 million) Energy Working Group Meeting (Bangkok, Thailand)
2012	Energy Working Group Meeting (Thimpu, Bhutan)
2013	SASEC Bangladesh-India Electrical Grid Connection Project (USD \$ 40 million) Meeting of SASEC Electricity Transmission Utility Forum (Colombo, Sri-Lanka)
2014	Meeting of SASEC Electricity Transmission Utility Forum-2 (Manila, Philippines)

Source: http://sasec.asia/sasec_timeline.html

Table A.5. Key Developments under BIMSTEC

Year	Developments
2005	First Ministerial meeting on Energy BIMSTEC Energy Center Established Prepared MOU on BIMSTEC Trans Power Exchange and Development Project
2006	BIMSTEC Workshop on Harmonization of Grid Standards
2015	Finalized MOU to set up power grid connections for electricity trade

Source: <http://bimstecenergycentre.org>