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SOUTH ASIA REGIONAL INITIATIVE FOR ENERGY INTEGRATION (SARI/EI)

Prospects for Sustainable Energy Infrastructure Development and Role of Cross Border Energy Trade in South Asia

Challenges, Opportunities and Way forward

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The report and its findings do not necessarily reflect the views of the SARI/EI Project Secretariat. The report can be considered as a base document for further analysis and it aims to stimulate further discussion and analysis for developing sustainable energy infrastructure through accelerated regional energy/electricity cooperation among South Asian countries—Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka.

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Integrated Research and Action for Development (IRADE)
March 2021

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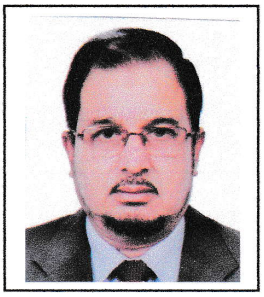
Message



South Asia (SA) region is one of the most vibrant and diverse regions in the world. It comprises 3% of the world's area, 21% of the world's population and 4.21% (US$3.67 trillion) of the global economy, as of 2019. Access to reliable, affordable, clean, and sustainable energy is a high priority not only to support rapid economic growth and improved welfare of more than 1.8 billion population of the SA region but also to ensure energy security in the region.

South Asia is highly vulnerable to the adverse impact of climate change. Energy mix in the SAARC region is predominantly based on fossil fuels and decarbonising power/energy sector is crucial in fight against climate change. Therefore, it is important to meet the rising energy demand through sustainable form of energy and minimise and eliminate pollution caused across the Energy Sector Value Chain through rapid adoption of clean and modern energy technologies.The South Asian Countries (SACs) have recognized the importance of Sustainable Energy Infrastructure and potential benefits of Regional Energy Cooperation (REC) and Cross Border Electricity Trade (CBET) and are undertaking transmission interconnections and development of hydro power for five decades.

The South Asia Forum of Infrastructure Regulators (SAFIR) is a one of its kind regional forum of regulators in the South Asian region. Ever since our establishment in May 1999, SAFIR has been working towards its objectives, including providing a platform for experience sharing amongst the regulators of the region; and building regulatory decision-making and response capacity in South Asia.

Energy has been a key focus area of SAFIR, it being one of the key components of infrastructure regulation. SAFIR has a separate Working Group on "Regulatory Cooperation to Facilitate Knowledge sharing, addressing Cross cutting Energy/Electricity Regulatory Issues and Capacity Building in South Asia". It has been dealing on issues such as regulatory interventions for grid discipline and grid reliability in the South Asian Region (SAR), with the assistance of SARI/EI.In addition, SAFIR has also created a Joint Working Group (JWG) of SAFIR "To study, formulate and recommend for facilitating Power trade development in South Asia". SARI/EI is also providing support this joint working group.

Considering the increased climate related risks and vulnerabilities in the region, SAFIR has decided to focus on "sustainable energy infrastructure" as a key focus area for its upcoming annual conference, jointly organized by SAFIR and SARI/EI.In this context, this Background Paper of SARI/EI on "Sustainable Energy Infrastructure Development and Role of Cross Border Energy Trade in South Asia: Challenges, Opportunities and way forward " is a welcome initiative.

I hope that this Background Paper of SARI/ El will stimulate constructive discussions among the South Asian countries on utilizing the potential for regional energy cooperation for the development of Sustainable Energy Infrastructure in South Asia and beyond.

Jalil 11-03-2021
Md. Abdul Jalil
Chairperson, SAFIR
and
Chairman, BERC

FOREWORD

The U.S. Agency for International Development (USAID) has been working to enhance regional energy cooperation in South Asia since 2000 through its South Asia Regional Initiative for Energy (SARI/E) program. The first three phases of the program focused on building trust, raising awareness and assessing potential transmission interconnections. The current and fourth phase of the program, called South Asia Regional Initiative for Energy Integration (SARI/EI), which was launched in 2012, focuses on promoting regional energy integration through cross-border power trade. This is being implemented by the Integrated Research and Action for Development (IRADe).

The fourth phase of the program also focuses on institutional strengthening and engaging regional institutions such as South Asia Forum for Infrastructure Regulations (SAFIR), a regional forum of regulators in the South Asian region. SARI/EI's association with SAFIR started with a joint workshop on cross-border power trade in 2016. Since then, the partnership has grown stronger with SARI/EI providing technical support to the SAFIR Working Group on "Regulatory Cooperation to Facilitate Knowledge sharing, addressing Cross cutting Energy/Electricity Regulatory Issues and Capacity Building in South Asia" and the Joint Working Group (JWG) of SAFIR. This includes undertaking studies and analysis, jointly hosting knowledge sharing workshops and developing a data portal.

This year, USAID through the SARI/EI program, is also collaborating with SAFIR in jointly organizing its annual conference. Considering the potential development of the energy sector as well as the perils of climate change in South Asia, the focus of this year's conference is on "Sustainable Energy Infrastructure Development and Role of Cross Border Energy Trade in South Asia: Challenges, Opportunities and Way forward".

As a part of the conference, SARI/EI developed a background paper that comprehensively covers topics to be discussed in the conference such as prospects for sustainable regional energy infrastructure development, deepening regional energy cooperation through sharing of knowledge on clean energy, and accelerating the sustainable cross border infrastructure through investments, etc. This background paper will serve as a baseline document to guide the discussions and deliberations during the conference.

I would like to take this opportunity to acknowledge the excellent work done by the SARI/EI team at IRADe and Deloitte India in developing the background paper. I hope the findings of this Paper will be useful for all the South Asian member countries, and especially the SAFIR delegates from South Asia.

Thank you

Julia Kennedy

Julia Kennedy
Indo Pacific Director (A),
USAID/India

Preface

We are pleased to present a Background Paper on "Sustainable Energy Infrastructure Development and Role of Cross Border Energy Trade in South Asia: Challenges, Opportunities and way forward" developed under the South Asia Regional Initiative for Energy Integration (SARI/EI) project supported by USAID and implemented by Integrated research and action for development (IRADe).

This Paper is intended to provide a background on the role of regional energy cooperation and Cross Border Energy Trade (CBET) in supporting the development of sustainable energy infrastructure, in the South Asia region. The Paper was prepared and is being released in the backdrop of the SAFIR annual conference on "Sustainable Energy Infrastructure Development and Role of Cross Border Energy Trade in South Asia: Challenges, Opportunities and way forward" jointly organized by SAFIR and USAID's South Asia Regional Initiative for Energy Integration (SARI/EI) program, implemented by Integrated research and action for development (IRADe).

The South Asia Region is endowed with huge renewable energy potential, cross border electricity can not only improve the energy integration in SA, but also can help in making energy transition in a sustainable manner.

This paper updates the current scenario in various South Asian countries, covers electricity trade experiences in the region as well as elsewhere in the world and describes the regulatory interventions for sustainable energy infrastructure development in the region, strategies for transitioning of South Asian electricity market from bilateral to trilateral and multilateral trade mechanisms, strategies for greening the South Asia energy system and promoting private sector investment. We hope that this Background Paper will help regulators and policy makers of all South Asian countries to take steps to enhance energy integration, promote sustainable energy infrastructure, accelerate their economy, and bring prosperity in the region.

I hope that this Background Paper will serve as a starting point for stimulating discussions on enhanced energy cooperation towards development of sustainable energy infrastructure in South Asia, by detailing the challenges and opportunities, including the role of CBET. The Paper also maps the role played by various Development Partners on regional energy cooperation efforts in the region and presents a potential roadmap to support the development of sustainable energy infrastructure in the region.

I am grateful to USAID for their support in the preparation of this background paper. I take this opportunity to thank the Technical team at SARI/EI Secretariat /IRADe, that worked diligently and enthusiastically to deliver this Paper in a short span of time.

Dr. Jyoti Parikh

Executive Director, IRADe

March 2021

IRADe

1. Introduction

1.1 Background

In the South Asian region, the US Agency for International Development (USAID) funded South Asia Regional Initiative for Energy Integration (SARI/EI) program has been working towards promoting regional energy cooperation since 2000. The program covers the eight countries of South Asia - Afghanistan, Bangladesh, Bhutan, India, The Maldives, Nepal, Pakistan and Sri Lanka. The latest and final phase of SARI/EI, implemented by Integrated Research and Action for Development (IRADe) focuses on advancing regional energy integration and increasing cross border electricity trade (CBET) in the region.

While SARI/EI has been focusing on promotion of CBET in the South Asia region, including efforts on regulatory harmonization for power trade, the South Asia Forum for Infrastructure Regulation (SAFIR) has been offering a platform for the infrastructure regulators in the region, including energy sector regulators, to share their knowledge, deliberate ideas and improve their capacity. Established in May 1999, with the support of The World Bank, SAFIR focuses on providing high capacity training and capacity building on Infrastructure regulation.

SARI/EI and SAFIR has been partnering with each other in various areas. SARI/EI is providing technical knowledge support /assistance to the SAFIR Working Group On "Regulatory Cooperation to Facilitate Knowledge sharing, addressing Cross cutting Energy/Electricity Regulatory Issues and Capacity Building in South Asia". SARI/EI is also providing support to SAFIR on organizing its annual conference.

This report is prepared in the backdrop of SAFIR's annual conference for 2021. The report is titled as "Prospects for Sustainable Energy Infrastructure Development and Role of Cross Border Energy Trade in South Asia: Challenges, Opportunities and way forward "in line with theme of the conference.

This report is developed with the following key objectives in mind:

1. Highlight the prospects for Sustainable Energy Infrastructure Development and role of CBET in supporting such infrastructure development in the region;

2. Illustrate the benefits of regional cooperation, and identify the key learnings from international experience, on the development of regional sustainable energy infrastructure; and

3. Serve as a foundation for the discussions to be undertaken during the conference.

1.2 Profile of South Asia

The eight countries of South Asia together have a total land area of 5,135,481 km2, with an estimated population of 1.79 billion. This is roughly equivalent to 4% of the world land area, and 24% of the world population. India, Pakistan and Afghanistan are the top three countries in terms of both area and total population. Among the countries, Sri Lanka and Maldives are island nations, in the Indian ocean. Afghanistan, Bhutan and Nepal are land locked countries. India, Bangladesh and Pakistan have coastal borders with Indian ocean.

Table 1 : South Asia - Demographic profile

Country	Land area Square KM	Population Million
Afghanistan	652,864	32
Bangladesh	147,570	168
Bhutan	38,394	0.7
India	3,287,469	1,327
Maldives	298	0.6
Nepal	147,181	30
Pakistan	796,095	208
Sri Lanka	65,610	22
Total	5,135,481	1,788

Source: Governments / statistical departments of respective countries[1]
Information is for 2020 for Bangladesh, and 2019 for all other countries

The macro-economic situation in the region also varies substantially. While India tops in terms of total GDP, it is smaller countries such as Maldives and Bhutan which have higher per-capita GDP and GDP growth. If viewed as a single entity, the region will be the fifth largest economy in terms of GDP, after USA, China, Japan and Germany. However, the region does not do substantial intra-regional trade when compared with other regional groupings. The intra-regional trade in South Asia was only 5.6%, when compared with 68.9% in Europe and 29.3% in ASEAN in 2019.[86]

The region also had performed well in GDP growth in the past years (~6%[87]), though the same had slowed down due to Covid-19. However, as per recent IMF forecasts, the emerging and developing economies of South Asia, covering South and South East Asia will bounce back with an average GDP growth of 8% by 2021.[88]

Table 2: South Asia - Macroeconomic profile

Country	GDP at current price US$ Billion	Per-capita GDP US$	Real GDP growth %
Afghanistan	18	555	4.03%
Bangladesh	329	1,970	5.24%
Bhutan	3	3,412	5.46%
India	2,635	1,986	6.80%
Maldives	6	10,541	7.00%
Nepal	32	1,085	2.28%
Pakistan	264	1,265	-0.38%
Sri Lanka	84	3,852	2.30%
Total	3,370	1,886	

Source: Governments / statistical departments of respective countries[2]
** The information relates to latest published sources, which is for FY20 for most countries, but for FY19 in the case of Afghanistan, Bhutan and Sri Lanka. Source: Governments / statistical departments of respective countries*

South Asia region has abundant natural resource and provides a significant opportunity to benefit from regional energy cooperation for its countries. Bulk of the hydropower potential is in India, Pakistan, Nepal and Bhutan. India also has the highest coal reserves in the region, and the largest renewable energy (solar and wind) potential. India, Bangladesh and Pakistan have substantial gas reserves also. There is also the case of Sri Lanka, where exploration activities are underway for oil and gas fields, and therefore there could be discoveries of proven reserves in the future.

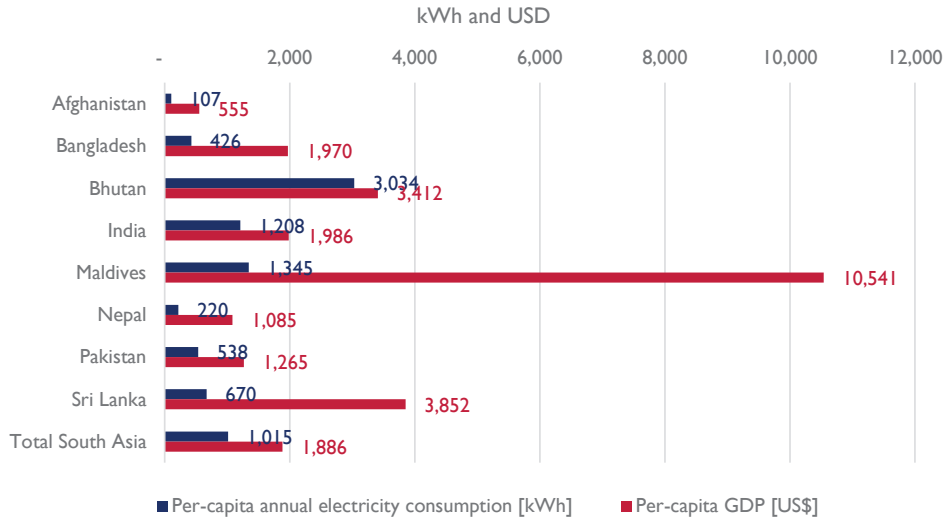
Table 3: Energy resource potential in South Asia

Resources Country	Coal Million Tonnes	Oil Million Tonnes	Gas Trillion Cubic Feet	Hydro GW	Renewable* GW
Afghanistan	400	45	4	23	68
Bangladesh	3,089	8	12	-	4
Bhutan	1	-	-	41	13
India	372,256	619	49	145	1445
Maldives	-	-	-	-	#
Nepal	<1	-	-	83	5
Pakistan	185,175	2	14	42	340
Sri Lanka	-	-	-	2	12

*Either resource is nil or value less than 0.5; # - No studies available on potential *Solar and Wind*
The information relates to multiple sources for the same country, which were not necessarily compiled in the same year
Source: BP Statistical Review, SAARC, Bangladesh Ministry of Petroleum, Investment Board of Nepal, Bhutan Statistical Bureau, Asian Development Bank, Central Electricity Authority, Bangladesh Power Division, Government of Myanmar, NIWE, India Ministry of Power, India Ministry of Statistics and Program Implementation[3]

The role of energy is very relevant to the socio-economic development of the South Asian countries. Countries with a better per-capita electricity consumption can also mostly be seen to have better per-capita GDP. If compared to the average for South Asia, Bhutan, India and Maldives can be seen to have better than average per-capita electricity consumption, and better than average per-capita GDP. However, there are also examples of countries such as Bangladesh and Sri Lanka which have a higher per-capita GDP in-spite of lower per-capita electricity consumption. The average per-capita consumption of the region is less than one third of the world average, which stands at 3300 kWh, as on 2018.[89]

Figure 1: Energy and economic linkages



Information relates to FY20 for Bangladesh, Nepal, Pakistan; and FY19 for others. Source: Government / utility statistics of respective countries[4]

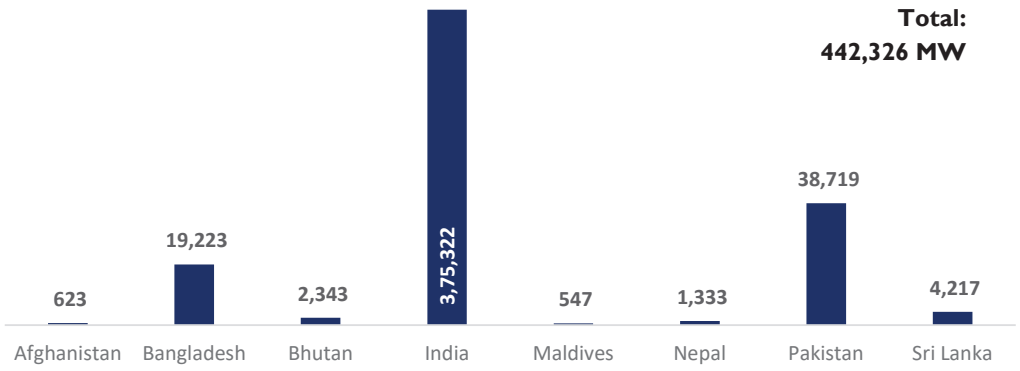
For the socio-economic development of South Asian countries, it is imperative to ensure access and availability of energy, especially in the form of electricity. However, in the quest towards improvement of energy access, the sustainability of incremental energy sources and energy infrastructure will also have to be considered. Considering the climate change impacts, energy security and energy affordability, energy sources and supply infrastructure will also have to be sustainable.

1.3 Overview of energy sector of South Asia

Electricity installed capacity and fuel mix

The total installed capacity of electricity generation in the region is 442 GW. Almost 85% of this capacity is located in India. After India, Pakistan and Bangladesh have the highest capacity respectively.

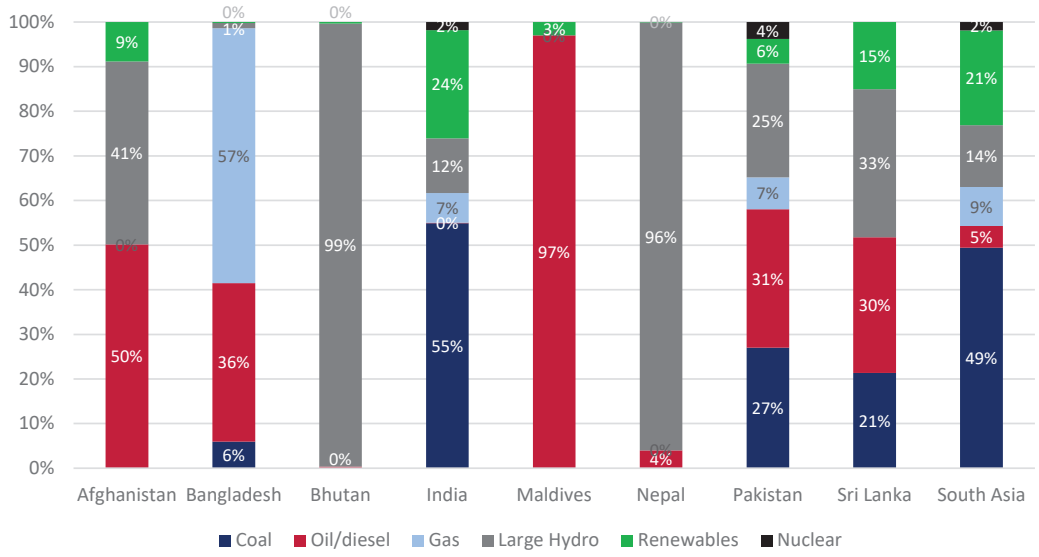
Figure 2: South Asia - Electricity installed capacity



** To avoid double counting and to consider only regional capacity, import capacity is not included. India's capacity is not shown to scale. Information relates to latest available data. Dec 2020 for India. FY20 for Nepal, Pakistan, Bangladesh. FY19 for Bhutan, Maldives, Sri Lanka. FY16 for Afghanistan.*
Source: Statistical departments / utilities of respective countries[5]

The individual countries vary substantially in the fuel mix. Bhutan and Nepal are almost entirely dependent on hydropower. Maldives is almost entirely dependent on oil based power generation. Dependence on gas is highest in the case of Bangladesh, whereas dependence on coal is highest in the case of India. In spite of these variations, due to India's large capacity, the overall fuel mix of South Asian electricity generation capacity closely tracks with that of India.

Figure 3: South Asia - Electricity fuel mix

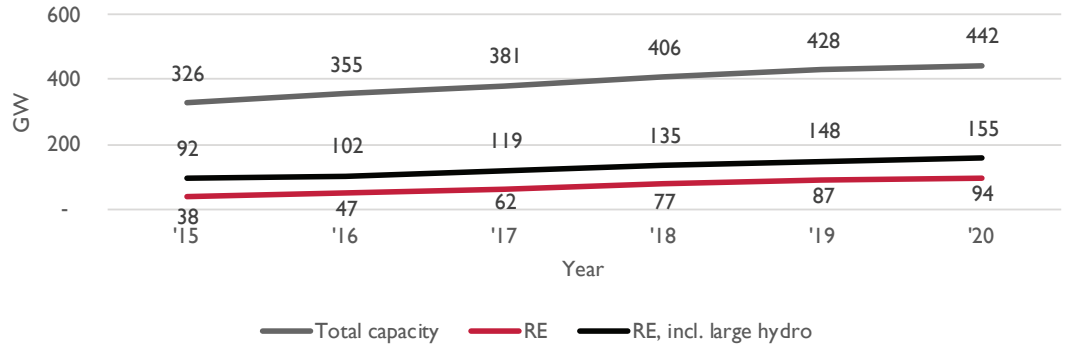


** For Pakistan, most gas plants are dual fuel enabled, and therefore distinction of gas and oil plants may not be reflective of actual fuel use scenario*

Information relates to latest available data. Dec 2020 for India. FY20 for Nepal, Pakistan, Bangladesh. FY19 for Bhutan, Maldives, Sri Lanka. FY16 for Afghanistan.
Source: Statistical departments / utilities of respective countries[6]

The region has come a long way in improving the installed capacity of renewable energy power plants. Between FY15 and FY20, while total installed capacity has increased at a CAGR of 6.3% in the region, the CAGR of renewable energy capacity was 19.7% (10.95% when large hydro is also included). This, in a way indicates the accelerated efforts of the South Asian countries in improving the share of sustainable energy in their electricity generation capacity.

Figure 4: Growth of RE capacity vis-a-vis total installed capacity in South Asia

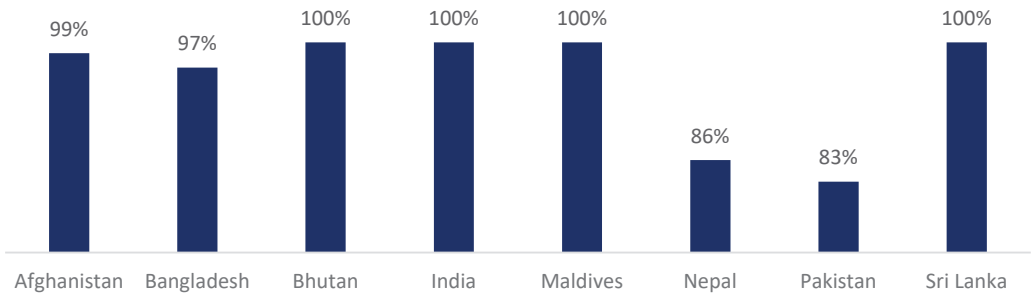


Information related to latest available data. Wherever data for FY/CY20 was not available (Afghanistan, Bhutan, Maldives, Sri Lanka), previous year's data has been extended.
Source: Statistical departments / utilities of respective countries[7]

Electricity access

Another important indicator is the access to electricity in each of the countries, in which almost all the South Asian countries have done a commendable job. Afghanistan, Bangladesh, Bhutan, India, Maldives and Sri Lanka have 100%, or near to 100% electricity access. Nepal's electricity access rate of 86% is considering access to grid electricity, whereas if off-grid electrification is also included, the access rate will be substantially higher.

Figure 5: South Asia - Electricity Access



** For Pakistan, village electrification rate is shown*
Source: Statistical departments / utilities of respective countries, The World Bank[8]

Use of traditional non-electric energy sources

In many of the countries, energy needs are met from traditional biofuels such as firewood. This is especially prevalent in countries such as Nepal and Bhutan. For example, in Nepal, 69% of the Total Final Energy Consumption (TFEC) was met from traditional fuels in 2019.[9]

Energy sector reform and market development initiatives etc.

Various South Asian countries are at varying stages of market reforms. All countries other than

Afghanistan has a separate regulatory authority for electricity. Bangladesh, India and Pakistan have also set up independent transmission companies to manage their national grid. However, only India has moved forward from the traditional single-buyer model. India also offers retail competition, though restricted to only certain consumer types and certain areas.

Figure 6: South Asia - Electricity market reforms

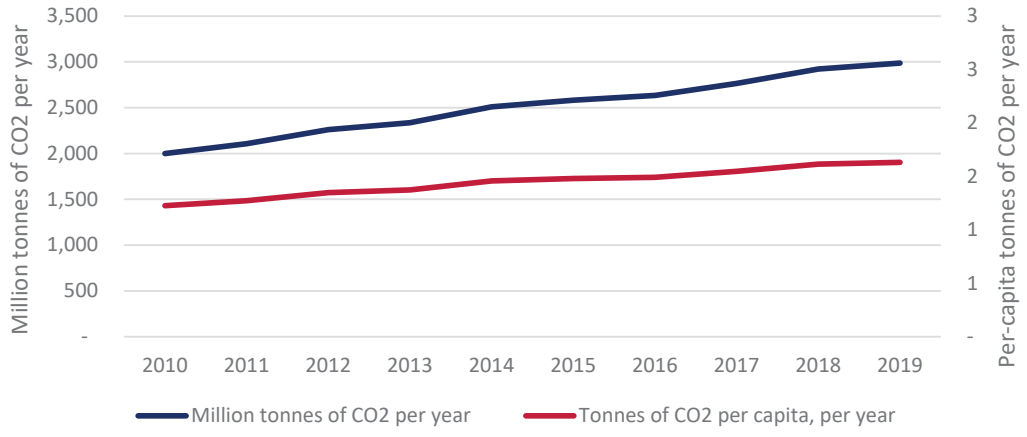
Country	Electricity regulatory commission / authority	Independent power transmission company	Removal of single-buyer models	Retail competition
Afghanistan	✗	✗	✗	✗
Bangladesh	✓	✓	✗	✗
Bhutan	✓	✗	✗	✗
India	✓	✓	✓	✓*
Maldives	✓	✗	✗	✗
Nepal	✓	✗	✗	✗
Pakistan	✓	✓	✗	✗
Sri Lanka	✓	✗	✗	✗

**Partial*

1.4 Challenges for development of sustainable energy in the region

The carbon emissions from the region continues to increase both in terms of total CO2 emissions and per-capita emissions. Between 2010 and 2019, the emissions have increased at a CAGR of 4.1% and per-capital emissions have increased at a CAGR of 2.9%. Even though the per-capita emission is still lower than developed countries by scales of magnitude (USA – 15.5, UK – 5.5 as compared to 1.6 in South Asia), the gradual year on year increase may still be a point to be tackled by the policy makers.

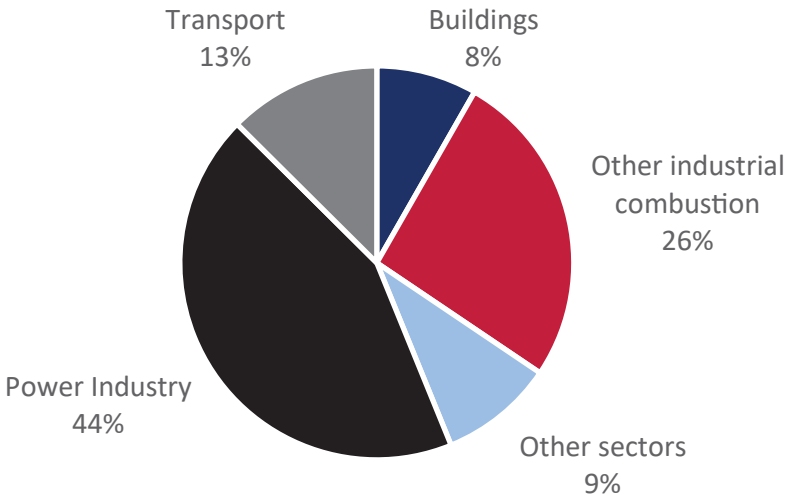
Figure 7: Total and per-capita carbon emissions in the region



Per-capita emissions of the region derived from the country wise total and per-capita emissions of the countries in the region.
Source: European Commission's Emissions Database for Global Atmospheric Research (EDGAR)[10]

Of the total emissions in the region, the majority (44% in 2019) is from power sector. Thus, it is imperative that any policy initiative for reduction in emission will have power sector as one of the key areas of focus.

Figure 8: Sector wise breakup of CO2 emissions, 2019



Source: European Commission's Emissions Database for Global Atmospheric Research (EDGAR)[11]

The South Asian countries have adopted targets under their Nationally Determined Contribution (NDC) under the UN Framework Convention for Climate Change (UNFCC) in terms of per-capita reduction, or reduction linked to economic activity. The NDC targets of South Asian countries are summarized below.

Table 4: Country wise NDC targets

Country	NDC target
Afghanistan	13.6% reduction in GHG emissions by 2030 compared to a business as usual (BAU) 2030 scenario, conditional on external support
Bangladesh	GHG reduction target of 15% (Unconditional – 10%, conditional upon external support – 5%) from a Business as Usual (BAU) level by 2030
Bhutan	Targets to remain carbon neutral where emission of greenhouse gases will not exceed carbon sequestration by the forests, which is estimated at 6.3 million tons of CO2
India	Reduce the emissions intensity of its GDP by 33 to 35 percent by 2030 from 2005 level
Maldives	Reduce unconditionally 10% of its Greenhouse Gases (below BAU) for the year 2030, which could be even 24% with external support
Pakistan	Reduce up to 20% of its 2030 projected GHG emissions subject to availability of international grants to meet the total abatement cost
Nepal	Separate sector wise activity targets
Sri Lanka	Reduce the GHG emissions against BAU scenario by 20% in the energy sector (4% unconditionally and 16% conditionally) and by 10% in other sectors (transport, industry, forests and waste) by 3% unconditionally and 7% conditionally by 2030

Source: NDC of respective countries[12]

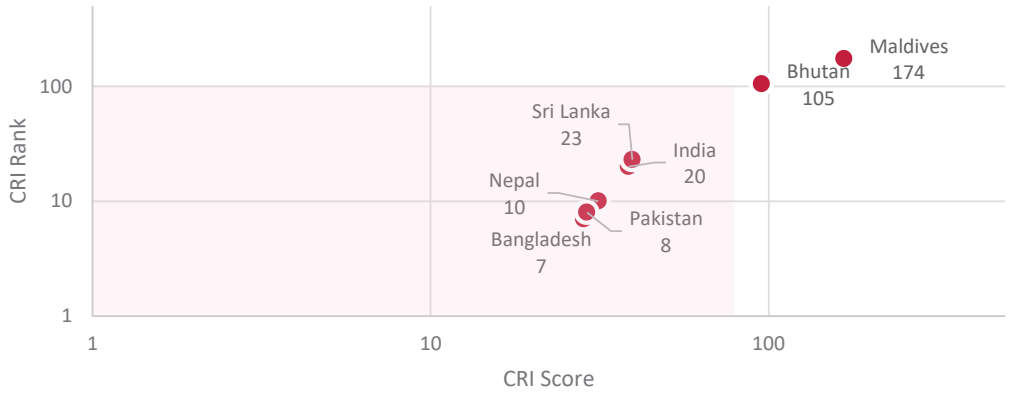
1.5 Climate change impacts and sustainability of the region

South Asia is a region which is highly vulnerable to adverse impact of climate change. Maldives and Sri Lanka are islands, which get directly impacted due to rising sea levels. Bangladesh, India, and Pakistan also have long coast lines. Even the landlocked countries of Nepal and Bhutan are in the ecologically sensitive Himalayan region, where the risk of impact of global warming, though melting of snow is higher.

The countries are also witnessing increased incidences of climate related extreme events, The Germanwatch Global Climate Risk Index (CRI) indicates a level of exposure and vulnerability to extreme events, which countries should understand as warnings in order to be pre-pared for more

frequent and/or more severe events in the future. As per this index, five South Asian countries – Bangladesh, Pakistan, Nepal, India and Sri Lanka come within the initial 30 rankings out of 180, indicating a higher incidence of extreme climate related incidents in these countries.

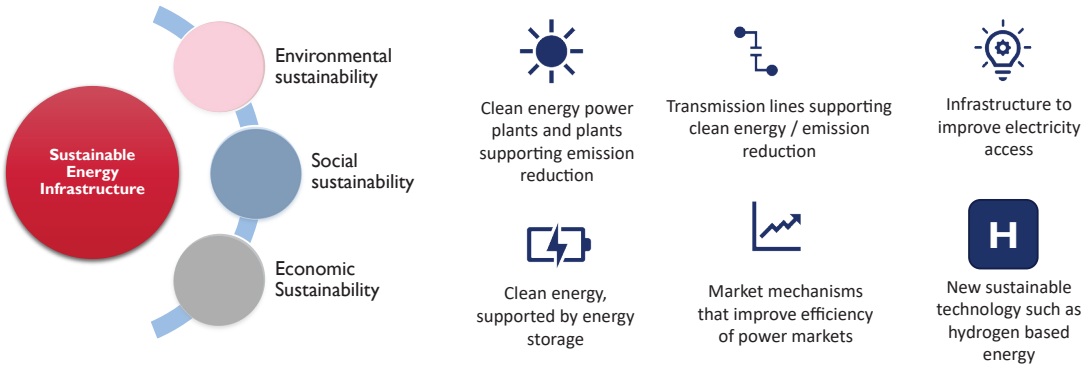
Figure 9: Climate Risk Index ranking (2000-2019) of South Asian countries



Dots in shaded background indicates higher number of climate related incidents *Source: Germanwatch Global Climate Risk Index*[13]

This is where the role of sustainable energy infrastructure comes in. Along with traditional clean power, there are emerging areas such as hydrogen based energy generation, off-river closed loop hydro power plants (pumped storage mode) and large capacity wind power plants. In addition, by sustainable energy infrastructure, we mean not merely the sustainable electricity generation resources, but also the supporting ecosystem, such as dedicated evacuation systems that enable renewable energy transmission. Another example is a power plant that helps in reducing the overall emissions of a country, though not necessarily a renewable energy power plant (example: clean coal based power plant) can also count as sustainable energy infrastructure.

Figure 10: Sustainable energy infrastructure



The above is important, as different countries in the region are at different levels of sustainability, in their development journey. As per the Sustainability Development Report, 2020 prepared based on achievement of Sustainability Development Goals, all the South Asian countries have a rank of 80 or above, out of 166.

Figure 11: Sustainability Ranking based on Sustainable Development Goals

Country	2020 SDG Index Score	2020 SDG Index Rank	Goal 6: Clean water and sanitation	Goal 7: Affordable and clean energy	Goal 9: Industry, innovation and infrastructure
Bhutan	69.27	80	Red	Yellow	Red
Maldives	67.59	91	Orange	Green	Orange
Sri Lanka	66.88	94	Red	Red	Red
Nepal	65.93	96	Red	Red	Red
Bangladesh	63.51	109	Red	Orange	Red
India	61.92	117	Red	Red	Red
Pakistan	56.17	134	Red	Red	Red
Afghanistan	54.22	139	Red	Orange	Red

Legend

2020 score			
Green	Goal Achievement	Orange	Significant challenges
Yellow	Challenges remain	Red	Major challenges

The Sustainability Development Goals are not limited merely to environmental aspects, but also looks at coverage and affordability of those services. For example, Goal 7 on Affordable and clean energy refers to "Ensure access to affordable, reliable, sustainable and modern energy for all."

This includes sub-indicators such as share of RE as part of total energy consumption, access to clean cooking fuels, CO2 emissions and access to electricity. Therefore, mere adoption of increased RE need not necessarily result in a favorable SDG achievement indicator

Source: Sustainability Development Report [14]

While the countries can develop policies to develop sustainable energy infrastructure on their own, there could also be synergies at the regional level, which can be exploited through regional cooperation. This aspect is further discussed in detail in the next chapter.

2. Prospects for sustainable regional energy infrastructure development, deepening regional energy cooperation and accelerating the sustainable cross border energy trade

2.1 Current status of Sustainable regional energy infrastructure development and CBET in South Asia

Sustainable regional infrastructure

Regional electricity generation infrastructure

There are various sustainable regional energy infrastructure already developed in South Asia. The most prominent of them are the hydropower plants developed in Bhutan, with India's assistance, that export most of their power to India. These plants were fully financed by India, including a high share of grant financing. Since India agrees to offtake power from these plants, financial closure of these plants was also easier to achieve. While these plants serve as a key revenue source for Bhutan, for India they provide a source of clean power.

Table 5: India-Bhutan hydropower cooperation

Hydropower plant	Chukkha Hydro power plant (HPP)	Kurichhu HPP	Tala HPP	Mangdhechu HPP
Capacity	336 MW	60 MW	1020 MW	750 MW
Financing	60% grant and 40% loan from India	60% grant and 40% loan from India	60% grant and 40% loan from India	30% grant and 70% loan from India

Source: Government of India[15]

While the above examples are more widely known, there is another regional energy project between India and Bhutan which was commissioned before these plants. The 27 MW Jaldhaka power generation project is situated on the Indian side of Indo-Bhutan border in West Bengal, while the barrage and catchment area are in Bhutan side. The plant was constructed under the 1961 Jaldhaka Agreement between Bhutan and India. The major part of power produced at Jaldhaka hydropower plant was exported to southern Bhutan.[16]

Similarly, there is the case of India's Tanakpur barrage, with 120 MW of hydropower generation capacity. A portion of the barrage is located in Nepal's territory, which is allowed to be used in lieu of assurance on water sharing and supply of 70 GWh of free power annually.

Sustainable energy infrastructure within the countries

Within the respective countries, many of the South Asian countries have built sustainable energy infrastructure. Even though these are not directly related to regional use, or regional trade, their presence and use does contribute immensely to the sustainability of the South Asia region as a whole.

For example, India has developed over 91 GW of renewable energy capacity, consisting of solar, wind, small hydro and biomass resources.[17] Along with avoiding emissions, such a large renewable energy capacity also provides a potential chance for their regional use, such as cross border trade of renewable energy.

Pakistan has developed 2.1 GW of renewable energy capacity, inclusive of 1,248 MW wind and 530 MW solar capacity. [18]

Other countries are also taking efforts of similar nature. Afghanistan has 55 MW of renewable energy projects, including a 15 MW solar power plant in Kandahar.[19] Bhutan has 8.5 MW of renewable energy capacity[20], while Bangladesh has 38 MW.[21] Maldives have taken initiatives to gradually increase the use of solar power in its islands, such as the 1.5MW Hulhumalé solar rooftop project.[22] In Nepal, recently, a 10 MW solar power plant was commissioned in Dhalkebar.[23] Sri Lanka has 636 MW of renewable energy power plants. [24]

Regional electricity transmission infrastructure

Various high voltage cross border electricity transmission lines have been developed in South Asia, which are used to support bilateral power trade arrangements. These are not necessarily limited to lines for transmitting clean power. For example, power from thermal power plants is also utilized by India for export to Nepal and Bangladesh. However, such power still has significance in terms of social sustainability, by improving the availability of electricity to the population in respective countries, as well as lesser emissions per unit of generation, on account of operation of the existing thermal power plants more efficiently, because of better utilization of the existing power plants.

The key transmission lines of 400 KV and above are as below:

Table 6: Key regional transmission infrastructure

Countries involved	High voltage transmission line (400 KV and above)	Primary purpose	Financing and implementation modalities
Bhutan - India	400 KV Tala HEP - Siliguri (Two lines) and 400 KV Malbase – Siliguri (LILO of one of the Tala – Siliguri lines) 400 KV Jigmeling – Alipurduar	Primarily used to evacuate power from hydropower plants of Bhutan to India	Tala evacuation: Line within Bhutan financed along with the generation component. Line in India developed by a PPP arrangement between Power Grid Corporation of India Limited (PGCIL) and Tata Power. Jigmeling-Alipurduar: Bhutan portion developed by Bhutan Power Corporation (BPC). India portion developed by PGCIL.
India – Nepal	400 KV Dhalkebar-Muzzafarpur line	Primarily used for import of power from India to Nepal, allowing improved electricity availability in Nepal	`Joint venture of Indian and Nepali companies formed in both countries, with each JV taking care of financing and construction of line within respective country's territory.

India - Bangladesh	400 KV Bheramara – Baharampur HVDC (2x500 MW)	Primarily used for import of power from India to Bangladesh, allowing improved electricity availability in Bangladesh	Indian side financed and built by Power Grid Corporation of India Limited (PGCIL) Bangladesh side financed by ADB and Government of Bangladesh, and built by Power Grid Company of Bangladesh (PGCB)

Source: SARI/EI[25]

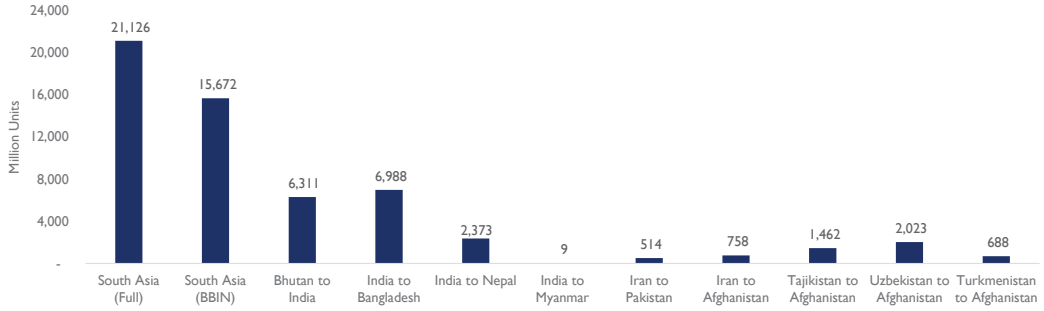
Regional oil and gas pipelines

A petroleum pipeline between Motihari in India and Amlekhgunj in Nepal was commissioned in 2019. The 69 km pipeline, with a capacity of 2 million metric ton per annum, was planned to provide cleaner petroleum products at cheaper cost to the people of Nepal. Of the total length, 33 KM was in India and rest in Nepal. The countries financed and constructed the project elements within their respective territories. The pipeline facilitates reduction in number of fuel tankers carrying fuel from India to Nepal by road.

Cross border electricity trade

CBET in South Asia is focused majorly within the BBIN (Bhutan, Bangladesh, India, and Nepal) sub-region in the east, and between Central Asia and Pakistan / Afghanistan in the east. The annual overall power trade between these countries presently is approximately 21,126 MU. If converted to MW on round the clock basis, this corresponds to a capacity of 2412 MW. However, actual capacity could be higher, as power trade is not on a constant round the clock basis. The sum of maximum power trade between Bhutan-India, India-Nepal and India-Bangladesh itself is nearly 3500 MW, as on 2020.

Figure 12: CBET within South Asia



India and Pakistan data are for 2020. Afghanistan import is for 2019. Source: POSOCO, NEPRA, NSIA[27]

CBET occurs through the various power grid interconnections present between the trading countries. The current status of these interconnections is shown below:

Table 7: Status of power grid interconnections

Countries	Power grid interconnection	Nature of power trade
India – Nepal	One 400 KV line, and multiple lines at 132 KV and lower voltages connected under synchronous mode. This includes: • 400 KV D/c Dhalkebar-Muzzafarpur line • 132 KV lines: Kataiya – Duhabi, Raxaul-Parwanipur, Kataiya-Kushaha, Gandak East – Gandak/Surajpura, Tanakpur – Mahendranagar	On an annual net basis, power is imported by Nepal from India. The line can also support export of seasonal surpluses from Nepal to India. Net export from India to Nepal in April 2019 to March 2020 was 2373 MU.[28]

India – Bangladesh	Primarily connected through an HVDC link. However there is also another AC interconnection at 132 KV. • 400 KV Bheramara – Baharampur HVDC (2x500 MW) • 132 KV Surjyamaninagar - South Comilla AC line	Bangladesh buys power from India under medium and long term PPAs. Net export from India to Bangladesh in April 2019 to March 2020 was 6988 MU. [29]
India – Bhutan	Multiple lines at 400 KV, 220 KV, 132 KV and lower voltages connected under synchronous mode. This includes: • 400 KV Tala HEP - Siliguri (Two lines) • 400 KV Malbase – Siliguri (LILO of one of the Tala – Siliguri lines) • 400 KV Jigmeling - Alipurduar • 220 KV Chukha HEP – Birpara • 220 KV Malbase - Birpara • 132 KV Geylephu – Salakati • 132 KV Deothang – Rangia	Net export from hydro power plants in Bhutan to India on an annual basis. However, during dry season when river flows reduce due to low temperature, there is import of power from India. Net export from Bhutan to India in April 2019 to March 2020 was 6311 MU. [30]
Iran – Pakistan	• 132 KV Sistan Baluchistan (Iran) - Mend • 20 KV Mir Jawa - Saravan 2 lines	Import of power, from Iran
Central Asia - Afghanistan	Iran – Afghanistan 132 KV Iran - Afghanistan • Tajikistan - Afghanistan • 220 KV Sangtuda (Tajikistan) - Pul-i Khumri (Afghanistan) • Turkmenistan - Afghanistan • 220 KV Turkmenistan - Afghanistan • Uzbekistan – Afghanistan • 220 KV Uzbekistan - Afghanistan	Import of power from Iran, Tajikistan, Turkmenistan and Uzbekistan

India – Bangladesh

Bangladesh Power Development Board (BPDB) imports power from India through the Indian trading entities PTC India and NTPC Vidyut Vyapar Nigam Ltd. (NVVNL). The supply has commenced from October 2013 after completion of Bheramara (Bangladesh)–Baharampur (India) 400 KV HVDC transmission link between India and Bangladesh. The initial line capacity of 500 MW was later enhanced by adding an additional line, to 1000 MW. There is also a 132 KV transmission line from Tripura in India to Bangladesh, through which nearly 160 MW of power is imported by Bangladesh.

Bhutan – India

Various power plants were developed by Bhutan under Inter-governmental arrangements with India, including 336 MW Chukha HPP, 60 MW Kurichhu HPP, 1020 MW Tala HPP and 750 MW Mandhechu HPP. There is also a 126 MW Dagachhu HPP in Bhutan, which is a PPP with private investment from one of India's private sector generation companies.

The cooperation between India and Bhutan in the Hydropower sector is covered under the 2006 Agreement on Cooperation in Hydropower and the Protocol to the 2006 agreement signed in March, 2009. Under this Protocol, Government of India has agreed to assist Royal Government of Bhutan in developing a minimum of 10,000 MW of hydropower and import the surplus electricity from this to India by the year 2020. Currently, there are two Inter-Governmental (IG) model HPPs - 1200 MW Punatsangchhu-I and 1020 MW Punatsangchhu-II under implementation. The 720 MW Mangdechhu which is also under this protocol has already been commissioned.

In April 2014, an Inter-Governmental Agreement was signed between India and Bhutan for development of four more HEP's of capacity 2120 MW (600 MW Kholongchhu, 180 MW Bunakha, 570 MW Wangchhu and 770 MW Chamkharchhu) under the Joint Venture Model. These projects will have both the JV partners owning 50:50 shareholdings each in the JV- company. Debt-equity ratio would be 70:30, with equity shared equally between JV partners. Further, India is providing Druk Green Power Corporation's (Bhutanese) share of equity as grant.[31]

India - Nepal

On February 2016, the 400 KV Dhalkebar (Nepal) - Muzaffarpur (India) was commissioned. There are also multiple 132 KV cross border lines. The import of power by Nepal from India is under various bilateral treaties / contracts under Government-to-Government mode, and a few commercial PPAs through Indian power traders.

Iran – Pakistan

Pakistan has been importing electricity from Iran since October 2002. However, the quantum has remained restricted, especially as the transmission capacity is also limited.

Central Asia – Afghanistan

Afghanistan imports power from Iran, Tajikistan, Turkmenistan and Uzbekistan, using 132 KV and 220 KV transmission lines. These imports serve almost 80% of the electricity requirements of the country.

2.2 Future plans for electricity and gas grids and regional energy markets

Regional power plants and power trade

Total CBET in South Asia is expected to increase significantly over the next decade with several governments/utilities having identified projects and plan to develop them with a focus on future CBET. This includes the following:

- Under an intergovernmental agreement, Government of India has agreed to assist Royal Government of Bhutan in developing a minimum of 10,000 MW of hydropower and import the surplus electricity from this to India.[32]
- Bhutan has identified 1125 MW Dorjilung HPP as one of the potential power plants for supply to Bangladesh.[33]
- India already exports close to 1200 MW of power to Bangladesh.
- India has agreed to import power from the 900 MW Arun-III hydropower project in Nepal. This is one of the largest FDI projects in Nepal.
- Bangladesh has agreed to import 500 MW of power from the 900 MW Upper Karnali hydropower project in Nepal. Considering the involvement of Indian developer, rest of the power may be considered to be off taken in India. Bangladesh's PSMP envisages new import of 1496 MW in 2022, and additional 4500 MW of import between 2023 and 2035, and another 4500 MW of import between 2036 and 2041.
- Under the CASA-1000 project, Tajikistan and Krygystan will supply power of up to 1000 MW to Pakistan and 300 MW to Afghanistan.

There have also been discussions on cross border renewable energy trade, such as potential purchase of solar power by Bangladesh from India.[34] A study of National Renewable Energy Laboratory (NREL) assessed the possibility of supplying 1000 MW of renewable energy from southern part of India to

Bangladesh, and concluded that the same is feasible without any major adverse implications, while allowing Bangladesh to reduce generation costs and emissions.[35]

To support CBET in future, new power grid interconnections are also being planned in the region. Following are the proposed CBET interconnections that are expected to be developed:

1 **India – Bhutan**

- Punatsangchu HEP – Alipurduar 400 KV Double Circuit (D/c): 170 km
- Alipurduar – Siliguri 400 KV D/c line and Kishanganj – Darbhanga 400 KV D/c line

2 **India – Nepal**

- 400 KV New Butwal-Gorakhpur
- 400 KV evacuation lines for export oriented hydropower plants such as Arun-III and Upper Karnali

3 India – Bangladesh

- 765 KV Bornagar (India NER) – Parbotipur (Bangladesh) – Katihar (India ER)

4 India – Sri Lanka

- Undersea HVDC cable or overhead transmission line, from Madurai in India to Anuradhapura in Sri Lanka, with a planned capacity of up to 1000 MW

5 Central Asia - Afghanistan

- 500 KV CASA-1000 network from Tajikistan and Krygystan to Pakistan, through Afghanistan. Proposed capacity of up to 1300 MW.

A SARI/EI analysis estimated that the capacity of cross border interconnections in the South Asian region will be up to 43.8 GW by 2036-2040. [90]

Oil & Gas

New cross-border cooperation initiatives are also planned in the oil and gas sectors where initial agreements/MoUs among the countries have been initiated. Some of the key developments in the region include:

1. India – Bangladesh
   The construction of 130 KM India – Bangladesh Friendship Pipeline Project was jointly inaugurated by the Prime Ministers of Bangladesh and India on September 2018. Once completed, the pipeline will transport refined diesel from India to Bangladesh.

2. India – Nepal
   A Joint Working Group on cooperation in the oil and gas sectors is considering advancing cooperation in areas such as the construction of a LPG pipeline from Motihari to Amlekhgunj and the construction of a natural gas pipeline from Gorakhpur to Sunwal.

3. Turkmenistan-Afghanistan-Pakistan-India (TAPI) pipeline
   The Turkmenistan-Afghanistan-Pakistan-India natural gas pipeline (TAPI) is planned to transport natural gas from Turkmenistan to Afghanistan to Pakistan and finally to India. The 1,735-kilometer pipeline will run from the Daulatabad gas field in Turkmenistan to Afghanistan.

2.3 Key drivers for sustainable regional energy infrastructure development and CBET in South Asia

Access to electricity and demand-supply gap

When a country's domestic power generation system is inadequate to meet the electricity requirements of the country, the countries often seek to import power from other countries in the region. This has been the key driver of major cross border electricity trade in South Asia such as:

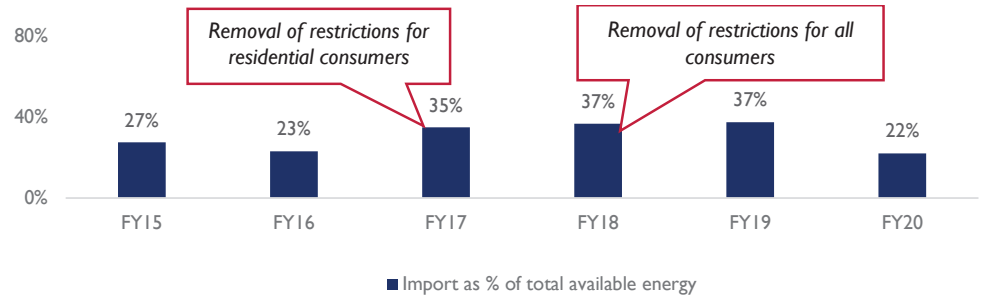
- Import of electricity from India to Nepal;
- Import of electricity from India to Bangladesh;
- Import of electricity from Iran to Pakistan; and
- Import of electricity from Iran, Tajikistan, Turkmenistan and Uzbekistan to Afghanistan.

A low access to electricity offers potential for regional energy cooperation, including:

- Import power from other countries in the region, if access issue is related to power deficit;
- Extend the grid from other countries in the region, if access issue is related to difficulties in accessibility in border areas; and
- Access financial assistance from other countries in the region, if access issue is related to financial difficulties.

One of the best examples is the case of Nepal wherein increased electricity imports have resulted in withdrawal of electricity load restrictions to all categories of consumers. Till 2017, there were electricity shortages, due to which supply was curtailed for up to four hours every day for all consumers. The commissioning of 400 KV Dhalkebar-Muzaffarpur transmission line in February 2016, though charged at a lower voltage, enabled increase of electricity imports from India. In 2017, the restrictions on residential consumers were removed. During 2018, planned curtailments for all categories of consumers were removed.

Figure 13: Nepal - Electricity import from India

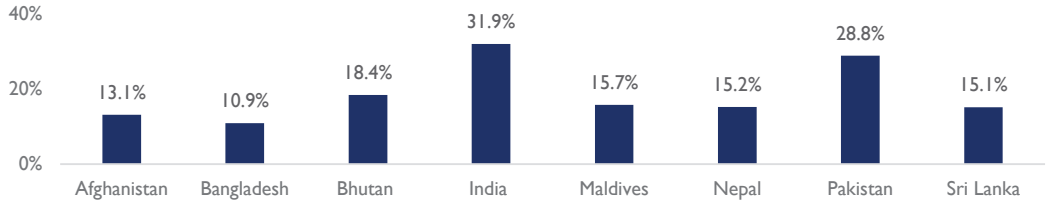


Source: Nepal Electricity Authority[36]

High and growing dependence on fossil fuel import

Most of the South Asian countries, barring Bangladesh are heavily dependent on import of fossil fuels for their energy and transportation needs.

Figure 14: Fuel imports as % of merchandise imports



India and Pakistan information relates to 2019. For rest of the countries last available data is used, which is 2018 for Afghanistan and Madlives, 2017 for Nepal and Sri Lanka, 2015 for Bangladesh

Source: World Bank World Development Indicators[37]

These imports are on a rising trend for most of the countries. Regional energy cooperation allows South Asian countries to avoid at least a portion of their fossil fuel imports by switching to non-fossil fuel generation such as wind, solar and hydropower. India's support to Bhutan for setting up multiple hydropower plants in Bhutan, for eventual power export to India is a case in example.

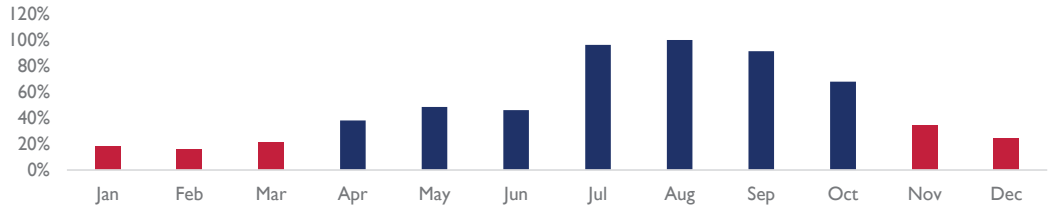
Demand diversity and resource complementarity

It is also in the interest of energy security and flexibility to have a country's power produced from multiple sources / fuels. Presence of a regional grid allows the countries to access power even from resources that it lacks domestically.

For example, Bangladesh imports power from India's coal power plants, while it lacks its own coal mines. India buys or plans to buy hydropower from large hydro power plants located in Bhutan and Nepal respectively, as it finds difficult to construct new large hydro power plants in its territories due to environmental and social issues.

In countries such as Nepal and Bhutan, during winter season the water sources freeze resulting in reduction of generation from hydropower sources. In comparison, in countries such as India, demand is lower in winter season, therefore leaving enough excess generation for trade with hydro dependent countries.

Figure 15: Average PLF of Bhutan's major hydro power plants in 2019



Source: Bhutan Power System Operator[38]

Climate change and need for sustainable power sector development

In line with global shift towards sustainable energy and climate friendly policies, South Asian countries have also made policy commitments for adoption of green energy. At the same time, not all the countries have adequate resources to develop such green generation resources. This leads to the possibility of utilization of cross border trade for access to green power. For example, India finds it difficult to develop new large hydropower plants in its territory. Therefore, it has helped to construct export oriented hydro power plants in Bhutan and Nepal. On the other hand, the large capacity of solar and wind power plants in India provides a chance for neighbouring countries such as Bangladesh to buy power from such plants, rather than waiting to develop similar resources in their country.

News report: Bangladesh plans to buy 2000MW solar power from India

"Bangladesh wants to buy at least 2,000MW of solar power from India to meet the growing demand of electricity in the country. The power will be bought from large solar power projects coming up in Gujarat and Rajasthan states, reports the Livemint quoting Prime Minister's Energy Adviser Tawfiq-e-Elahi…"

Source: Dhaka Tribune (18 April 2018), Bangladesh plans to buy 2000MW solar power from India - https://www.dhakatribune.com/bangladesh/power-energy/2018/04/18/bangladesh-plans-buy-2000mw-solar-power-india

Synergies in power system development and operation and renewable energy integration and regional grid balancing

South Asian countries have synergies in power system development, operation, RE integration and regional grid balancing. The geographically interconnected region allows rerouting of new high capacity transmission lines through another country if there are right of way / other issues in direct point-to-point connection. This is already being explored in the case of 'India – Bangladesh power corridor', which is reported to be able to transport 6000 MW of power from India's North East to Bangladesh and Indian load centres.

On the other hand, the currently RE rich countries like India do not have adequate storage hydro plants in their domestic energy mix, as well as inadequate incentives for use of the existing domestic gas sources for grid balancing,. This presents the possibility of utilization of storage based hydro power plants in countries like Nepal, and Bhutan; and gas power plants in countries like Bangladesh for RE integration through regional grid balancing. In addition, there is also the possibility of utilizing India's over 25 GW of gas power capacity which is currently underutilized due to lack of adequate domestic gas sources in India. If regional mechanisms can be developed to supply gas from Central Asia at a cheaper rate, even these plants can be utilized.

There are already established global models in similar regional grid balancing for RE integration, in the case of Denmark and Norway, where Norway's hydro power plants are utilized to balance Denmark's wind power capacity. Similar models in South Asia are expected to become a key driver of regional energy cooperation.

Clean and sustainable energy technology transfer

With new technologies such as smart grid, electric mobility and electricity storage moving from technology demonstration phase to commercial implementation, there is scope for energy technology transfer as one of the drivers of regional cooperation. This could vary from sharing of best practices to supporting the implementation of commercial scale projects. Most of these new technologies support clean and sustainable energy sources.

One of the best examples of such technology transfer is the case of Rooppur Nuclear Power Plant which is under construction is in Bangladesh. Even though the plant is of Russian technology, and being built by Russian companies, the fact that similar technology was deployed and commissioned successfully in India's Kudankulam Nuclear Power Plant was a key point of comfort for the Bangladesh. In fact, as per a deal signed in 2018, even Indian companies are involved in some of the non-critical parts of the plant construction.91

Clean and sustainable energy technology research and development

South Asian countries can undertake joint research and development of new energy technologies, which could act as an enabler of regional cooperation. This could be on topics that are relevant to the region, such as clean coal, sustainable hydropower, and renewable energy integration. The national research institutions and SAARC Energy Center can collaborate with each other on areas of interest.

Regional political stability and welfare

Regional energy cooperation has geostrategic implications, and often has interlinkages with political stability and peace. In regions where relations between the countries are not cordial, it is difficult to start or sustain energy cooperation. On the other hand, almost all the well-established examples of regional energy cooperation have the underlying factors of regional stability and peace as one of the enablers and drivers, be it European Union, South African Power Pool or Gulf Cooperation Council.

In the South Asian region, though there is an east-west divide, within eastern and western regions, the international relations are cordial. Member States with a history of political unrest such as Nepal and Sri Lanka have also now become more stable. This aspect can serve as a key driver of regional energy cooperation, and serves as an opportunity for strengthening the cooperation.

2.4 Potential benefits of sustainable regional energy infrastructure development and CBET in South Asia Sustainability

Technical and operational benefits

Access to wider range of generation resources

It is in the interest of energy security and flexibility to have a country's power produced from multiple sources / fuels. Presence of a regional grid allows the countries to access power even from resources that it lacks domestically.

Figure 16: Dominant fuel sources in domestic electricity generation capacity of South Asian countries

Afghanistan	Bangladesh	Bhutan	India	Maldives	Nepal	Pakistan	Sri Lanka
Oil – 50%	Gas – 57%	Hydro – 99%	Coal – 55%	Oil – 97%	Hydro – 96%	Oil – 31%	Hydro – 33%
Hydro – 41%	Oil – 36%		Hydro & renewables – 12% and 24%			Coal and hydro – 27% and 25%	Coal and oil – 21% and 30%

Information relates to latest available data. Dec 2020 for India. FY20 for Nepal, Pakistan, Bangladesh. FY19 for Bhutan, Maldives, Sri Lanka. FY16 for Afghanistan.

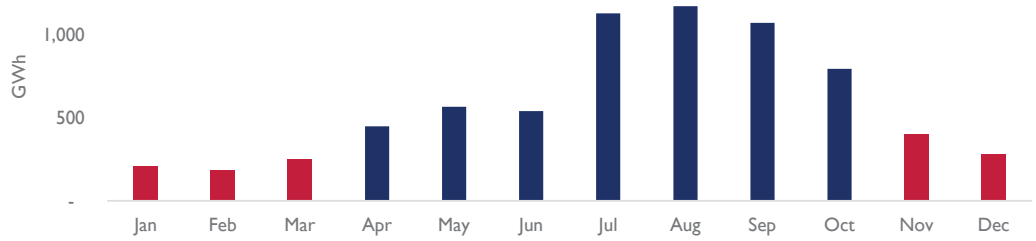
** For Pakistan, most gas plants are dual fuel enabled, and therefore distinction of gas and oil plants may not be reflective of actual fuel use scenario Source: Statistical departments / utilities of respective countries*

For example, Bangladesh imports power from India's coal power plants, while it lacks its own coalmines. India buys or plans to buy hydropower from large hydro power plants located in Bhutan and Nepal respectively, as it finds difficult to construct new large hydro power plants in its territories due to environmental and social issues.

Seasonality of generation in hydropower dependent countries

In countries such as Nepal and Bhutan, during winter season the water sources freeze resulting in reduction of generation from hydropower sources. In comparison, in countries such as India, demand is lower in winter season, therefore leaving enough excess generation for trade with hydro dependent countries.

Figure 17: Generation profile of Bhutan's major hydro power plants in 2019



Source: IRADe analysis, based on PLF data from Bhutan Power System Operator

Difference in time zones

Due to the difference in time zones, there is a diversity in the exact time of peak demand among the SAARCs. This offers the possibility of meeting peak demand with less peak generation capacity coupled with CBET, instead of each country trying to meet peak demand entirely on its own.

Figure 18: Time zones in South Asia

Pakistan	Maldives	Sri Lanka	India	Nepal	Bangladesh	Bhutan
GMT + 5:00	GMT + 5:00	GMT + 5:30	GMT + 5:30	GMT + 5:45	GMT + 6:00	GMT + 6:00

Optimum alignment of transmission lines

In some countries, geographic factors might limit the possibility of new transmission lines between two locations, which can be solved by routing the line through nearby countries, if there was a regional grid.

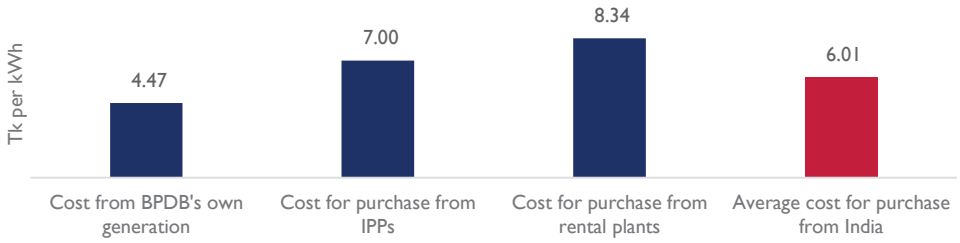
For example, India has been facing difficulties in planning new transmission lines from large hydropower plants being planned in its northeast region, to major load centres. However, India's north east region and rest of its mainland is connected by a narrow corridor, with a width of only 22 KM. A solution being explored is the routing of lines instead through Bangladesh, which will also help Bangladesh in importing power.

Economic and financial benefits

Cheaper power

With CBET, it becomes possible for countries to access cheaper generation sources in neighbouring countries rather than increasing reliance on fossil fuels. A case in example is Bangladesh. The cost for import of power from India in FY20 was 14% cheaper than the cost of power purchased from IPPs.

Figure 19: Difference in cost of power purchase from various sources, FY20



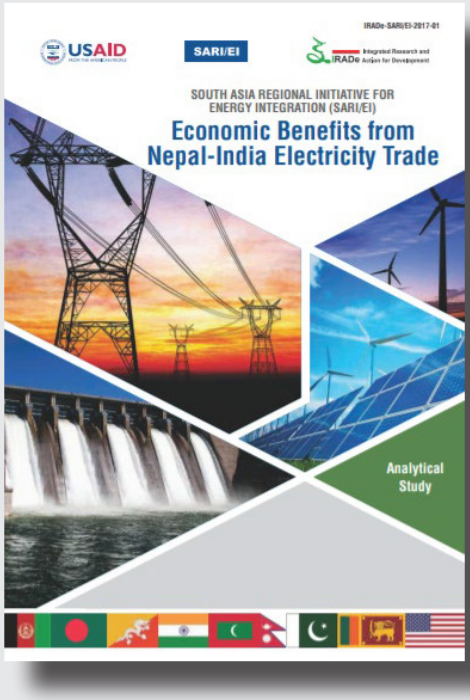
Source: BPDB[39]

SARI/EI studies on economic benefits of cross border electricity trade

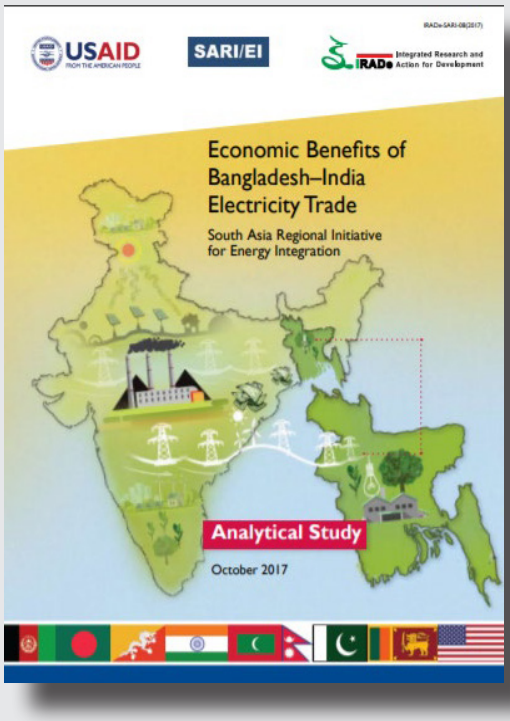
There are separate detailed studies undertaken by SARI/EI on economic benefits of India-Nepal and India-Bangladesh CBET, which describe in more detail about the macroeconomic impacts, including increase in GDP, inflow of foreign exchange and per capita electricity consumption.

As per these studies, Nepal-India electricity trade is expected to improve Nepal's GDP by 39%, by 2045; and reduce India's CO2 emissions by 5.4%. Similarly, Bangladesh-India electricity trade is expected to reduce power purchase costs of Bangladesh, and to increase foreign exchange inflow for India.

For more details, please refer to the following studies:



SARI/EI (2017), Economic benefits of Nepal-India Electricity Trade

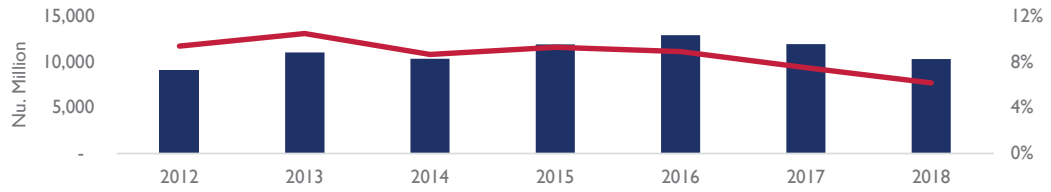


SARI/EI (2017), Economic benefits of Bangladesh-India Electricity Trade

Foreign exchange revenue

A regional power grid allows SAARC countries with surplus electricity to sell to other countries that require such energy, in a commercially profitable manner. One of the best illustrations of such a trade is the sale of hydropower from Bhutan to India. Revenue from power exports of Bhutan is estimated to be in the range of 6-10% of its GDP during 2012-2018.[0 41]

Figure 20: Share of revenue from electricity export in Bhutan's GDP



Source: National Statistics Bureau and Ministry of Economic Affairs[42]

Economic extension of grid

In border areas, it might be economical to supply power from a neighbouring country instead of extending the domestic grid over large distance and rough terrain.

Environmental benefits

Potential for large-scale hydropower plants in countries like Bhutan, and Nepal, coupled with demand for large-scale clean power in India and Bangladesh.

In densely populated countries like India, it is no longer possible to plan for new large hydro power plants without risking large-scale population displacement and ecological impacts. In comparison, countries like Bhutan, and Nepal offers possibility of setting up large-scale export oriented hydro power plants, which can meet the requirement of clean energy for India, Bangladesh etc.

Similarly, Bangladesh has constraints on land for utilization of solar power, thereby providing a possibility of import of solar power from neighbouring countries.

Sharing of variable generation source at regional level, for system balancing under high rates of RE penetration

Hydropower plants with large reservoirs are utilized as a balancing source in regions with high share of renewable energy, such as Denmark and Norway. However, in South Asian countries such as India where there is a large quantum of RE (and significantly higher quantum of RE planned for future) the availability of standalone hydropower plants (not linked with irrigation) is limited. A regional power grid offers the possibility of utilizing flexibility of large hydro power plants in other countries in the region, for accommodating the variability of RE in India.

Regional energy market development

A South Asian power grid will enable the eventual development of South Asian regional power market also. A regional grid facilitates cross border transactions beyond bilateral mode, such as allowing power trade between two countries that are not directly connected. The availability of such a capable grid allows the introduction of new agreements and new market products thereby enabling regional energy market development.

Mobilizing of investment

Regional energy cooperation also allows countries to have access to foreign direct investment for developing their generation sources. For example, India is building the 900 MW Arun-III hydropower project in Nepal, which is one of the largest FDI projects in Nepal. Most of the electricity generated from the plant will be exported to India through cross border lines. Such investments in FDI mode also frees up the capital of host countries, which can then be used for alternate purposes.

3. Sustainable energy infrastructure development and role of cross border energy trade: International experiences & lessons learned.

TThere are various international experiences, within and outside South Asia, on how cross border energy trade supports the development of regional sustainable energy infrastructure or sustainable energy CBET infrastructure. These international experiences can serve as an inspiration for South Asian countries and can serve as a reference point for deriving the key learning to apply in the South Asian context.

3.1 Regional power projects/plants

Nam Theun 2 Hydroelectric project

The Nam Theun 2 Hydroelectric Plant is located in Laos. It was commissioned in 2010, with an installed capacity of 1,070 MW. Nearly 995 MW of the power is exported to Thailand and rest is used domestically.

The Nam Theun 2 Power Company (NTPC) owns the plants, with its shareholders as EDF International (40%), the Thai Electricity Generation Company EGCO (35%), and the government of Laos (25%). NTPC is a key company for Lao PDR development and is expected to generate 2 billion US$ in government revenue over the 25 year concession period.[43] A 138km double-circuit 500kV transmission line connects the power station to Thai border near Savannakhet.

Project name	Nam Theun 2 Hydroelectric Plant, Laos
Project cost	US$ 1450.00 million
Benefits to Laos	Government of Laos earns royalties, dividends, profit taxes, and dividend taxes. Over $170 million in revenues were received by the Lao treasury in income from the project between 2010 and 2017. In keeping with the project's legal agreements, these were all allocated to projects and programs contributing to poverty reduction or environmental management. $1.3 million from the project is allocated each year to protection of the watershed
Benefits to Thailand	Availability of hydropower at an economic rate
Financing and cost recovery	The project company NTPC funded the project through shareholders equity, loans and grants. This includes 35% equity from Thai Electricity Generation Company and 25% equity from Government of Laos through Lao Holding State Enterprise (LHSE). The equity contribution of Laos was supported through grants and loans from development financing institutions such as ADB, International Development Association (IDA), European Investment Bank and Agence Française de Développement (AFD). Cost recovery is through tariffs agreed to in the PPA, which has a USD and Thai Baht component, with separate tariff for each year of PPA.

Tala Hydroelectric Project

The 1020 MW Tala Project is located in Chhukha, Western Bhutan. Bulk of the power from the project is exported to India. The Agreement for the implementation of the Tala Hydroelectric Project was signed by the Governments of India and Bhutan on 05th March 1996. An autonomous body named the Tala Hydroelectric Project Authority (THPA) was constituted for the construction, operation, and

maintenance of the Project. The project was commissioned in phases between 2006 and 2007. The power is evacuated through 400 KV lines to Malbase and New Siliguri (Indian border).

Project name	Tala Hydroelectric Project
Project cost	Nu 41283 million Equivalent to 570 million USD
Benefits to Bhutan	Revenue, through sale of power to India. (Nu 5691 million, i.e. ~79 million USD revenue in 2019)[45] Increased availability of power within the country
Benefits to India	Availability of hydropower, especially in the East and North Eastern regions of the country where generation capacity is lesser
Financing and cost recovery	The Government of India has fully financed the project in the ratio of 60% grant and 40% loan, repayable in 12 equated annual installments at a simple interest rate of 9% per annum. The project is owned by Government of Bhutan, through Druk Green Power Corporation. The project recovers its cost through tariff payments, as per the PPA with India. The project was able to pay off this loan in 2018.

Tanakpur barrage

The Tanakpur barrage has some of its elements within Nepal, such as 9 hectare of pondage area and 2.9 hectare of land in which on the bunds are located, with the remaining portions in India. This was developed as per the provisions of Mahakali treaty between the Governments of India and Nepal. The 120 MW hydro power plant in the barrage was commissioned in 1993. The entire cost was borne by India. Along with sharing of water, the barrage also supports the delivery of up to 70 GWh of electricity to Nepal, free of cost, under the Mahakali treaty.

Ruzizi III

The Ruzizi III is a 147MW hydropower project being developed on the Ruzizi River that flows along the borders of the Democratic Republic of Congo, Burundi, and Rwanda. The power from the project will be equally shared by these three countries.

The project is being developed as a public-private partnership (PPP) between the three countries, and a consortium of Industrial Promotion Services and SN Power through a 25-year concession agreement. The consortium will develop the plant under build, own, operate and transfer (BOOT) basis and will run the plant as an independent power producer.

In July 2019, the project agreement was signed after negotiations between the three countries and the consortium. Each three of the contracting states will have a stake of 10% with an equal off-take share in the project. The consortium will own the remaining 70% stake.

The project is being developed with an estimated investment of $650m to $700m and is expected to be operational by 2026. International financial institutions such as the World Bank, the EU, the European Investment Bank (EIB), the African Development Bank (AfDB), Kreditanstalt Für Wiederaufbau (KFW), and French Development Agency (AFD) will fund 60% of the project cost.

Itaipu Dam

The14000 MW (20 x 700 MW) Itaipu dam is located on Paraná River on the border between Brazil and Paraguay. It is a co-owned project between Brazil and Paraguay, under a 50 year treaty, signed in 1973. The project was commissioned in 1982, with electricity supply commencing in 1984.

Treaty of Itaipu created a binational entity called Itaipu Binacional, founded in 1974 and co-owned by Brazil and Paraguay. The national administrations in charge of electricity in the two countries, Centrais Elétricas Brasileiras (Eletrobras, Brazil) and the Administración Nacional de Electricidad (Ande, Paraguay), each share 50% of the entity's equity.

As per the Treaty of Itaipu, all the costs and benefits, as well as the implementation of social and environmental mitigation measures from Itaipu Binacional, are split equally between the two countries. This means that the debt for the construction of the dam and its maintenance costs are also evenly distributed.

Furthermore, the Treaty stipulates that the total quantity of energy generated must be bought by the two countries and is divided equally, such that any surplus electricity not used by either country must be sold to the other at a price corresponding to the cost of generation defined in the Treaty

The costs of building the dam were assumed by loans guaranteed by the Brazilian Government. The repayment of the debt is assured by sales of the energy to Eletrobras and Ande, which hire the installed power available. Itaipu Binacional has not been set up to commercially operate and deliver profits. As per the Treaty of Itaipu, the fare charged for the contracted power (defined as the unit cost of the electricity service) should be sufficient to cover all service costs such as:

- Royalties: A financial compensation payment is due to the Brazilian and Paraguayan Governments for the use of the hydraulic potential of the Paraná The amount is defined in Annex C of the Treaty of Itaipu, as the equivalent of USD650 per GWh generated by the dam. This amount cannot be less than USD18 million, shared equally between the two parties.
- Capital investment income: This is payable to Ande and Eletrobras in the amount of 12% per year of participation in the paid-up capital, adjusted for inflation.
- Operating expenses: These include expenses for personnel, materials and goods
- Financial charges and amortisation: These include costs of loans
- Reimbursement of management and supervision charges: These are payable to Ande and Eletrobras as compensation for their management and supervision efforts. The charge is calculated as the equivalent of USD50 per GWh generated by the dam.
- Operating account income for the year: This is the annual balance between revenue and the cost of electricity

The rate applied as on 2008 was USD22.60 per kW of contracted monthly power. The debt is expected to be repaid by 2023.[46]

3.2 Regional electricity interconnections

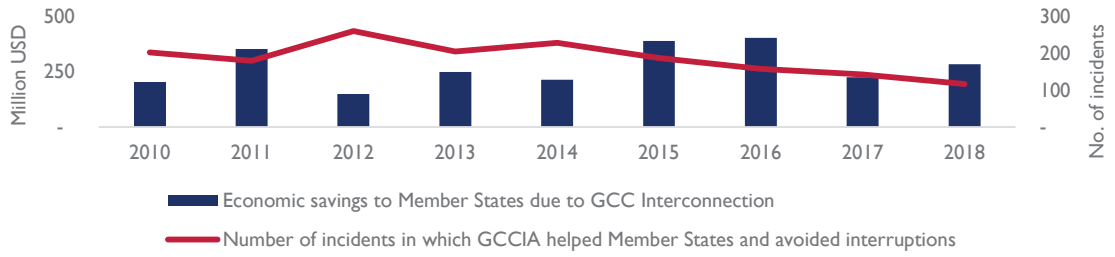
Gulf Cooperation Council interconnection

The Gulf Cooperation Council Interconnection Authority (GCCIA) has commissioned a 400-kV grid that connects the electrical power networks of the Arabian GCC countries of Bahrain, Kuwait, Qatar, Oman, United Arab Emirates (UAE) and Saudi Arabia. This interconnection enables electrical energy exchange and emergency support among these countries. Physical infrastructure between countries consist of 50 Hz AC interconnection between Kuwait, Bahrain, Qatar, UAE and Oman with a back-to-back High Voltage Direct Current (HVDC) interconnection to the 60 Hz Saudi Arabian system.

The GCC interconnection provide stability to the electricity system, owing to the larger size of interconnected grid. In case of outage of major elements in any country, reserve support is readily available through the interconnection. Thus, avoidance of outages due to emergency support provided by the interconnection provides significant economic savings. The project has also resulted in economic savings by reducing the installed capacity, operational reserves, and carbon emissions.

GCCIA estimates annual savings of over 200 million USD due to the GCC interconnection, with the interconnection providing support during more than 100 network incidents every year.

Figure 21: Estimated benefits of GCC interconnection



Source: GCC interconnection authority[47]

The GCC member states decided to self-finance the GCCIA project, by sharing the costs in proportion to the present value of reserve capacity savings. Each country was responsible for sourcing their share of the capital required, which could be from combinations of debt or equity as decided by each member state. As the project was developed in three phases, the cost sharing also varied as per the phases. The cost sharing was decided as per the below proportion.

Table 8: GCC interconnection cost sharing

Country	Phase I	Phase I & III*
Kuwait	33.8%	26.7%
Saudi Arabia	40.0%	31.6%
Bahrain	11.4%	9.0%
Qatar	14.8%	11.7%
UAE	-	15.4%
Oman	-	5.6%
Total	100.0%	100.0%

** Phase II was related to internal strengthening and connectivity within UAE grid, that was to be financed by UAE.*
Source: GCC Interconnection Authority[48]

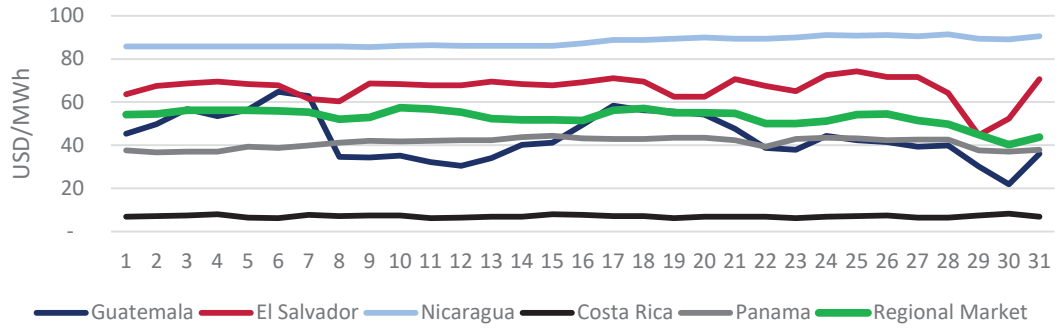
Central American Interconnection

Sistema de Interconnexion Eléctrica para los Países de América Central (SIEPAC), popularly known as the Central American Interconnection, is a high voltage regional transmission network, which connects six Central American countries - Guatemala, El Salvador, Honduras, Costa Rica, Nicaragua and Panama. The 230 KV interconnection, with a length of 1790 KM, was commissioned in stages, between November 2010 and October 2014.[49]

Due to the relatively small size of the power system in each country, the opening of a regional market was seen as a means for creating a larger market that would enhance competition among power producers. The prices discovered in the regional market of SIEPAC has mostly been beneficial to all participants, with countries which export getting a more attractive price than their national markets, and countries which import getting cheaper power than available from their national markets.

A comparison of national and regional prices in some of the SIEPAC countries, for August 2020 is illustrated below. It can be seen that countries such as Nicaragua and El Salvador can import electricity from the regional market at a cheaper rate than their domestic market, whereas countries such as Guatemala, Panama and Costa Rica can obtain a higher rate by selling their power to regional market.

Figure 22: Average daily pre-dispatch price, by national electricity system - August 2020



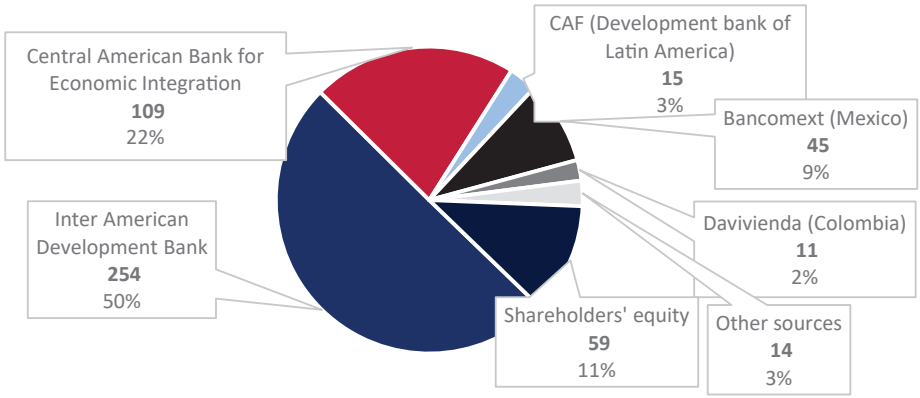
Source: CRIE[50]

The owner of transmission line - Empresa Propietaria de la Red SA (EPR) pays dividends to its shareholders, most of whom are the electricity utilities of Central American countries. The total project was 505 million USD, which was funded mostly with loans. Equity funding was for 58.5 million USD, forming 11.6% of the project cost.

Loans from Inter-American Development Bank (IADB) formed more than 50% of the project cost. These loans were granted to the six electricity companies in the SIEPAC countries, with the respective governments acting as guarantors. In turn, the electricity companies transferred the funds directly to EPR for construction of the line. EPR assumed the entire cost of servicing the loans taken out by the electricity companies with the Bank on its behalf.[51]

The overall financing of the line was through the following sources:

Figure 23: Financing of SIEPAC infrastructure (in million USD)



Source: Inter-American Development Bank[52]

France – Spain interconnection

INELFE (Interconexión Eléctrica Francia-España or Electricity Interconnection France-Spain) is a joint company that was set up on 1 October 2008 by the national grid management companies of Spain and France - REE (Red Eléctrica de España) and RTE (Réseau Transport d'Électricité) - with each partner holding an equal stake.

It was responsible for building and operating the 64.5 km, 320 KV, Baixas-Santa Llogaia HVDC electricity interconnection to increase the interchange capacity between the Iberian Peninsula (Spain and Portugal) and the rest of Europe. The company was set up following the Zaragoza Agreement, which was signed on 27 June 2008 between the governments of Spain and France to build this electricity interconnection. The projects objectives included the following:

- Improve the reliability of the European power supply system;
- Enhance the security of supply for the French and Spanish power grids;
- At the local level, improve the quality of the power supply;
- Promote the production and commercialisation of electricity from renewable energy sources;
- Better integrate the Iberian market into the European electricity market, improving competitiveness and impacting positively on electricity prices in Europe;
- Supply the Spanish section of the future Perpignan-Barcelona high-speed rail line;
- Foster economic and social development in the municipalities either side of the border with substantial benefits for local businesses and employment during the construction of the interconnector.

The resulting infrastructure, commissioned in 2015 has enabled the interconnection capacity between France and Spain to be doubled from 1,400 MW before its construction to 2,800 MW.[53]

The investment for the line was 700 million euros ($756 million), 225 million euros of which came as a European Commission grant, and 350 million euros of which came as a loan from the European Investment Bank. The remaining cost was split 50-50 between RTE and REE. [54]

Spain-Morocco interconnection

At the end of 1997, the grids of Spain and Morocco were interconnected by a single 28 KM, 400 kV circuit in alternating current (AC) through a submarine cable line that links the substations of Tarifa in Spain and Ferdioua in Morocco. In July 2006, a second submarine 400 kV line became operational. The maximum transfer capacity is 600 MW from Morocc.o to Spain and 900 MW from Spain to Morocco, with a thermal limit of 1 400 MW. The interconnector is currently owned 50/50 by Spain's Red Eléctrica de España (REE)and Morocco's National Office of Electricity (ONEE).

3.3 Regional initiatives for renewable energy integration

Denmark – Norway – Sweden

Denmark has a generation mix consisting of more than 41% of wind power capacity. Its electricity grid is connected to the Nordic grid (with Sweden and Norway) and to the European continental grid (with Germany). The electricity generation mix of Sweden and Norway is dominated by large hydro stations. Norway had a generation mix consisting of 91% hydro capacity, and Sweden had about 43% hydro capacity.

During time of high wind generation in Denmark, the excess generation is accommodated by reducing the generation from hydro stations in Sweden and Norway. This also helps in reducing the drain on the water reservoirs in the hydro power plants of Sweden and Norway. When the wind calms down, the hydropower stations in Norway and Sweden step up production, often transmitting electricity to Denmark as and when required.

European Union: Projects of common interest (PCI)

Projects of common interest (PCIs) are key cross border infrastructure projects that link the energy systems of EU countries. They are intended to help the EU achieve its energy policy and climate objectives: affordable, secure and sustainable energy for all citizens, and the long-term decarbonisation of the economy. Article 4 of Regulation (EU) No. 347/2013 defines a Project of Common Interest (PCI) as one that has significant benefits for at least two member states, contributes to the integration of the electricity markets and to greater competition within the European Union, improves the security of energy supply, increases the amount of electricity generated from renewable energy sources (RES) and reduces CO2 emissions.

PCI projects have the right to apply for funding from the Connecting Europe Facility (CEF), the EU's €30 billion fund for boosting energy, transport, and digital infrastructure. A total of €998 million in CEF grants was allocated to 10 PCIs in 2020, 2 for electricity transmission, 1 for smart electricity grids, 6 for CO2 transport (including 5 studies), and 1 for gas.[92]

In order for an electricity transmission and/or storage project to be eligible as a PCI, it must be included in the Ten-Year Network Development Plan (TYNDP) drawn up by ENTSO-E. The list of PCIs are reviewed every two years, through a consultative process of European Commission, followed by review of European Parliament and European Council. Some of the examples of PCI projects are listed below: [93]

- COBRAcable: It is a new offshore link, completed in 2019, stretching approximately 350km and with a capacity of 700 megawatts, that connects Denmark and the Netherlands. This interconnection enables the integration of more renewable energy and is designed to enable the connection of an offshore wind farm at a later stage. It will also ensure energy security by increasing energy exchanges between the two countries and providing a back-up for other connections in the event of failure.
- The Biscay Gulf Interconnector: The new 370 km-long electricity link through the Bay of Biscay will strengthen the interconnection between Spain and France and improve security and guarantee of supply. As interconnection capacity is increased, the volume of renewable generation will be maximised and even redistributed within neighbouring systems to where it is needed most. The project is part of the priority corrdidor for North-South interconnection in Western Europe and is expected to be completed in 2022.

3.4 Regional fuel pipelines

Blue Stream

Blue Stream is a major trans-Black Sea gas pipeline that carries natural gas from Russia into Turkey. The pipeline has been constructed by the Blue Stream Pipeline B.V., the Netherlands based joint venture of Russian Gazprom and Italian Eni. The Blue Stream Pipeline B.V. is an owner of the subsea section of pipeline, including Beregovaya compressor station, while Gazprom owns and operates the Russian land section of the pipeline and the Turkish land section is owned and operated by the Turkish energy company BOTAŞ.

Total length of the pipeline is 1,213 kilometres. he pipelines delivers more than 50 percent of Turkey's total gas imports from Russia. Blue Stream enabled the supply of considerable amounts of gas directly via the shortest and most effective route that has mitigated transit risks for Turkey.

Myanmar – Thailand gas pipeline

Thailand has joint exploration / production sharing contract arrangements with Yadana, Yetagun and Zawtika gas fields in Myanmar. In each of these projects, the Myanmar Oil and Gas Enterprise (MOGE) has a share of 15-20%. There are pipelines for transfer of gas from these three gas fields in Myanmar to Thailand.

3.5 Regional energy/electricity markets

South African Power Pool

The Southern African Power Pool comprises 12 Southern African Development Community (SADC) member countries (Angola, Botswana, Democratic Republic of Congo, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe) of which nine are operating members whose interconnected grid carries about 97% of the power produced by SAPP countries.

In addition to bilaterally negotiated contracts, there also exists multilateral power trade (day ahead, intraday, forward physical market - monthly and forward physical market – weekly). The competitive trade is executed through a market trading platform SAPP Market Trading Platform (SAPP-MTP).

According to SAPP Pool Plan 2017, it is estimated that the full integration of the SAPP countries' power systems and the development of power trade could bring cumulative savings of over US$42 billion[56] (NPV) in investment and operating costs for the region till 2040, as compared to the option of

implementing individual country plans. These savings would be achieved through investments of USD3 billion (NPV) in power transmission corridors.

European Union (EU) Internal Power Market

The internal market of European Union also contains a single internal market for electricity. The market focuses on providing market access to third parties and on ensuring competition on wholesale and retail markets. The market hosts day ahead, intra-day, forward and balancing products.

The EU member countries benefit from the power trade in the region in the following ways:

- Increased resilience offered by larger grids;
- Availability of multiple market avenues such as spot markets, and intra-day markets;
- Availability of ancillary services which can even be procured from other countries;
- Availability of more options for system and market operators for balancing.

3.6 Lessons from international experience

Based on the successful/ongoing regional initiatives discussed in this section, the following key success factors can be identified, that has helped in the development of sustainable energy infrastructure at a regional level.

Table 9: Success factors behind regional sustainable energy infrastructure

Parameter	Description	Examples
Inter-governmental support	Need for inter-governmental agreements, and their effective implementation	Intergovernmental agreement signed between Governments of India and Bhutan for Tala hydropower project Treaty of Itaipu between Brazil and Paraguay Zaragoza Agreement between Spain and France for the Baixas-Santa Llogaia interconnection
Joint ownership	Ownership of utilities / governments at the generation and supply side allows ensuring their support on project development, and comfort on both buying and selling sides.	Nam Theun 2 Hydroelectric Plant jointly owned by Laos, Thailand and private partner Ruzizi III jointly owned by Democratic Republic of Congo, Burundi, and Rwanda Itaipu dam jointly owned by utilities of Brazil and Praguay Baixas-Santa Llogaia interconnection jointly owned by utilities of Spain and France Spain-Morocco interconnection jointly owned by utilities of Spain and France Gulf Cooperation Council Interconnection jointly owned by the GCC countries
Cost sharing	Common understanding / mechanism/principle on cost sharing for the project	Nam Theun 2 - 35% equity from Thai Electricity Generation Company and 25% equity from Government of Laos Ruzizi III – 30% equity shared between Democratic Republic of Congo, Burundi, and Rwanda GCC interconnection cost sharing

Support of development financing institutes	Role of development financing institutions are very crucial, in terms of improving project viability through grants, low interest loans and mechanisms such as funds for Projects of Common Interest (PCI) in Europe.	Nam Theun 2 – Equity contribution of Laos supported by ADB, International Development Association (IDA), European Investment Bank and Agence Française de Développement (AFD) Ruzizi III – 60% project cost supported by World Bank, the EU, the European Investment Bank (EIB), the African Development Bank (AfDB), Kreditanstalt Für Wiederaufbau (KFW), and French Development Agency (AFD) Central American Interconnection – 75% of project cost supported by Inter-American Development Bank, Central American Bank for Economic Reconstruction and Development Bank of Latin America

4. Policies and regulations for sustainable energy infrastructure development and accelerating CBET for a cleaner and greener energy future in South Asia

4.1 Key conducive policies and facilitating regulatory design & frameworks

Countries in South Asia have introduced a range of policies and regulatory frameworks to facilitate development of sustainable energy infrastructure and accelerate CBET. These include renewable energy capacity targets under power sector masterplans, targets set under national climate policy, focus on smart grid and energy efficiency measures, and sustainable transportation. This is supplemented by plans to scale up transmission infrastructure facilitating renewable energy grid integration as well as regional trade. Following are some of these policy and regulations introduced by countries in South Asia:

Afghanistan

In Afghanistan, there are only a few provisions on the policy and regulatory framework, that explicitly supports the development of sustainable energy infrastructure.

Power Services Regulation Act

The Power Services Regulation Act, 2015[57] envisages the creation of an Energy Services Regulation Authority within the Ministry of Energy and Water. The agency's duties specified in the Act includes providing facilities to attract domestic and foreign investment in the area of energy services. As per the Act, energy services up to 100 KW that are supplied for rural areas are exempted from the licensing requirement.

The Act also specifies that foreign investment in energy services and its infrastructure facilities shall be subject to the private investment law of the country in the following cases:

1. Access to banking facilities,
2. The transfer of capital and port,
3. Transfer of the actual foreign debt and its other payments,
4. Sale of approved enterprise and transfer of its income.
5. Expropriations, compensation and the transfer of its funds and the right of reference to the court.

Afghanistan Renewable Energy Policy

The Ministry of Energy and Water (MEW) has developed the Renewable Energy Policy for Afghanistan in 2015. The Policy has set a target for deploying 4500 – 5000 MW of RE capacity by 2032, which is equivalent of 95% of the total electricity generation capacity mix of 5000 –6000 MW as per the targets of the country's Power Sector Master Plan.

The Policy stipulates that a new entity" Renewable Energy Coordination Committee (RECC)" will be set up within the MEW, having statutory powers. The Policy also encourages private sector involvement by providing financial incentives and other facilitation in terms of wheeling and banking, "must-run" status, freedom to sale power to third party, land acquisition and leasing, licensing, regulatory oversight.

The Policy lays the foundation for setting up "basket-funds" for RE projects which would evolve into a dedicated RE financing institution. The Policy recognizes the need to establish Feed-in-Tariff, Regulated investment Return Net/Smart Metering, Market Premium, Tax Based Incentives,

Bangladesh

Renewable energy policy of Bangladesh, 2008

The policy aimed to develop renewable energy sources to meet 10% of power demand by 2020. It aimed to enable, encourage and facilitate both public and private sector investment in renewable energy projects; and to develop sustainable energy supplies to substitute indigenous non-renewable energy supplies.

The policy led to the creation of Sustainable and Renewable Energy Development Agency (SREDA), which serves as the focal point for sustainable energy infrastructure development. BREDA oversees various RE programs such as:

- Solar mini-grids under Remote Area Power Supply System (RAPSS) guidelines. 11 solar mini grids with a cumulative capacity of 2.19 MW has been installed;
- Solar irrigation, under Guidelines for the Grid Integration of Solar Irrigation 2020; and
- Rooftop solar program and solar home systems.

Quick enhancement of electricity supply (Special provisions) Act, 2010

This Act made special provisions for facilitating urgent measures to enhance generation, transmission, transportation and marketing of electricity and energy to ensure uninterrupted supply of electricity and energy to meet demand. The Act also incorporated provisions to import electricity or energy from neighbouring countries/abroad and implementation of any transmission or distribution infrastructure required to support such imports.

Power Sector Masterplans

The major energy sector outlook and plans of the country are outlined in the Power Sector Master Plan (PSMP). The PSMP targets for 2041 currently include:

- Increasing per-capita electricity consumption to 2100 kWh;
- Generation capacity of 79,500 MW, including RE capacity of 7,900 MW; and
- Electricity import of up to 12,000 MW.

The 2030 targets under Nationally Determined Contribution includes the following:

- 100% of new coal based power plants to use super-critical technology;
- 400 MW of wind generating capacity;
- 1000 MW of utility-scale solar power plant;
- 10% energy consumption reduction in the industry sector compared to the business as usual; and
- 25% reduction of overall energy consumption of the commercial sector compared to the business as usual.

Climate Policy

As per its NDC, Bangladesh is projected to achieve a reduction of 15% in emissions leading up to 2030 in comparison to BAU scenario in a conditional contribution scenario. This is to be achieved by a range of targets in power, transport, and the industry (energy-related) sector.

Bhutan

Overall regulatory and policy framework

Bhutan has focused on developing large hydro power projects for the development of sustainable energy infrastructure in the country. The tariff for domestic supply from these plants are regulated by the Bhutan Electricity Authority (BEA).

The Bhutan Sustainable Hydropower Development Policy 2020 lays down the Government's vision and policy priorities. As per the policy, hydropower plants will be developed under five modes:

a) **RGoB initiatives** – 100% equity owned by Royal Government of Bhutan (RGoB)

b) **IG/Bilateral Arrangement** - Projects in collaboration with government of development partner countries provided full financing is provided by the partner countries in the form of untied equity as grant and balance as loan.

c) **Regional/Multilateral arrangement -** The RGoB shall take up projects with partner countries from the region/sub-region where the power shall be sold to the partner country(s). Under this arrangement, RGoB shall first pursue full financing by the partner country(s) with ownership resting with the RGoB.

d) **JV-bilateral arrangement -** The RGoB shall directly award projects for development as JV undertaking between PSUs owned by participating governments on equal share holding basis provided the participating government gives a full and untied free equity for the Rob's PSU. The participating external government's PSU shall not be allocated with more than one project.

e) **Public-Public arrangement -** The RGoB shall directly award projects for development as 100% Royal Government undertaking or through Public-Public partnership in which the RGoB and participating Governments have majority shareholding in the Public sector companies. For Public-Public partnership, the RGoB undertaking shall have a minimum of 51% shareholding.

f) **Public-Private-Partnership -** The RGoB may develop hydropower projects through Public-Private Partnership. For this, the RGoB shall allocate projects directly to Royal Government undertaking. The private partner(s) shall be selected through open and transparent process by the RGoB's PSU. Subject to special approval by the Royal Government of Bhutan, an investor(s) can be selected as strategic partner(s) having appropriate minority shareholding not more than twenty six percent (26%). Under all circumstances, the RGoB's PSU shall have the majority shareholding in the company.

The Policy envisages a concession period of 30 years, excluding the construction period. At the end of the concession period, the entire project shall be transferred and vested in the RGoB at no cost and in good running condition.

The Department of Renewable Energy is the nodal agency for the implementation of the renewable energy policy within the Ministry of Economic Affairs (MOEA). Its responsibilities, among others, include:

- The development of the renewable energy master plan;
- supporting the Renewable Energy Development Fund (REDF);
- co-ordination of the action plans of different organisations and agencies;
- facilitation of project developers in all phases of project development; and
- development of policy directives related to renewable energy

The National Environment Commission (NEC) is the national body concerned with the environment. It is also charged with responsibility for ensuring expedient, efficient and high priority processing and issuance of clearances/permits to promote the development of renewable energy projects.

As per the Renewable Energy Management Master Plan (2016), Bhutan could produce 12 gigawatts (GW) of solar and 760 megawatts (MW) of wind energy in technical terms. The Alternative Renewable Energy Policy (AREP) in place since 2013 envisions 20 MW of RE capacity, including 5 MW from solar PV, 5 MW from wind and 3 MW for solar water heating, by 2025. The AREP also includes provisions for a Renewable Energy Development Fund (REDF), which aims to provide financial assistance to

create a favourable investment climate for renewable energy in Bhutan. The REDF is envisioned to be the central financing instrument for the development of renewable energy projects in Bhutan, and it is supposed to be funded through contributions form hydropower plant owners and through royalties. However, so far, the funds have not been put in place.

Power Sector Masterplans

Bhutan's National Transmission Grid Masterplan of 2018 lays down the plan for expansion of power system. The plan looks at the hydropower projects and transmission line scenario by 2025, 2030, 2035 and 2040. For example, the 2035 scenario anticipates generation of 13,538 MW, out of which 12,329 MW will be exported.[59]

The Government has also notified a National Energy Efficiency & Conservation Policy in 2017, which entrusted the Department of Renewable Energy (DRE) to come up with roadmap for Energy Efficiency. A draft roadmap published by DRE in 2018 has set a target of cumulative saving of 1.5 MTOE over a period of 15 years.

Climate Policy

Bhutan's NDC commitments to UNFCCC include:

- Offset up to 22.4 million tons of additional CO2e per year by 2025 in the region through the export of electricity from our clean hydropower projects;
- Promotion of low carbon transport system;
- Promote clean renewable energy generation; and
- Energy demand side management by promoting energy efficiency in appliances, buildings and industrial processes and technologies.

India

Policy and schemes for sustainable energy infrastructure

Government of India's Tariff Policy provides the broad guidelines for promotion of renewable energy. This includes:

- Renewable Power Obligation (RPO): In order to promote renewable energy and energy security, 8% of electricity consumption excluding hydro power, shall be from solar energy by March 2022.
- Renewable Generation Obligation (RGO): New coal/lignite based thermal plants after specified date to also establish/procure/purchase renewable capacity
- Affordable renewable power through bundling of renewable power with power from plants whose PPAs have expired or completed their useful life.
- No inter-State transmission charges and losses to be levied for solar and wind power commissioned till June 2023, for 25 years.
- Distribution utilities to undertake procurement of 100% power produced from Waste-to-Energy plants.
- Ancillary services to support grid operation for expansion of renewable energy.
- Promotion of Renewable Energy Certificate (REC) mechanism, to support development of RE power by states which do not have local resource potential for development of RE power.

The policy efforts of the Government were backed by various schemes and projects, such as National Solar Mission, competitive procurement of RE plants and/or large RE parks, and development of Ultra Mega Solar Power Plants (UMSPP).

Regulatory promotion for sustainable energy infrastructure

The regulatory promotional measures for sustainable energy infrastructure are put in place by Central Electricity Regulatory Commission (CERC) at the federal level, and by respective State Electricity Regulatory Commissions (SERC) at the state level.

The measures undertaken by CERC to promote sustainable energy infrastructure includes:

- Solar and wind power plants developed at Inter-state level to be exempted from payment of inter-state transmission charges and losses, for a period of 25 years from Commissioning. This has been provided consequent to the policy directives from Government of India on the same;
- Regulatory framework for Renewable Energy Certificates (RECs); and
- Feed-in tariff for RE plants developed at inter-state level, which also served as the benchmark ceiling tariff for competitive bidding in the past.

The efforts are further enhanced by measures at state level by SERCs, which issue regulations on binding RE targets under Renewable energy Purchase Obligation (RPO) and similar regulatory measures. States also issue state level RE policies, declaring various incentives to achieve their policy targets.

Policy and regulatory framework for CBET

India's framework for CBET is developed through three key documents:

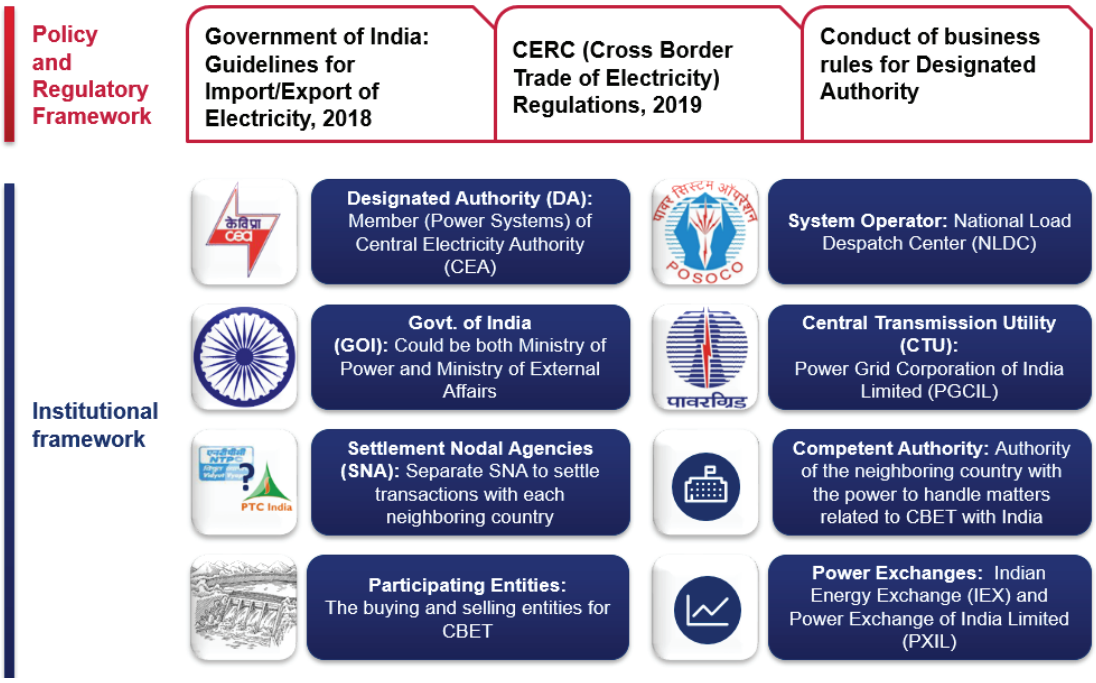
1. Government of India's Guidelines for Import/Export of Electricity, 2018;
2. CERC's (Cross Border Trade of Electricity) Regulations, 2019; and
3. Conduct of Business Rules of Designated Authority.

Table 10: Key aspects of India's Guidelines for Import/Export of Electricity

Guideline / law / policy related to CBET	Government of India's Guidelines on import and export of Electricity (2018)
Key institutional framework	Member (Power Systems) of Central Electricity Authority is identified as the 'Designated Authority' for key approvals related to CBET Open access and tariffs will be handled by the Central Electricity Regulatory Commission (CERC)
Nature of approval	The Designated Authority provides approvals to build new cross-border transmission lines and conduct cross-border electricity trade
Planning Process for cross-border transmission lines	Planning is to be jointly carried out by Designated Authority in India and Transmission Planning Agency(TPA) for neighboring country
Process for cross-border electricity trade	Import / export is approved on the basis of eligibility requirements set out in the Guidelines such as surplus/deficit position of domestic power market, and equity ownership pattern of the applicant.

The Guidelines specify the key requirements of CBET, approval of Participating entities, role of Designated Authority, treatment of Government-to-Government transactions etc. The CERC regulations on CBET further develops on this, expanding especially upon aspects such as granting open access to cross border lines. The conduct of business rules of Designated Authority provides the procedural framework for its activities. Between these documents, a comprehensive institutional framework has been made available.

Figure 24: Institutional framework for CBET in India



Climate policy

India has specified its long term plans as part of its NDC document:

- Reduce the emissions intensity of its GDP by 33 to 35 percent by 2030 from 2005 level; and
- Achieve about 40 percent cumulative electric power installed capacity from non-fossil fuel based energy resources by 2030.

However, most recently, the Government has adopted a more ambitious target of 450 GW of renewable energy by 2030.

The detailed electricity generation and transmission plans are laid out in India's National Electricity Plan. A longer time perspective planning for transmission is also undertaken.

To support the development of renewable energy viz-a-viz variation in resource potential of various states, India also introduced a "Renewable Energy Certificate" (REC) mechanism, which provided an alternative tradeable market for green component of electricity from renewable energy plants.

Energy efficiency

India has a very comprehensive ecosystem for energy efficiency, under the overall guidance and control of the Bureau of Energy Efficiency (BEE). BEE runs energy efficiency standards, appliance labelling, and energy certification programs. India also has an emissionscap-and-trade programme, in the name of "Perform, Achieve and Trade" (PAT) scheme, where targets for improvement in specific energy consumption are set for specific industries. The scheme is linked to an Energy Saving Certificate (ESCERT) mechanism, so that industries that overachieve can monetise the same, while allowing other industries to buy ESCERTS or pay penalties to offset their shortfall in reduction in specific energy consumption.

The Energy Conservation Building Codes (ECBC) are also imposed at Central and State level for various sectors. In many states, the electricity distribution utilities have their own demand side management (DSM) programs. India has undertaken a successful and large scale adoption of energy efficient lighting, by switching over to LED bulbs.

Smart Grids

Smart grid adoption in the country is being implemented by various electricity utilities including the central transmission utility – Power Grid Corporation of India Limited (PGCIL). India's National Smart

Grid Mission (NSGM), operating under the aegis of Ministry of Power, is charged with the planning and monitoring of implementation of policies and programmes related to smart grid activities in India. The NSGM goals relating to Smart Grid rollout are to be implemented in two phases (Phase-I till 2020 and Phase-II from 2020-2025). It envisages creating a state project management unit (PMUs), preparation of utility level roadmap for Smart Grid, rollout of Advanced Metering Infrastructure (AMI), Network mapping and consumer indexing, Distribution Automation, Microgrid and renewable integration, and preparing utility infrastructure to facilitate deployment of electric vehicles. The NSGM measurement, reporting, and verification (MRV) framework is an important tool to monitor progress of these various initiatives. [60]

It is further envisaged that the Smart Grid Knowledge Centre (SGKC) under the Power Grid Corporation of India Limited will be resource for providing technical support to NSGM. NSGM commenced with an initial budget outlay of 990 crores.

Electric Vehicles

Electric Vehicle adoption is still in in the initial stages, though a scale-up is expected in the medium term. The Government has recently launched Phase II of its Faster Adoption and Manufacturing of (Hybrid) and Electric Vehicles (FAME) program. The program in its current phase aims to generate demand by way of supporting 7000 e-Buses, 5 lakh e-3 Wheelers, 55000 e-4 Wheeler Passenger Cars (including Strong Hybrid) and 10 lakh e-2 Wheelers.

Maldives

One of the policy priorities under Maldives National Energy Policy and Strategy 2010 is the promotion of renewable energy. This included the following strategies:

- Compile and assess all data and information necessary to promote renewable energy investments;
- Create enabling framework for large scale promotion of renewable energy investments; and
- Prepare and implement a project pipeline of priority renewable energy projects and seek funding for priorities.

In addition, Maldives' $30 million SREP investment plan is supporting efforts to create an enabling environment for the growth of a reliable and sustainable energy sector and meet the constitutional obligation of the government in the provision of electricity to every inhabited island. It had three components with sub-projects under it.

ASPIRE: Renewable Energy for Greater Male' Region
1. Greater Male' Region Solar PV investments
2. Waste-To-Energy (Tilefish)
3. Greater Male' Region Renewable Power System Integration
POISED: Renewable Energy for Outer Islands
1. Small power station RE
2. RE readiness -Power system rehabilitation
3. Outer Island Solar/wind investments
4. Outer Island Waste-To-Energy investments
Technical Assistance and Capacity Building
1. Creating an enabling environment
2. Human Capacity Building
3. Project Preparation and Feasibility studies
4. Improved access to quality data

The Maldives Energy Authority, which deals with regulatory aspects, had issued a Net Metering regulation, in 2015 to support distributed renewable energy.

Nepal

Policy and regulatory frameworks

Nepal focuses on development of hydropower to develop its energy resources in a sustainable manner. To this end, Government of Nepal's efforts have been through policy and plan provisions such as Hydropower Development Policy of 2001. The Hydropower Development Policy of 2001 identified key action areas such as:

- Hydropower potential of the country shall be utilized to the maximum extent in order to meet the domestic demand of electricity.
- Hydropower projects suitable to the electric system for domestic use as well as the storage projects shall be developed as per requirement on competitive basis.
- Implementation of hydropower projects based on the concept of Build, Operate, Own and Transfer shall be encouraged.
- Appropriate incentive provisions shall be provided, and transparent process shall be pursued to attract national and foreign investment in hydropower development.
- Efforts shall be continued for implementation of large storage type hydropower projects and multi-purpose projects. Large storage type multi-purpose projects shall be developed in such a way that downstream benefits resulting from the projects would yield maximum benefits to the nation.
- In the case of multi-purpose projects, Government may participate with the private sector in view of possibility of irrigation development.
- Contribution shall be made to environment protection by developing hydropower as an alternative to biomass and thermal energy.
- Emphasis shall be given on mobilization of internal capital market for investment in power sector.
- Electrification of remote rural areas shall be encouraged by operating small and mini hydropower projects at the local level.
- It shall be encouraged to utilize the electric power available during low demand in the sectors such as rural water supply, irrigation, industry, tourism, etc.
- In view of the concept of bilateral and regional cooperation and taking into consideration the abundant hydropower generation capacity in the country, **export of electricity** shall be encouraged.

The Government's White Paper on Energy, Water Resources and Irrigation Sector's Status and Roadmap for the Future issued in May 2018 has set a target of developing 15000 MW hydropower within 10 years.

Meanwhile, the Government had also published Grid Connected Alternative Energy Working Procedures, which deals with aspects such as feed-in-tariffs for small RE power plants.

Regulatory framework

Nepal's Electricity Regulatory Commission is the youngest electricity sector regulator in the region, established in 2019. The Commission has so far made the following enabling provisions to support sustainable energy infrastructure:

- As per Bylaws Relating to Purchase / Sale of Electricity and Conditions to Be Fulfilled by The Licensees, 2076, for hydropower projects of capacity less than 10 MW, there shall not be any penalty imposed for low generation, if such decrease in generation is due to reduced water availability. The Bylaws also continued the adoption of hydropower tariffs, determined earlier by Nepal Electricity Authority (NEA).

- For smaller projects of 100 KW and below, the electricity buyer can determine the power purchase and selling rate for Power Purchase Agreement , if the project is established with approval of local authority

Master Plans

The Government's vision for energy sector is laid out in the whitepaper issued by MoEWRI in 2019.

Table 11: Nepal's Energy Sector Whitepaper of 2019

Sl No	Area of intervention	Strategies / targets
1	Energy production	15000 MW hydropower by 2029
2	Electricity usage	Annual per-capita consumption of 1500 kWh by 2029 100% electricity access by 2024
3	Domestic transmission network expansion	East-West, Mid-Hill and River Basin Corridors to be developed at 400 KV
4	Cross border transmission lines	400 KV Butwal-Gorakhpur (India) to be completed in four years 400 KV Galchhi-Rasuwagadi-Kerung line with China to be completed in five years 400 KV Lamki-Bareli, Duhabi-Purniya and Kohalpur-Lakhnau lines with India to be developed
5	Demand Side Management	Demand management of up to 200 MW by 2022
6	Alternate energy	200 MW small scale systems to be developed with subsidy support

Source: Ministry of Energy, Water Resources and Irrigation [61]

Climate policy

The Nationally Determined Contribution of Government of Nepal (GoN) has laid down the following targets:[62]

- By 2020, Nepal intends to expand its energy mix focusing on renewables by 20% and diversifying its energy consumption pattern to more industrial and commercial sectors;
- By 2050, Nepal will achieve 80% electrification through renewable energy sources having appropriate energy mix. Nepal will also reduce its dependency on fossil fuels by 50%;
- By 2020, Nepal aims to increase the share of electric vehicle up to 20% from 2010 level;
- By 2050, Nepal will decrease its dependency on fossils in the transport sector by 50% through effective mass public transport means while promoting energy efficient and electrical vehicles; and
- Nepal will develop its electrical (hydro-powered) rail network by 2040 to support mass transportation of goods and public commuting.

Pakistan

Policy

The Government has notified its Alternative Renewable Energy Policy (AREP) in 2019. As per this Policy, Pakistan intends to have at least 20% of its generation capacity as ARE technologies by 2025 and 30% by 2030 (20X25 and 30X30 target). This is in addition to the 30% target set aside for hydropower. The policy offers the following incentives to RE projects:

- Exemption from corporate income tax
- Exemption from import duties
- Repatriation of dividends and disinvestment proceeds
- 100% foreign equity permitted
- Foreign currency accounts permitted
- Protection against change in law
- Robust market-tested contractual framework
- Protection against expropriation
- International dispute resolution
- Project land made available by the Provinces

As per the Policy, for RE projects developed through auctions, foreign bidders may bid with indexation to a foreign currency (USD, GBP, JPY, CNY, or Euro) in respect of tariff components specified for this purpose by National Electric Power Regulatory Authority (NEPRA). Indexation of tariff components will be automatic, based on predetermined formulae and reference parameters specified in the bid documents; AREPs will not have to approach NEPRA periodically for tariff indexation.

Alternative Energy Development Board (AEDB) is agency of the Federal Government that was established in May 2003 with the main objective to facilitate, promote and encourage development of Renewable Energy in Pakistan and with a mission to introduce Alternative and Renewable Energies (AREs) at an accelerated rate.

Regulation

NEPRA's Upfront Tariff (Approval & Procedure) Regulations, 2011 are applicable to the generation of electricity from Wind-Power, Hydel Power (only up to 25 MW run of the river/canal/stream), Solar Power, Bagasse etc. The Regulations provide the process in which the RE projects get an "upfront tariff" determined by NEPRA. These typically have local and foreign inflation indexed components also.

NEPRA's (Alternative & Renewable Energy) Distributed Generation and Net Metering Regulations, 2015 provide the regulatory framework for interconnection of distributed renewable energy, and net metering.

NEPRA (Interconnection for Renewable Generation Facilities) Regulations, 2015 specifies the standards for interconnection of RE plants with the grid.

NEPRA (Import of Electric Power Regulations, 2017 specifies the procedure to be followed, including approvals required for import of power from other countries.

NEPRA also provides a conducive regulatory framework for large hydro projects. This includes:

- Hydropower tariffs indexed to local and foreign inflation indices, and foreign exchange;
- Capital cost considered for hydropower tariff adjusted based on actual project cost, after completion; and
- Procedure for accommodating variation in anticipated versus actual Tunneling costs, due to geographical surprises.

Masterplans

Pakistan intends to reduce up to 20% of its 2030 projected GHG emission, as specified in its NDC document. Its Vision 2025 document envisages adding 25,000 MW of electricity to the national grid by 2025.

Sri Lanka

Policy

The government's energy policy is published in the National Energy Policy and Strategies document of 2019. As per the policy, the Government will endeavour to reach a minimum level of 10% of electrical energy supplied to the grid to be from RE by a process of facilitation including access to green funding such as CDM. The document lays down the following strategies:

Table 12: Sri Lanka's Energy Policy, 2019

Policy Pillars	Implementing Strategies
Assuring Energy Security	Diversity in energy resources used in electricity generation will be ensured A liquefied natural gas(LNG) terminal of optimum size and technology would be established at the most suitable location Percentage installed power generation capacity from a single imported fuel shall not exceed 50% of the total installed firm capacity Viable cross-border electricity transmission and cooperation with countries in the region will be pursued on the basis of multilateral power pool operation
Providing Access to Energy Services	Access to electricity using either on-grid or off-grid sources and to modern petroleum products will be ensured to all citizens in the country Smart grid technologies will be introduced, and smart metering will be deployed for enhanced customer experience, and to automate power system management, reducing manual intervention where such interventions are uneconomical
Providing Energy Services at the Optimum Cost to the National Economy	Power plants identified in the Long-Term Generation Expansion Plan will be implemented as scheduled.
Improving Energy Efficiency and Conservation	The national energy efficiency improvement and conservation programme will be further strengthened engaging all stakeholders in household, industrial and commercial sectors Energy efficiency improvement and conservation will be promoted through minimum energy performance standards and labelling of appliances, and by introducing green procurement processes in state and private sector organisations A strategic plan for street lighting will be formulated to ensure proper management of street lighting that will enhance the safety of road users, and to contribute to energy conservation with a better aesthetic sense. Automated demand response technologies will be considered as a main demand-side management strategy. Smart technologies, including smart buildings and complete conversion to smart metering will be ensured to convey price signals to customers, altering the demand profile to reduce the overall cost of supply.
Enhancing Self Reliance	Oil and natural gas resources of the country will be explored. Renewable energy resources will be exploited based on a priority order arrived at, considering economics, technology and quality of each resource.

Caring for the Environment	Impacts to the environment in the context of climate change due to the construction and operation of energy sector facilities will be minimised. Waste to energy projects will be favourably considered
Enhancing the Share of Renewable Energy	Renewable energy investments for electricity generation will be realised through a competitive Scheme Distribution infrastructure will be upgraded with smart grid technologies to facilitate renewable energy-based distributed generation Energy storage solutions will be encouraged for firming intermittent renewable sources, voltage and frequency regulation, local grid support, peak shaving and improving grid resilience
Strengthening Good Governance in the Energy Sector	All sub sectors in the energy industry will be brought under respective regulatory framework. Digitalisation of the energy sector entities using an enterprise resource planning platform will be taken as a priority, spanning the whole length of the value chain from smart meters, addressable appliances and smart grids that allows further adoption of new technologies such as artificial intelligence (AI), internet of things (IoT) and distributed ledgers to drive efficiency, transparency and optimisation of asset utilisation.
Securing Land for Future Energy Infrastructure	Best sites to locate large scale renewable energy infrastructure such as wind and solar farms would be identified in advance and marked on a master plan
Providing Opportunities for Innovation and Entrepreneurship	Sri Lankan enterprises will be encouraged to engage in energy sector infrastructure development Potential offered by vehicle energy storage systems (ESS) will be studied considering ESS as a local standby energy storage device, deploying those as an automated demand response (ADR) option and a load profile management too. Small scale on-grid distributed and off-grid stand-alone applications using renewable energy with local value addition will be encouraged as an economic development thrust.

While the above mentioned policy refers to a macro-level overview, specific targets are laid out in Sri Lanka Energy Sector Development Plan, Renewable Energy Master Plan, and Nationally Determined Contributions.

Sri Lanka's specific nationally determined contributions[63] for the energy sector include:

Establishment of large scale wind power plants of 514 MW;

Establishment of 115 MW of solar power plants;

Establishment of 105 MW of biomass power plants;

Establishment of 176 MW of mini hydro power plants;

Introduction of Demand Side Management (DSM) activities;

Strengthening sustainable energy related policies with a view to increasing the share of renewable energy from the existing 50%, to 60% in 2020; and

Converting existing fuel oil based power plants to LNG.

Regulations

The Public Utilities Commission of Sri Lanka (PUCSL) has notified its 'Methodology for Feed-In-Tariffs – NCRE'. It defines the basic principles and the methodology for calculating feed-in tariffs for non-conventional renewable energy based electricity generation. The methodology is applicable for

purchasing non-conventional renewable energy based electricity from plants having capacities below 10 MW and operating under Standard Power Purchase Agreements (SPPA) with the transmission licensee of Ceylon Electricity Board.

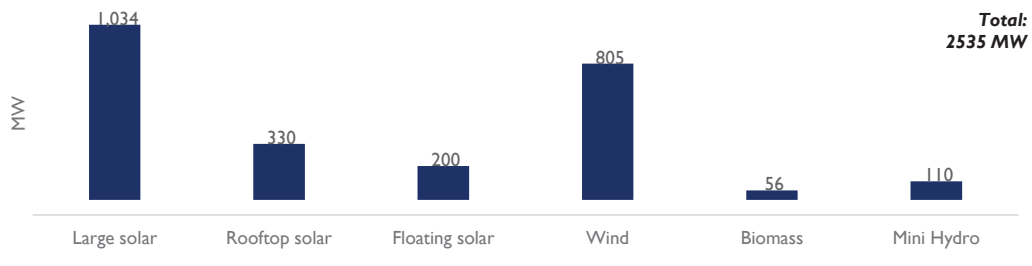
Masterplans

The Sri Lanka Energy Sector Development Plan of 2015[64] had set the following energy sector targets:

1. To make Sri Lanka an energy self-sufficient nation by 2030
2. Increase the share of electricity generation from renewable energy sources from 50% in 2014 to 60% by 2020 and finally to meet the total demand from renewable and other indigenous energy resources by 2030.
3. Increase the electricity generation capacity of the system from 4,050 MW to 6,400 MW by 2025
4. Generate a minimum 1,000 MW of electricity using indigenous gas resources discovered in Manner basin by 2020
5. Increase generation capacity of low cost thermal power plants fired by natural gas and biomass to 2,000 MW to reduce the generation costs and to diversify generation mix by 2020
6. Provide affordable electricity coverage to100% of the people of the country on a continuous basis before end 2015
7. Reduce the technical and commercial losses of the electricity transmission and distribution network from 11% to 8% by 2020
8. Reduce annual energy demand growth by 2% through conservation and efficient use
9. Reduce the petroleum fuel use in the transport sub-sector by 5% by introducing alternative strategies such as efficient modes of transport and electrification of transport by 2020
10. Produce the total petroleum product demand of the country through our own refinery by 2025
11. Upgrade quality of Gasoline and Diesel to EURO IV and EURO III respectively by 2018
12. Further enhance the quality and reliability of electricity and fuel supply
13. Broadening energy sector investment windows to include bonds, debentures, public private partnerships and other such novel financial instruments
14. Reduce the carbon footprint of the energy sector by 5% by 2025

Similarly, RE targets are laid out in the Government's RE Development Plan. It aims to have solar capacity of 1564 MW, wind power of 805 MW, biomass power of 56 MW and mini hydropower plants of 110 MW between 2019 and 2025. The solar power plants are planned as utility scale, rooftop solar and floating solar separately.

Figure 25: Sri Lanka RE capacity expansion plans for 2019-25



Source: Sri Lanka Sustainable Energy Authority [65]

Other efforts

The National Energy Policy and Strategies document of 2019 has stated the Government's support towards energy efficiency, energy conservation, smart grids, energy storage etc.

Compact fluorescent lamps (CFLs) are already under a legally enforced energy performance standard, and a performance label. Energy efficiency building code has been in practice since 2002. PUCSL issued its Utility-Driven Demand Side Management (DSM) Regulations in 2016. As per these regulations, the distribution licensees are required to submit their DSM Master Plan and DSM Programme to PUCSL for approval.

4.2 Lessons learned and experience of SA countries on designing appropriate policy regulatory instruments and their impacts

Sustainable energy infrastructure

SA countries across the region are prioritising the scale up renewable energy capacity and energy efficiency targets. This is being achieved by setting targets under national power sector master plan and climate policy. For example, Bangladesh has a target to achieve 7900 MW of RE capacity as per its power sector master plan. Countries have set quantifiable emissions reduction targets as well as targets to achieve a percentage of their total energy consumption from renewable energy resources. For example, India has a target to achieve 40% share of non-fossil fuel in total installed capacity of power generation by 2030 in its NDC.

However, among the South Asian countries, only India and Pakistan have so far been able to undertake substantial scale-up of non-hydro renewable energy sources. While the size of the countries also plays a role, it is also important to explore the policy and regulatory successes behind the achievement.

In case of India, the key drivers and successes of policy and regulatory instruments have been the following:

1. Government policy on fiscal incentive in the form of Accelerated Depreciation benefits drove the initial years of growth of wind power capacity.
2. The policy and regulatory framework for "Renewable energy purchase obligation (RPO)" targets with associated penalties created a demand for renewable energy in the initial years when cost of renewable energy was higher than cost of conventional energy.
3. The early stage of renewable energy development was also supported by the feed-in-tariffs determined by the regulators, which provided an assured tariff to developers.
4. The earlier stages was also kick-started by mixing solar with coal-based thermal generating capacity in the ratio of 1 MW of coal based power with 1 MW of solar PV power, making the tariff affordable.
5. Once there is a minimum scale achieved, the regulatory framework was able to transition to an auction based mechanism for RE development, which, along with the commitment shown by the Government, brought down the price substantially.
6. The RE development was almost entirely driven by private sector, due to the unrestricted participation allowed for private sector IPPs.
7. Long term certainty matters. In India, this was brought through the lifetime inter-state transmission charge and loss exemption for solar and wind power plants at inter-state level; and long term RPO trajectory.

In the case of Pakistan, the factors which have worked in favour of sustainable energy infrastructure includes:

1. Regulatory framework for determination of upfront tariff for RE plants drove the growth in the initial years. It was only in 2019, when an auction based methodology was adopted.
2. The practice of indexing the tariff with inflation components, foreign exchange variation etc. has been comfortable to the developers, in terms of reducing their risks.

3. Role of Alternative Energy Development Board (AEDB) in supporting the RE initiatives, especially those related to roll out of distributed renewable energy.

Even in other South Asian countries, there are lessons that can be adapted, such as the case of Bhutan's clear delineation of type of project models that are allowed, Nepal's regulatory bylaws that partially protect small developers from water flow related risks, and Sri Lanka's supportive framework for solar power net metering.

Cross border electricity trade

Policy and regulatory initiatives in CBET have been taken in the past years in countries such as India and Pakistan. India's guidelines for Import/Export of Electricity have created a foundation for neighbouring countries to plan their future activities related to CBET. More importantly, these guidelines improve upon the previous guidelines, drawing learning and experiences from the past version of guidelines. The guidelines provide a clear description of institutions involved, their roles, and the broad parameters under which approvals are granted.

In Pakistan, NEPRA's (Import of Electric Power Regulations, 2017 specifies the procedure to be followed, including approvals required for import of power from other countries. This is a comparatively simpler process, where only the matter of NEPRA's approval for rate of import of power is involved.

Rest of the South Asian countries can also draw upon these experiences to design the guidelines / regulations related to CBET.

4.3 Opportunities and challenges in the region for sustainable energy infrastructure development and CBET

CBET

While CBET has been gradually increasing in South Asia, there are several challenges that post as barriers to scaling up to its full potential. This includes problems related to development of cross border transmission lines, and absence of multilateral regional institutional frameworks. The investments in the region also face issues of lack of long term policy and regulatory certainty, including certainty in tariff frameworks, benefits, environmental compliance and taxation.

- **Long term policy uncertainties**
  In the absence of a binding and detailed regional agreement on energy cooperation, the investments in CBET are open to risk relating to policy uncertainties. There are risks of Governments changing the policy priorities, such as a shift from supporting run-of-river project to reservoir projects, or a shift from large hydro to renewables. It is even possible to have one country's policy changes to impact project in another country. For example, if selling countries plan the construction of run-of-river plants, and the buying countries reorient their priority towards reservoir based hydropower plants, there could be the risks of planned projects not being able to get developed.

- **Regulatory risks**
  There are also regulatory risks, as the regulatory regime for CBET is still evolving. This is in the form of risks on generation tariff determination, risks related to wheeling of power / transmission tariff and even regulatory risks related to change in environmental regulation.

However, despite the above challenges, opportunities of regional energy cooperation and cross border electricity trade (CBET) in South Asia are expected to bring several benefits. This includes the following:

Figure 26: Benefits of energy cooperation

Access to wider range of generation resources All countries	**Access to cheaper power sources** Nepal, Bangladesh, Sri Lanka	**Potential for large-scale hydropower plants** Bhutan, Nepal
Seasonality of generation in hydropower dependent countries Bhutan, Nepal	**Foreign exchange revenue** Bhutan, Nepal	**Sharing of variable generation source for RE balancing** India
Difference in time zones All countries	**Utilization of surplus generation of one country in another** India	**Regional energy market development** All countries
Optimum alignment of transmission lines India	**Economic extension of grid** Afghanistan	**Mobilization of investments at regional level** All countries

Regional cooperation in other matters

Countries in South Asia can cooperate among each other to identify the emerging renewable energy technologies and policy frameworks relevant in the regional context and leverage domestic learnings from other countries in order to commercialise the renewable energy technologies both for domestic and regional purposes. Countries can learn from each other from various best practices in the area of sustainable hydropower development and various business models associated with it.

The regional level energy centre can play a key role in knowledge sharing. Meanwhile, there have been bilateral initiatives on knowledge sharing within the region. For example, India and Bangladesh signed an agreement on Cooperation in the Peaceful Uses of Nuclear Energy, on 08 April 2017. The agreement envisages cooperation between the countries on various knowledge sharing activities such as:

- Transfer and exchange of knowledge, expertise and technology as appropriate, sharing of resources and experience, training of personnel and capacity building;
- Exchange of operation and maintenance experiences between utilities; and
- Technical training and education.

Regional cooperation can also extend on new and emerging technologies such as hydrogen based electricity generation, electric mobility and smart grids; and topics of common interest such as resilience planning and disaster management.

4.4 Role of CBET in development of cleaner, greener, and sustainable energy future in SA

Countries in SA have a significant energy resource base of hydro and renewable energy. Energy demand in the region is expected to continue to grow as countries improve energy access and economic growth. There is an opportunity for countries in SA to achieve these objectives at least cost while also decarbonizing their power/energy sector through regional cooperation. CBET can play a pivotal role in achieving economic optimization of energy production of clean energy through regional cooperation. Developing an interconnected and integrated power system to support CBET can facilitate large-scale Cleaner, Greener and Sustainable Energy Infrastructure (CGSEI) across the region.

Given the reduction in cost of generation for clean as well as renewable energy, CBET of hydro and renewable power from resource rich countries can become a financially attractive option for countries across the region. With further enhancements of CBET framework such as introduction of multilateral and trilateral along with the ongoing bilateral trade, a sustainable market supported by regional cooperation can be created. Price signals from such as regional CBET market will increasingly enable

SA to prioritize development and procurement of cleaner and greener energy while leaving carbon-intensive fuel in the ground.

Further CBET can also incentivize countries such as India to develop its vast 1445 GW of renewable energy potential and help countries in SA achieve emission reductions by procuring cheaper renewable power. The availability of regional balancing sources to support this high level of intermittent renewable energy will be a key driver of such RE capacity development. Alternatively, the renewable energy developed in India can even be utilized for evacuation to neighboring countries, as many of them lack the required land or RE potential to develop domestic RE capacity.

CBET can continue to enhance the current levels of hydro power traded within the region as well as create opportunities of renewable energy trade in the future. SA has over 350 GW of hydro resource out of which only 20% has been developed. Developing hydro resource Nepal and Bhutan with a focus on CBET can help reduce the emission intensity and prices in the SA region. At least a portion of these hydro resources could be designed as reservoir based projects, which can provide balancing support to renewable energy in the region.

Role of India's guidelines on Import/Export of Electricity

In many of the potential use cases of CBET discussed in this section, Government of India's Guidelines for Import/Export of power, 2018 has enabling or supporting provisions.

The guidelines allow Indian generators to export power, if the domestic market is not deficient in power. This could eventually support the development of large export oriented RE power plants.

The guidelines also allow neighboring countries to access the power exchange through trading licensees in India. This would provide an additional market platform for the countries in the region to sell/buy power.

Additionally, CBET can play a key role in achieving social, economic, and development objectives in the region. CBET can provide the necessary platform for cooperation which will be required to combat climate change impacts given the high vulnerability of population to impact of climate change in SA.

4.5 Need for coordinated policies and regulation for advancing CBET

Without consistent and coherent regional regulatory framework in place, investment opportunities and consequently large scale CBET between nations that could benefit both importing and exporting nations may not happen. In the South Asian regional context, the risks associated with forging an intraregional, CBET project would be greatly minimized if each participating country adopts complementary regulatory frameworks to facilitate cross-border interconnection and electricity trade. Moreover the existing electricity regulatory, policy and legal frameworks of south Asian countries primarily address domestic power sector issues and are not necessarily developed to address issues related to CBET. Therefore there is a need for coordination/ harmonization of policies and regulations related to CBET.

Advancing the CBET framework requires a coordinated effort by countries in SA for establishing a supporting regulatory and policy framework. This has also been observed in the case of similar experience of other regional power pools / regional groupings. For example:

- Guidelines on CBET, issued by Regional Electricity Regulator's Association (RERA) in South African Power Pool;
- Regional Energy Market Regulations (REMR) in Central American Interconnection; and
- Directives and regulations of European Commission in the European common market for electricity.

Case study: Coordinated guidelines for CBET in SAPP

RERA has developed their Guidelines on Cross Border Power Trading in Southern Africa in 2010. The regulatory bodies of Lesotho, Malawi, Mozambique, Namibia, South Africa, United Republic of Tanzania, and Zambia have been reported to have adopted these guidelines for implementation.

The RERA Guidelines aim to provide an enabling framework for cross-border trade and investment in infrastructure that will reduce some of the uncertainties deterring investment and undermining efforts to improve security of supply through cross-border trading. The guidelines state its objective as:

"Ensure that efficient cross-border deals are not constrained by unclear or complicated processes for making regulatory decisions"

The RERA Guidelines cover the following areas:

1. Regulator's powers and duties in cross-border trading
2. Working to ensure compatible regulatory decisions
3. Timing of regulatory interactions for proposed cross-border transactions
4. Licensing cross-border trading facilities, imports and exports
5. Approving cross-border agreements in importing countries
6. Approving cross-border agreements in exporting countries
7. Approving cross-border agreements in transit countries
8. Approving transmission access and pricing and ancillary services
9. Promoting transparency in the regulation of cross-border trading

The guidelines require the national regulators to issue licenses for import and export of electricity, subject to the following conditions:

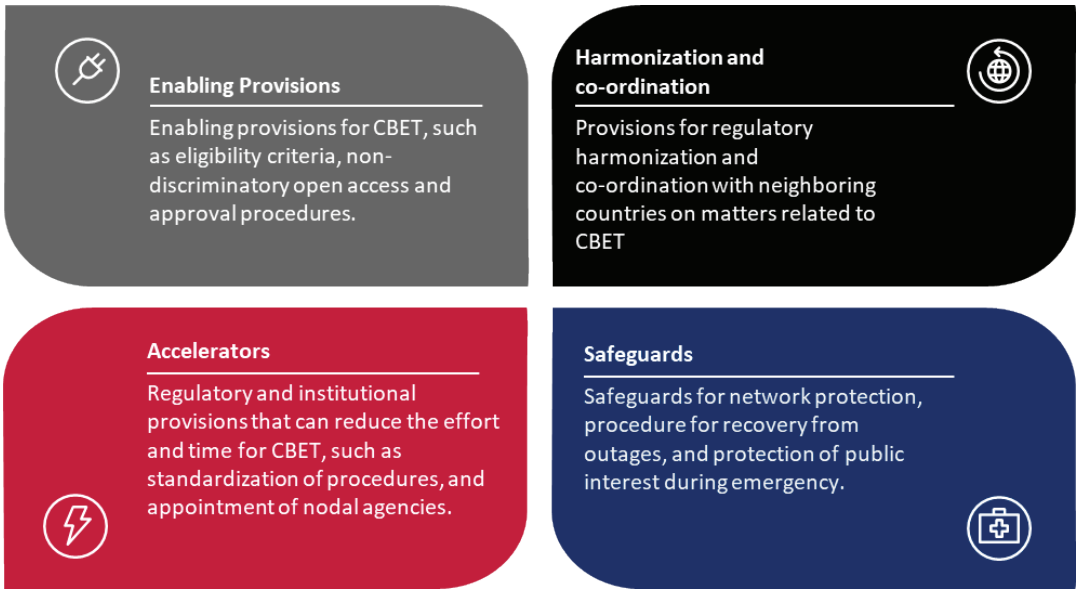
- The application complies with the applicable legal and regulatory framework;
- The applicant has demonstrated the technical expertise to construct, operate and maintain any associated power facility in compliance with any national grid code;
- The applicant has demonstrated sufficient financial resources to properly construct, operate and maintain the facility or to undertake the cross☐border trading activity; and
- Issuing a licence would not undermine national security of electricity supply.

The guidelines mandate the country level regulators / decision making authorities to oversee access to transmission for cross☐border transactions to ensure that access is non☐discriminatory to the greatest extent possible under the law.

The following four aspects can be identified as the minimum key requirements in the policy and regulatory framework of the countries to support CBET.

1. Enabling provisions for CBET, such as eligibility criteria, non-discriminatory open access and approval procedures;
2. Regulatory and institutional provisions that can reduce the effort and time for CBET, such as standardization of procedures, and appointment of nodal agencies;
3. Provisions for regulatory harmonization and co-ordination with neighboring countries on matters related to CBET; and
4. Safeguards for network protection, procedure for recovery from outages, and protection of public interest during emergency.

Figure 27: Key requirements of policy and regulatory framework to support CBET



In South Asia, the above components are mostly restricted to only the basic enabling provisions in countries other than India. It will be rare to find examples of other countries in the region having put in place elements relating to harmonization, accelerators and safeguards relating to CBET. An exception is Pakistan, where is a regulation on approval of import power tariff by the regulator.

While the above four elements are up to the individual countries to implement, a wide agreement on these elements and their manner of implementation will help in having more harmonized policy and regulatory frameworks. Specifically, there exists potential for coordinated policies and regulations in the following areas:

1. Clear specification / identification of the authority responsible for providing approvals related to CBET (It will be up to the respective Governments to decide if this will be the ministry, regulator or utility.)
2. Specification of licensing/authorization/approval requirements for undertaking CBET, or constructing cross border electricity transmission lines;
3. Specification of eligibility requirements for entities to undertake CBET;
4. Principles for determination of transmission pricing, for regional interconnectors and transit arrangements;
5. Provisions to support access to power exchanges;
6. Provisions to support nondiscriminatory access to transmission networks;
7. Enabling provisions for third country transit; and
8. Regulatory provisions to enable the operation of power traders as market intermediaries and aggregators.

Similarly, the following regulatory and policy issues become relevant in the context of sustainable energy projects:

1. Unambiguous policy frameworks with a long term perspective to support sustainable energy;
2. Any regional benchmarks / targets / action plans on sustainable energy; and
3. Market mechanisms to support sustainable energy. (Power exchanges, certificate trading mechanisms etc.)

In the above areas, the policy makers and regulators in the region can further deliberate on how to approach such issues in a harmonized manner, while incorporating country specific adjustments on the overall approach agreed at the regional level.

SARI/EI studies on policy and regulatory harmonization

A detailed report on "Suggested Changes/Amendments in Electricity Laws, Regulations and Policies of South Asian Countries for Promoting Cross-Border Electricity Trade in the South Asian Region" is already available.[66]

The report analyzed the electricity laws, regulations and policies in South Asian countries and gave recommendations for amendment for the promotion of CBET under various key topics.

4.6 Need for regional institutional mechanisms

Regional institutions are important pillars for driving regional power trade. Institutions can play an important role in providing advisory and coordination support and can also act as market operators/ power exchanges. Efforts to create such regional institutions mechanism have proved to be successful in enhancing regional power trade. Some of the examples are as follows:

Southern African Power Pool:

Regional Electricity Regulators Association of Southern Africa (RERA) provides recommendations on harmonization of the regulatory framework as well as provide an enabling environment for investment in the region's power sector.

The SAPP Coordination Centre is in charge of coordinating activities of planning and expanding generation, transmission and distribution among member countries.

Regional Energy Market (MER) in Central American Interconnection

MER has a strong regional institutional framework in the form of CDMER (Coordination at intergovernmental level), CRIE (Development of regulations, dispute resolution), EOR (Development of commercial and operational procedures and reports, operation of regional transmission line, undertake transmission right auctions, manage contingencies and network congestions) and EPR (Build and maintain the regional transmission network).

Greater Mekong Sub-region (GMS) Power Market

The GMS power market is supported through Regional Power Trade Coordination Committee (RPTCC), which is comprised of officials from the energy departments and ministries. A more permanent institution - Regional Power Coordination Center (RPCC) is planned. The planned Regional Power Coordination Center (RPCC) will serve as a permanent institution to enhance regional power trade and implement regional power interconnection in the GMS.

ASEAN Power Market

ASEAN already has the presence of various institutions having a strong foothold in the member states working together to facilitate the transition of the market into a full-fledged regional power market. These include Heads of ASEAN Power Utilities (HAPUA), ASEAN Power Grid Consultative Committee (APGCC), ASEAN Centre for Energy (ACE), ASEAN Energy Regulatory Network, and LTMS PIP working group.

Nord Pool

In the initial days, Nord Pool was supported by Norden, founded in 1963 as a body for co-operation between the transmission system operators of Nord Pool. Once ENTSO-E was established, this function was taken over by ENTSO-E. The Agency Cooperation of Energy Regulators (ACER) approves the network codes, and coordinates the work of national regulatory authorities. Meanwhile, a more region specific association of regulators is also present, in the form of NordREG, which is an organisation for the Nordic energy regulators.

EU internal power market

The key coordination body on transmission within the EU internal power market is the European network of transmission system operators for electricity (ENTSO-E). ENTSO-E was established in 2009 and was given legal mandates by the EU's Third Legislative Package for the Internal Energy Market. The Agency Cooperation of Energy Regulators (ACER) approves the network codes, and coordinates the work of national regulatory authorities.

In summary, regional institutions can play a key role as important regional entities (CRIE and EOR in Central American Interconnection, ENTSO-E in Europe) or regional entities with an advisory and coordination role (RERA in SAPP, RPTCC in GMS, APGCC in ASEAN) etc.

In comparison to the above regions and the corresponding institutions, the South Asia region has been slow in developing institutional frameworks for regional energy coordination. Establishing permanent regional coordination bodies for transmission utilities, system operations, regulators etc. in SA could enable quicker decision making on arriving at harmonized procedures for regulatory, technical, operational and commercial management of trilateral / multilateral power trade. In this context, existing ideas / plans that were being supported by SARI/EI for organizations such as South Asia Forum of Transmission Utilities, South Asia Forum of System Operators and South Asia Forum of Regulators can be taken forward.

South Asia Forum of Regulators (SAFER)

Establishing forum/ association of electricity/ energy regulators of south Asian countries will be a critical step in promoting regional cooperation in energy sector. A transparent, stable regional regulatory framework for CBET supported through a regional regulatory institutional mechanism such as forum/agency/association of electricity regulators to take care of CBET regulations is critical for smooth and rapid expansion of trade of electricity among the south Asian countries and for creating a conducive environment for investment in CBET.

SARI/EI study on Regional Energy/Electricity Regulatory Institutional Mechanism in South Asia:

In 2016, SARI/EI had undertaken a detailed study on "Regional Energy/Electricity Regulatory Institutional Mechanism in South Asia". The study recommended options for setting up South Asia Forum of Regulators (SAFER) which will be a dedicated regional forum of electricity regulators that would help drive the agenda for building the necessary environment to support regional electricity integration, working in close coordination with various national electricity regulators, other regional entities and SAARC bodies.

South Asia Forum of Transmission Utilities (SAFTU)

On matters relating to CBET and regional cooperation, the planning can be optimised if the plans of the different countries are in harmony and are based on an integrated regional approach. A regional level technical institution such as South Asia Forum of Transmission Utilities (SAFTU (can facilitate towards such regional cooperation in a very effective manner and can play a potential role in the matters related to CBET. It can play a key role in activities such as integrated network/system planning, support in harmonisation of guidelines and operating codes, support regional efforts on renewable energy integration and grid balancing, and organize knowledge sharing and training sessions.

South Asia Forum of System Operators (SAFSO)

SAFSO is envisaged as a regional forum of system operators in South Asian countries for co-ordination on system operation and market operation from the perspective of accelerating CBET. SAFSO can deal with aspects such as facilitating the work of development and implementation of common procedures/ guidelines and frameworks for system operation and provide inputs/advice to the national regulatory agencies and provide technical support and assistance to Regional Regulatory Institutional mechanism and Regulators of South Asian countries on the matters related to system and market operation.

South Asia Forum of Electricity Market (SAFEM)

SAFEM is envisaged as a regional forum of electricity market participants in South Asian countries support market- based electricity trade in South Asian Region including bilateral, multilateral and collective electricity trade.

5. Transitioning to Trilateral/Multilateral Power Trade and Development of Regional Power/Energy Market and its implication on infrastructure development

5.1 Current status of CBET models and energy market models in South Asia

The power trade in South Asia is predominantly bilateral, be it in the eastern region between India – Bangladesh/Bhutan/Nepal, or in the western region, between Iran – Pakistan, Iran – Afghanistan, Tajikistan – Afghanistan, Turkmenistan – Afghanistan and Uzbekistan – Afghanistan. The trade is undertaken mostly under medium term and long term power purchase agreements. In the recent times, Nepal has also commenced undertaking energy banking with India, wherein surplus power exported from Nepal to India is adjusted against the overall drawal of power from India to Nepal on a net basis.

The availability of primary sources for electricity generation varies across the region, and the potential for operational synergy provide room for cross-border electricity trade cooperation in the region. Power Trading in South Asian countries is primarily driven by the fundamental characteristics of individual countries.:

- Countries like Nepal, Bhutan, Pakistan, Afghanistan have access to large hydropower resources but also experience seasonal power shortages;
- Bangladesh faces severe power shortages and relies heavily on domestic natural gas;
- India has large power needs with its rapidly increasing demand, and the power market is coal power dominated. Coal shortages, power deficits are an issue and there have been significant advances in clean energy development; and
- Countries like Maldives and Sri Lanka rely heavily on liquid fuel.

Within the South Asian region, there are multiple projects that are planned or ongoing, for strengthening of existing cross border electricity transmission links, and for building new cross border grid interconnections. In the backdrop of these initiatives, the power market model is expected to evolve further, beyond bilateral models.

5.2 Development of regional power market

Since most of the power trade in South Asia is bilateral, this unlocks only a limited trading regime. However, the regional power trade market is expected to transition to a trilateral model, with a third country offering wheeling facilities for the buyer and seller countries, who are otherwise not directly interconnected.

One of the trilateral transactions that might be finalised in the near future is the Nepal-India-Bangladesh trade, where the Indian grid will be used to wheel power from Nepal to Bangladesh. The Letter of Intent was issued in February 2020, for purchase of 500 MW of power by Bangladesh from the 900 MW Upper Karnali hydropower project in Nepal. [68] Also, Dorjilung hydropower project of 1125 MW capacity in Bhutan is being considered for trilateral trade. [69] This will allow Bhutan to export electricity to Bangladesh through India.

For unlocking the vast economic, reliability and environmental benefits to be fully realized, the power exchange needs harmonization of the appropriate policies and legal and regulatory frameworks in all the systems involved. The experience in India and a number of international power market developments show that legal and regulatory changes have been accomplished successfully.

Major developments for advancement of regional cooperation for energy have been ongoing in South Asian region on a gradual basis. In late 2014, the South Asian countries under the auspices of South Asian Association for Regional Cooperation (SAARC) agreed to a "framework agreement" for regional cooperation in electricity. The agreement contains broad-ranging provisions that could support the efforts for regional cooperation in electricity.

5.3 Potential benefits of trilateral/multilateral power trade, and regional sustainable energy infrastructure

While the benefits of bilateral power trade are widely known, there are additional benefits that are brought together by trilateral and multilateral power trade. This has also been proven in the international context. Some of the key potential benefits of trilateral/multilateral power trade are listed below.

Table 13: Benefits of trilateral/multilateral power trade

Benefits	Examples
Increased diversity in resource mix	Planned CASA-1000 where Pakistan will be able to tap into the vast hydropower potential of central Asian countries which are not neighbouring countries of Pakistan. The Laos – Thailand – Malaysia power trade, where Malaysia is able to obtain hydropower from Laos
Increased grid resilience - A larger grid allows sharing of reserves, and improves the grid's ability to absorb generation/transmission element outages	Gulf Cooperation Council interconnection – Provides support during more than 100 network incidents every year European common market
Improved energy security, including reducing regional weather related vulnerabilities	South African Power Pool (SAPP) where thermal power in South Africa can support other countries in the region in the times of draught.
Improved renewable energy integration	Nordic energy markets, such as wind-hydro balancing between Denmark, Norway and Sweden
Improved commercial viability – Access to cheaper power for buyers, and access to attractive markets for sellers	Central American interconnection - Nicaragua and El Salvador imports electricity from the regional market at a cheaper rate than their domestic market, whereas countries such as Guatemala, Panama and Costa Rica obtain a higher rate by selling their power to regional market

5.4 Opportunities and challenges in the transition to trilateral/multilateral power trade

In South Asia, there are various opportunities in the transition to trilateral/multilateral power trade. The eastern side of South Asia, comprising of Bangladesh, Bhutan, India and Nepal already have high voltage electricity interconnections. The countries in the region have also signed various bilateral power trade agreements / MoU such as those between India and Bangladesh, India and Nepal and Nepal and Bangladesh.

Another opportunity is the ready availability / presence of large power exchanges in India, which can also support expansion of the market area by adding new regions, subject to approval of governmental and regulatory authorities. These exchanges offer week-ahead, day-ahead, intra-day and real time markets. This should also be seen in the context of presence of traders as market intermediaries who can facilitate trilateral/multilateral trade involving India and other countries in the region.

Another key opportunity is the progress in development of explicit guidelines, regulations and rules relating to regional power trade, as is happening in the case of India. Such clarity in policy and regulatory provisions allow investors to better plan for utilizing the market opportunities in the region. Then there is also the potential for utilizing platforms such as South Asia Forum of Infrastructure Regulation (SAFIR) for regional discussions, till more dedicated regional regulatory cooperation frameworks are put in place,

Such opportunities can be tapped to further develop various trilateral/multilateral power trade arrangements such as:

- Planned new network under CASA-1000 from Central Asia to Pakistan through Afghanistan;
- Planned / future power trade between Nepal to Bangladesh and Bhutan to Bangladesh through India;
- Development of regional power plants and regional mechanisms for reserve sharing;
- Potential development of South Asian Power Exchange which can support the development of a multilateral power market in the region; and
- Potential linking of South Asian grid with South East Asia, through Myanmar.

However, there are also a few barriers / challenges that need be tackled, in order to make optimum use of the opportunities for trilateral and multilateral power trade. A few such challenges are described below.

1. **Physical connectivity**
   The cross transmission links are not adequate in the western side of South Asia. There are no high voltage, high capacity interconnections between Afghanistan and Pakistan (till CASA-1000 gets commissioned), and between these countries and rest of South Asia.

2. **Institutional frameworks**
   Compared to initiatives such as Greater Mekong Sub region (GMS), and Association of South East Asian Nations (ASEAN), the institutional frameworks for regional energy cooperation have not fully realised their potential in the case of South Asia. For example, ASEAN has ASEAN Power Grid Consultative Committee (APGCC), Greater Mekong Subregion has Regional Power Trade Coordination Center (RPTCC) and SAPP has SAPP coordination center and Regional Electricity Regulators Association (RERA). In comparison, similar institutional arrangements are lacking in South Asia.

3. **Dynamic Political Climate**
   The government-to-government model for cross-border trade typically involves lengthy political as well as technical negotiations, and this has not fully translated into political will for cooperation amongst the countries.

4. **Absence of a Platform for Cross-Border Regulatory Coordination**
   The absence of a platform for cross-border regulatory coordination is reflected upon management of key technical aspects such as rules and procedures concerning transmission access and its pricing, congestion management, operational codes and protocols for system operation, energy accounting and payment, and for seamless and stable operation of the transmission systems.

5. **Technical, operational and commercial frameworks**
   Regional level technical, operational and commercial frameworks are required to support the transition from bilateral power trade to trilateral and multilateral trade arrangements. This includes a broad consensus on aspects such as transmission pricing methodology, loss sharing, network access approvals etc. Such commonly accepted frameworks / practices are currently not present in South Asia.

5.5 Ongoing initiatives in SA for the transition to trilateral/multilateral power trade

For future CBET, the respective governments in have identified a set of projects for the gradual transition to trilateral from bilateral trade. This includes the following:

- CASA-1000 project, where Tajikistan and Krygystan will supply power of up to 1000 MW to Pakistan and 300 MW to Afghanistan.
- Bhutan has identified 1125 MW Dorjilung HPP as one of the potential power plants for supply to Bangladesh.[70]
- Bangladesh's PSMP envisages new import of 1496 MW in 2022, and additional 4500 MW of import between 2023 and 2035, and another 4500 MW of import between 2036 and 2041. Some of this could be from countries beyond India, such as Nepal and Bangladesh.
- Bangladesh has agreed to import 500 MW of power from the 900 MW Upper Karnali hydropower project in Nepal. Considering the involvement of Indian developer, rest of the power may be considered to be off taken in India.

Figure 28: Potential new trilateral power trade in South Asia

5.6 Key ingredients to enable trilateral/multilateral power trade

Based on a review of various international examples of trilateral/multilateral power trade, the following key enablers can be identified:

- Strong political support, to undertake regional cooperation expressed through entering into a binding treaty, and the follow-on activities;
- Dedicated institutional frameworks for regulatory coordination and harmonization;
- Permanent and well-equipped regional institution for operational and commercial coordination;
- Availability of a market platform such as power exchange to support multilateral power trade; and
- Availability of regional master plans on energy cooperation.

Among the above, the most crucial are the aspects of political support and institutional frameworks.

Political consensus among the member countries is a critical factor in enabling energy trade cooperation. Mutual understanding between the governments of the countries involved is needed to proceed on a synchronised footing. Intergovernmental Agreements while has been successful in developing bilateral trade to high volumes, especially among countries like India, Nepal, Bhutan & Bangladesh- this needs to be translated to initiate trilateral trading arrangement.

The regional institutions have played a key role in the case of European common market, SAPP, GCC interconnection and Central American Interconnection. Technical and regulatory coordination institutions will be a key element for future initiatives to enable trilateral/multilateral power trade.

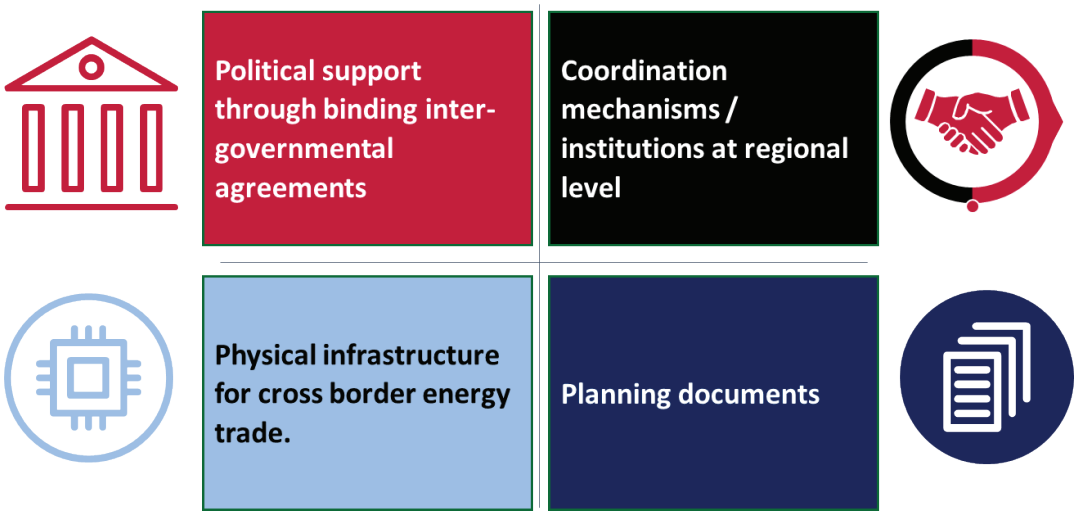
5.7 Framework for development of regional projects and trilateral/ multilateral power trade

The framework for development of regional projects and trilateral/multilateral power trade would be based on four key pillars:

1. A common inter-governmental agreement for energy cooperation;
2. Coordination mechanisms / institutions at regional level; and
3. Physical infrastructure for cross border energy trade.
4. Planning Documents

- **A common inter-governmental agreement for energy cooperation:** A binding regional electricity trade agreement among the South Asian countries can provide an umbrella framework to move toward a South Asian power market and facilitate appropriate legal and regulatory changes
- **Coordination mechanisms / institutions at regional level:** A regional mechanism for energy accounting, clearing, and settlement would be necessary. Coordination committee of the participating member states could be empowered to adjudicate between the parties involved in cross-border electricity trade. Similarly, a mechanism for regulatory coordination will also be required.
- **Physical infrastructure for cross border energy trade:** Transmission infrastructure development would help in developing cross-border links with adequate capacity to facilitate regional trade through a power exchange
- **Planning Documents:** Development of planning documents in coordination with all South Asian countries. Regional mechanism to develop transmission in a regional power market would require coordinated planning across countries in the region

Figure 29: Framework for development of regional projects and trilateral/multilateral power trade



5.8 Strategies to overcome challenges and develop regional sustainable energy infrastructure to support transition

The strategies to overcome challenges and develop regional sustainable energy infrastructure to support transition to trilateral/multilateral power trade in the region can be taken up at multiple levels:

1. Initially, with the consent of respective governments, the key power utilities in the region can discuss together on the roadmap for improving regional coordination, for trilateral/multilateral power trade, and identify the key areas where political support / consensus will be required.

2. Assisted by the findings of respective national power utilities, the governments can undertake discussions for binding commitments expressed through intergovernmental agreements. This should also cover the support for creation of regional institutions for coordination.

3. Once the regional institutions are in place, they should take the lead role in driving the efforts to support trilateral and multilateral power trade. A key element in this phase will be the regional institutional framework for coordination between the electricity regulators in the region.

4. In the long term, more advanced elements of competitive markets such as open access, non-discriminatory allocation of transmission, trading licensees and power exchanges will need to be put in place, without which a power market providing customer choice and competitive returns to private investors cannot flourish

6. Greening the South Asia Energy/Power System Infrastructure for a Sustainable Future: An investment perspective

6.1 Investment opportunities in greening the South Asia energy/power system

Various South Asian countries have set ambitious capacity addition targets for sustainable energy infrastructure. The recent history indicates that bulk of such clean energy investments are mobilized through private investments. Some of the key sustainable energy targets / roadmaps where there will be investment opportunities are listed below:

Afghanistan

Afghanistan's commitments under National Determined Contribution (NDC) under UN Framework Convention on Climate Change (UNFCCC) includes a target of 13.6% reduction in GHG emissions by 2030 compared to a business as usual (BAU) 2030 scenario, conditional on external support.

Bangladesh

In the power sector, Bangladesh aims to achieve 400 MW of wind generation and 1000 MW of utility-scale solar power plants by 2030. A range of measures are to be implemented. In the transport sector, it aims to achieve a shift in passenger traffic from road to rail of up to around 20% and a 15% improvement in the efficiency of vehicles due to more efficient running.

Lastly, it aims to achieve a 10% energy consumption reduction in the industry sector compared to the BAU.

Bhutan

Bhutan's NDC commitments to UNFCCC include:

- Offset up to 22.4 million tons of additional CO2e per year by 2025 in the region through the export of electricity from our clean hydropower projects;
- Promotion of low carbon transport system;
- Promote clean renewable energy generation; and
- Energy demand side management by promoting energy efficiency in appliances, buildings and industrial processes and technologies. [71]

India

India has specified its long term plans as part of its NDC document:

- Reduce the emissions intensity of its GDP by 33 to 35 percent by 2030 from 2005 level; and
- Achieve about 40 percent cumulative electric power installed capacity from non-fossil fuel based energy resources by 2030.

However, most recently, the Government has adopted a more ambitious target of 450 GW of renewable energy by 2030.

Maldives

Maldives intends to reduce unconditionally 10% of its Greenhouse Gases (below BAU) for the year 2030, which could be even 24% with external support. This includes adoption of renewable energy technologies for power up the islands.

Nepal

Key power sector target for Nepal is the development of 15000 MW hydropower by 2029. In addition, the Nationally Determined Contribution of Government of Nepal (GoN), published in 2016, has laid down the following targets:[73]

- By 2020, Nepal intends to expand its energy mix focusing on renewables by 20% and diversifying its energy consumption pattern to more industrial and commercial sectors; (The share of renewables in energy consumption mix has reached 3.21% as on initial 8 months of FY20. In addition, 3.88% of energy consumption is from electricity, of which nearly two-thirds is from hydro power plants.)
- Under National Rural and Renewable Energy Programme (NRREP), Nepal aims to develop 25 MW of mini and micro hydropower, 600,000 solar home systems, 1500 solar PV and solar pumping systems, 4000 improved water mills, 475,000 improved cooking stoves, 131,000 biogas systems and 200 community biogas plants.
- By 2050, Nepal will achieve 80% electrification through renewable energy sources having appropriate energy mix. Nepal will also reduce its dependency on fossil fuels by 50%;
- By 2050, Nepal will decrease its dependency on fossils in the transport sector by 50% through effective mass public transport means while promoting energy efficient and electrical vehicles; and
- Nepal will develop its electrical (hydro-powered) rail network by 2040 to support mass transportation of goods and public commuting.

Pakistan

Pakistan intends to reduce up to 20% of its 2030 projected GHG emission, as specified in its NDC document. Its Vision 2025 document envisages adding 25,000 MW of electricity to the national grid by 2025.

Sri Lanka

Sri Lanka's specific nationally determined contributions for the energy sector include:

- Establishment of large scale wind power plants of 514 MW;
- Establishment of 115 MW of solar power plants;
- Establishment of 105 MW of biomass power plants;
- Establishment of 176 MW of mini hydro power plants;
- Introduction of Demand Side Management (DSM) activities;
- Strengthening sustainable energy related policies with a view to increasing the share of renewable energy from the existing 50%, to 60% in 2020; and
- Converting existing fuel oil based power plants to LNG.

6.2 Potential areas for private sector investment in CBET

Private sector investment is also possible in cross border electricity trade, in the following areas:

1. Development of large export oriented projects in countries such as Nepal and Bhutan;
2. Development of renewable energy power plants in countries such as India, Bangladesh, Pakistan, Afghanistan, Sri Lanka and Maldives; and
3. Investment in cross border lines, subject to policy and regulatory provisions in respective countries.

For example, a company set up in Nepal by Korean companies have signed an agreement for developing 216 MW Upper Trishuli I project, at a cost of US$ 453 million. The financing agreement has already been signed with nine international banks and financial institutions led by International Finance Corporation (IFC).

In addition, there will be opportunities in sustainable energy infrastructure development within the South Asian countries, such as:

- Renewable energy and de-carbonizing power generation;
- Cleaner and efficient public transport;
- Electric vehicle & charging infrastructure;
- Natural gas, LNG and region gas grid; and
- Modernizing power grid - smart grid, smart utilities etc.

6.3 One Sun, One World and One Grid (OSOWOG) Initiative

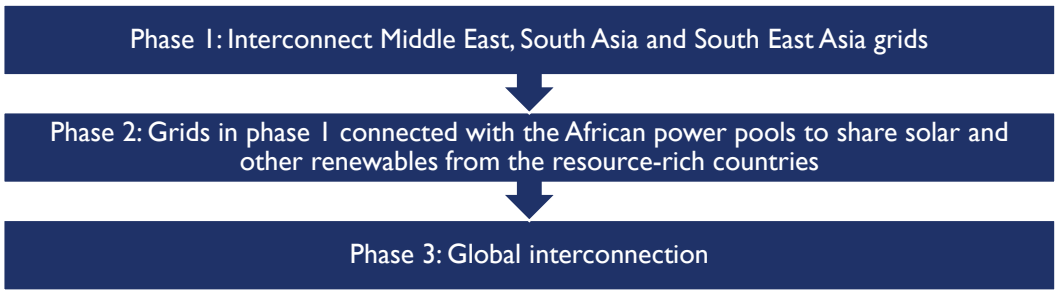
A case in example for the potential for investments in sustainable energy infrastructure is the One Sun, One World and One Grid (OSOWOG) Initiative. India has advocated for this idea of a trans-national electricity grid supplying solar power across the globe.

According to the draft plan of the Ministry of New and Renewable Energy (MNRE), the ambitious OSOWOG will connect 140 countries through a common grid that will be used to transfer solar power. The vision behind the OSOWOG mantra is 'The Sun Never Sets' and is a constant at some geographical location, globally, at any given point of time.

The OSOWOG initiative is planned across 3 phases:

- **Phase I** (Middle East-South Asia-South East Asia (MESASEA) interconnection): Indian Grid interconnection with Middle East, South Asia and South-East Asian grids to share solar and other renewable energy resources for meeting electricity needs including peak demand;
- **Phase II** (Solar and other Renewable Energy resources-rich regions' interconnection): MESASEA grid getting interconnected with the African power pools to share solar and other renewable energy power of the countries located in solar and renewable energy-rich areas; and
- **Phase III** (Global interconnection): to achieve the One Sun One World One Grid vision.

Figure 30: Plan for OSOWOG



An interconnected grid under OSOWG would help all the participating entities in attracting investments in renewable energy sources as well as utilizing skills, technology, and finances. Further, the proposed integration would lead to reduced project costs, higher efficiencies, and increased asset utilization for all the participating entities. If the plan proceeds further, this will be one of the largest investment initiatives for sustainable energy infrastructure.

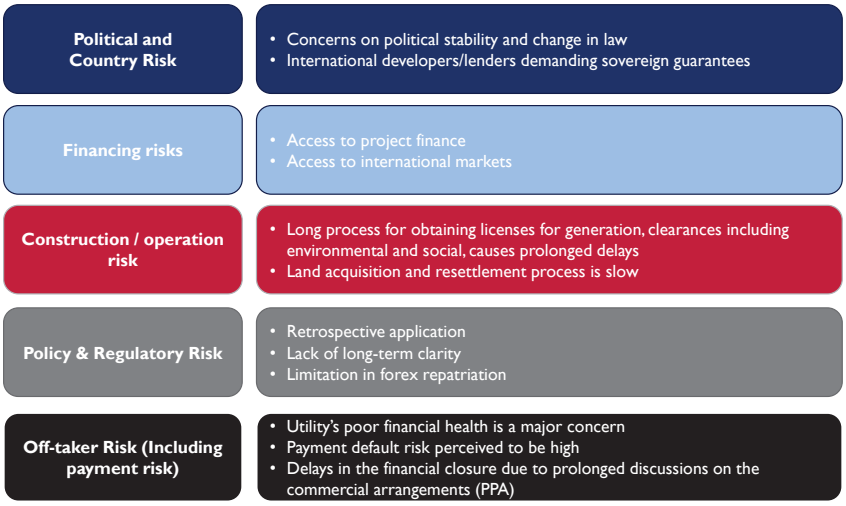
6.4 Challenges and risks for investment in greening the South Asia energy/ power system

Investment scenario for sustainable energy infrastructure in South Asia faces various challenges and risks:

1. Across the region, there are challenges of low compliance to contracts, dynamic/volatile policy and legal regime, and slow judiciary processes.
2. In countries such as Nepal, there is no concept of pure project financing. A high level of collateral is required for accessing domestic financial market. There are also foreign exchange restrictions, limiting the developer's ability to repatriate the earnings.
3. There are also cases such as that of Bhutan, where at least a partial government ownership is preferred for large generation projects, instead of pure private sector IPPs.

A list of similar risks is provided below:

Figure 31: Risks to sustainable energy investments



Examples:

Construction and operation risks

The project to develop 750 MW West Seti hydropower project in Nepal was cancelled by China Three Gorges Corporation (CTGC) citing increased costs of resettlement and rehabilitation, that made the project commercially unviable.

Offtaker risk and financing risks

The Project Development Agreement (PDA) for 900 MW Upper Karnali hydropower project in Nepal was signed between Government of Nepal and the developer in 2014. Even after seven years, due prolonged discussions on the commercial arrangement, financial closure for the project has not yet been achieved. In 2020, Bangladesh has issued letter of intent for purchase of 500 MW of power. Even then, financial closure has not been declared, as on February 2021.

6.5 De-risking energy investments

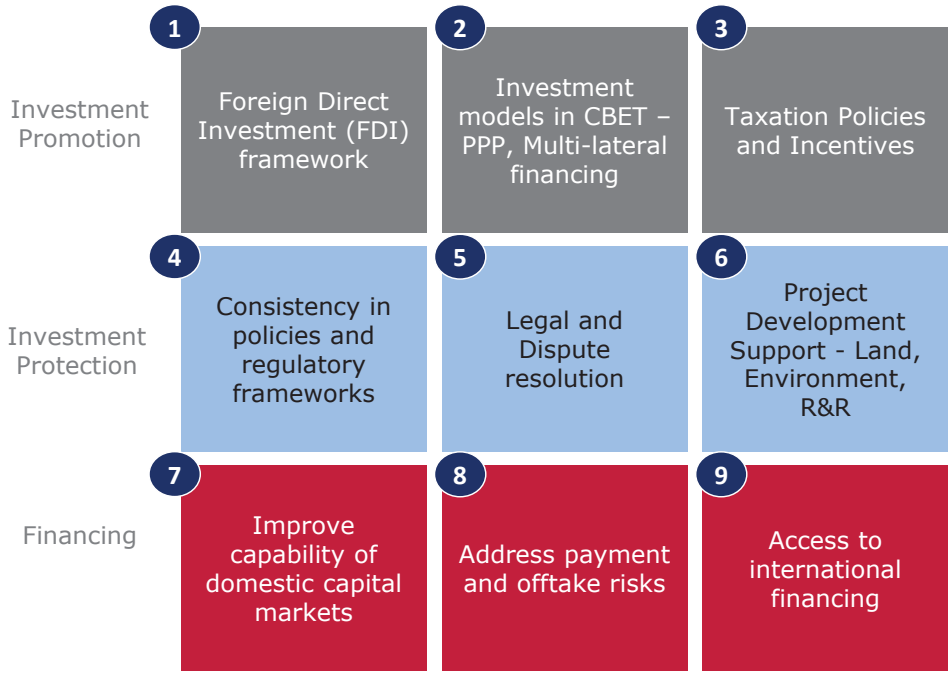
Considering the above challenges and risks, there is a need for de-risking of energy investments, which could happen in the following manners:

- Policy makers and regulators to offer more long term policy roadmaps, with long term certainty on offered benefits;
- Government and utilities to take steps to address payment default risks and breach of contract by Government owned energy utilities, through institutional and judicial reforms, and offering risk mitigation support directly, or with the support of development financing institutions;
- Develop institutional structure for faster legal and dispute resolution, including alternate dispute resolution;

- Provide one-stop services for assistance for projects to deal with multiple governmental entities/ departments;
- Allow investors to access foreign exchange and international financial markets;
- Undertake more practical risk sharing under PPP contracts, rather than offloading risks that developers practically cannot be expected to bear;
- Provide clear investment framework, taxation policies and incentives; and
- Support / promote the introduction of innovative financing instruments, which is described further in the next section.

The above can be further expanded and grouped in the following matrix of de-risking strategies for investment.

Figure 32: De-risking strategies for investments



The above de-risking strategies will have to be viewed and adopted along with the judicious choice of various risk mitigation instruments.

Figure 33: Risk mitigation instruments

Instrument	Description	Examples of institutions providing the instrument
Political risk insurance	Risk insurance against events such as nationalization by the Government, breach of contract by the Government, currency transfer restrictions, war, terrorism and civil unrest.	Multilateral Investment Guarantee Agency
Partial risk guarantee	Partial risk sharing between the insurer and the Government, typically through a dedicated fund. This lowers the moral hazard associated with 100% insurance.	The World Bank
Partial credit guarantee	Covers part of the debt service default by the borrower regardless of the cause of default.	Asian Development Bank
Government guarantee	Government / sovereign guarantee promises to meet payment and other contract obligations, of either the Government of any Government owned enterprises.	Sovereign Governments

¶These instruments are discussed further with examples, below.

- **Political Risk Guarantee**
  Offered by Multilateral Investment Guarantee Agency (MIGA). MIGA price its guarantee premium based on a calculation of both country and project risk. Fees average approximately one percent of the insured amount per year. Coverage is usually provided for up to 15 to 20 years.

MIGA provided $91 million in political risk insurance for Nam Theun 2 hydropower project in Laos. The bulk of the guarantee, $86 million, is covering a non-shareholder loan by BNP Paribas.

MIGA's guarantee was key to lowering the project's risk profile, which in turn enabled the government and developers to attract commercial financing at better rates and gave the investor the assurance needed to go ahead with the deal. MIGA's guarantee complements a $50 million partial risk guarantee issued by the World Bank, as well as a $20 million grant from the International Development Association.[76]

Partial Risk Guarantee Funds (PRGF)
World Bank guarantee program provide partial risk mitigation for obligations due from government and government-owned entities to private investors. Guarantee is also available to foreign public entities in the case of cross-border projects. Such guarantees can bring down the overall risk perception on payment risks / payment defaults. The guarantees are typically either:

- Loan Guarantee: Risk mitigation to commercial lenders with respect to debt service payment defaults caused either directly or indirectly by government failure to meet obligations under Power Purchase Agreement; or
- Payment Guarantee: Risk mitigation to private projects, or to foreign public entities with respect to payment default on non-loan related obligations by government, such as payments under Power Purchase Agreement, or termination payment due to a Support / Implementation Agreement.

The guarantee is primarily dependent upon an indemnity agreement signed between the World Bank and the Government of host country of project

The Maldives Ministry of Environment and Energy, with support from the World Bank and from the Scaling Up Renewable Energy Program (SREP), a funding window of the Climate Investment Fund (CIF), has designed a 12 million USD program, named as ASPIRE (Accelerating Sustainable Private Investments in Renewable Energy). The program focuses on development of solar photovoltaic (PV) rooftop Installations in Maldives.

Under the first phase of ASPIRE, 4 MW of solar PV systems were built on public buildings in Malé, the capital, and Hulhumalé, a large residential island nearby. The projects were built under DFBOOT model, and power is supplied to the state owned utility – State Electricity Company Limited (STELCO), under a 20 year, dollar denominated PPA. The developers were selected through tariff based competitive bidding.

- To mitigate the risks, and improve the attractiveness of project for the bidders, an escrow fund and a partial risk fund for termination was provided:
- To mitigate the utility's payment risk, the government funded a six-month escrow account using an SREP grant. The solar power seller is empowered to draw on the account if a payment is delayed, thus mitigating liquidity risk for the investor. STELCO and the government then have an obligation to replenish the account during a "cure period".

In case of failure of STELCO and government to replenish the escrow account, a guarantee from the International Development Association (IDA) - the concessional lending arm of the World Bank Group, will partially cover the government's termination obligations.

In this manner, risk is shared between the private investor and the government, with the help of risk mitigation support from the World Bank.[77]

Sovereign / Government Guarantee
ADB provides partial credit guarantee to lenders for most forms of debt. The guarantee covers nonpayment by the borrower or issuer (for any reason) on the guaranteed portion of the principal and interest due, usually for a period of 15 years.

Partial credit guarantee can be applied to loans or other debt instruments issued by private and public sector projects (limited recourse financing), public–private partnership, corporate, as well as (sub) sovereign entities. The guarantee is provided to project, in which ADB has participation.

Unless covered by a sovereign guarantee / indemnity, the partial credit guarantee shall be limited to 25% of the total project cost, and is further limited to a maximum amount of $250 million. The cost of a guarantee typically consists of three components: a front-end fee, an annual guarantee fee, and a commitment fee.

ADB issued guarantee for 676 MW Tiwi and MakBan geothermal power projects in Philippines, to assist the project owner in its transition from an all-equity financing to a more conventional debt–equity mix, through the issuance of a project bond.

ADB has agreed to cover up to 75% of scheduled principal payments and interest of the ten-year project bonds under partial credit guarantee assistance.[78]

- **Sovereign / Government Guarantee**
  Government guarantees are required by many development funds to ensure lenders that the project is fully supported by the national government in the country where the project is taking place, including covering full default risk. This continue to be one of the most prevalent measures for providing payment security and are widely adopted for energy projects. However, these are getting less common as the fiscal space available for Governments reduce.

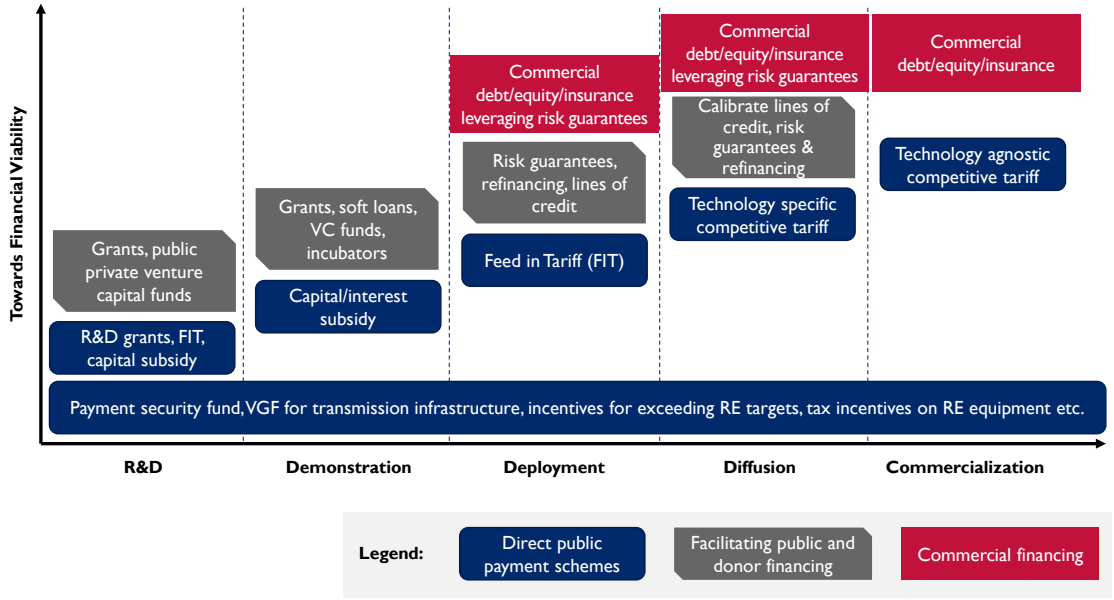
6.6 Innovative financing instrument/mechanisms

The choice of the financing instrument/mechanism for sustainable energy technologies should be viewed in the context of the life-cycle of that technology's development in the respective country/ region. In particular, distance the technology has to travel to be purely commercial and competitive in nature this determines the extent of public funding support required over the entire program cycle.

For example, established technologies such as solar power are under commercialization phase, which can now be supported through competitive tariff based auctions. There is no more a case for supporting such projects, at least for large scale plants, through mechanisms such as capital subsidies. In comparison, newer technologies such as fuel cells or offshore wind power plants may require different forms of support. While this is the case for revenue mechanism, there exists similar distinction for financing options also.

Technologies in the early adoption, or projects developed in special circumstances may require grants, soft loans etc., whereas technologies in deployment or wider diffusion face can utilize commercial financing, along with risk mitigation mechanisms such as risk guarantees and line of credit.

Figure 34: Financing support for sustainable energy technologies



Source: The World Bank[79]

Therefore, going beyond conventional commercial financing, there are various financing instruments / mechanisms that are available. A few illustrations of innovative financing instruments are listed below:

- Access to **bond market (including green bonds).** This also includes bonds in international market, designated in domestic currency.

  Bond financing tends to be difficult for pre-construction and construction stage projects because investors typically require a few years of operational history from the underlying assets. Bond financing has thus mainly worked as a refinancing option for operative renewable energy assets and asset pools.

  Various RE IPPs in India already utilize this route of international bond market, for refinancing their portfolio;

- Clean energy **market mechanisms** such a Certified Emission Reduction (CER) certificates in Europe and Renewable Energy Certificates (REC) in India.

- **Interest subsidy schemes** in lieu of capital subsidy / grants from the government – Long term support instead of one time support. Also does not impact competitiveness of equipment prices, in comparison to capital subsidy.

- **Yieldcos** - A yield co is created around a project or number of projects that are producing predictable, stable cash flows. These cash-generating projects are grouped together and "spun off" into a separate, publicly traded company. Doing this separates the risky projects, still under development from the de-risked projects already completed, lets the parent company recoup capital, and provides investors a stable investment option.

- Creation of **fund-of-funds** – A larger fund with Governmental / multilateral backing, supporting projects indirectly through smaller funds.

- Example: The Global Energy Efficiency and Renewable Energy Fund (GEEREF) is a Fund-of-Funds advised by the European Investment Bank Group. GEEREF invests in private equity funds which, in turn, invest in private sector projects, thereby further enhancing the leveraging effect of GEEREF's investments.[80]

6.7 Role of institutions/forums

To support, protect and manage investments in regional energy assets, a coordinating agency may be considered for South Asia, such as a "South Asia Forum for Energy Investment (SAFEI)". This agency can perform its duty in close coordination with national level authorities/departments of member countries. The coordination agency's roles could include the following:

1. Facilitate in standardization of key elements of power purchase agreement and other contract documents to harmonize capital investment experience in the region;
2. Facilitate capacity building among member countries for awareness of protecting the investments made in regional CBET projects;
3. Assist in financing of priority projects and actively market them to investors for the development;
4. Act as a facilitator and build consensus for integration of capital markets in the region for the purpose of financing large scale cross border projects;
5. Act as a single window for proving information regarding projects and investment requirements and available risk mitigation instruments in the member countries; and
6. Provide forum for discussion of important issues such as pricing, dollar denominated PPA and other enabling factors to smoothen investment experience in the region.

7. Institutional Efforts for the Sustainable regional energy infrastructure and Cross border electricity trade (CBET) and Energy Sector Integration in SA Countries

7.1 South Asia Forum for Infrastructure Regulation (SAFIR)

Established in May 1999, with the support of The World Bank, the South Asia Forum of Infrastructure Regulators (SAFIR) focuses on providing high capacity training and capacity building on Infrastructure regulation. The objectives of the forum are:

- Provide a platform for experience sharing amongst the regulators of the region;
- Build regulatory decision-making and response capacity in South Asia;
- Facilitate the regulatory process;
- Conduct training programs to serve regulatory agencies and other stakeholders;
- Spur research on regulatory issues; and
- Provide a databank of information relating to regulatory reform processes and experiences.

As per the Memorandum of Association of the forum, a Steering Committee is formed comprising all the members. Further an Executive Committee is formed consisting of a representative each from India, Bangladesh, Pakistan, Nepal, Bhutan and Sri Lanka.

Members of SAFIR include academic institutions, Consumer bodies/ NGOs, Corporate/Utilities and Regulatory bodies including Energy Regulators.

In order to overcome the constraints due to time, space and organizational boundaries, SAFIR forms "Virtual Working Groups" from amongst the representatives of the Member organizations, to discuss, deliberate various issues of great importance to the infrastructure sector. The SCM (Steering Committee Meeting) and the ECM (Executive Committee Meeting) of the SAFIR are also held at regular intervals.

Some of the key activities of SAFIR include:

- Organizing a 'Core course on infrastructure regulation';
- Annual general meeting; and
- Organizing investor conferences on issues relating to regulation.

7.2 South Asian Association for Regional Cooperation (SAARC)

There have been efforts at the level of SAARC to promote energy sector co-operation in the region. The most significant achievement of SAARC in this regard was the signing of SAARC Framework Agreement for Energy Cooperation (Electricity) by the SAARC Member States in November 2014. The Framework Agreement lays down the guiding principles for enabling cross-border trade of electricity on voluntary basis, between 'Buying and Selling Entities' of the SAARC Member States. As per the Framework Agreement, the "Member States may enable cross-border trade of electricity on voluntary basis subject to laws, rules and regulations of the respective Member States and based on bilateral/ trilateral/ mutual agreements between the concerned states".

SAARC also put forward the vision of a 'SAARC Energy Ring' consisting of interconnection that form SAARC power grid and SAARC gas grid, and a SAARC Market for Electricity (SAME).

Under SAARC, the SAARC Energy Centre was established on 1stMarch 2006, with the objective of serving as a regional institution of excellence for the initiation, coordination and facilitation of SAARC programs in energy. The Centre is envisaged to provide technical inputs to the SAARC Working Group meetings on Energy, and facilitate accelerating the integration of energy strategies within the region by providing relevant information and expertise.

The key activities of SAARC Energy Centre are:

- Development of various study reports related to energy sector in SAARC;
- Compilation of Energy Data Books;
- Development of an Energy Data Portal;
- Organize seminars, workshops and conferences;
- Provide training; and
- Provide support to SAARC Working Group (and other) meetings on Energy.

Another organization that operates for regional coordination within SAARC is the Council of Experts of Energy Regulators – Electricity (CEERE). CEERE serves as a regional forum to discuss, share knowledge, and achieve consensus on harmonized rules to enable bilateral and multilateral power trade in the SAARC region.

7.3 Asian Development Bank (ADB)

ADB had launched multiple projects, mainly for providing technical assistance, on activities to promote cross border energy trade in South Asia and South East Asian regions. A list of key projects and activities related to the same, undertaken by ADB in the past five years are listed below.

Table 14: Key projects of ADB on regional cooperation in energy in South Asia

South Asia Subregional Economic Cooperation Regional Energy Cooperation, 2018	The regional knowledge and support technical assistance (TA) will prepare development master plans and enhance capacity development for the energy sector's regional cooperation and integration (RCI) under the South Asia Subregional Economic Cooperation (SASEC) program. It will cover Bangladesh, Bhutan, India, Maldives, Myanmar, Nepal, and Sri Lanka.
Central Asia South Asia Regional Electricity Market (CASA REM) Project	Technical assistance to help prepare the Central Asia –South Asia Regional Electricity Market (CASAREM) power transmission project.
South Asia Economic Integration Partnership - Power Trading in Bangladesh and Nepal, 2014	Conduct feasibility studies on establishing power trading companies in Bangladesh and Nepal; Develop databases from Bangladesh and Nepal to for the South Asia Sub-regional Economic Cooperation (SASEC) Regional electricity transmission plan; and Support to improve networking of Bangladesh and Nepal officials with their counterparts in other SASEC countries.
South Asia Subregional Economic Cooperation Cross-Border Power Trade Development, 2014	Identify the most economical cross-border power transmission options along with the selected power generation development plans.

Source: ADB[81]

7.4 The World Bank

The World Bank has played a key role in promoting and supporting regional energy trade within South Asia, through its Nepal-India Electricity Transmission and Trade Project. The project aims to establish a high voltage cross-border transmission link between India and Nepal of about 1,000 MW to facilitate electricity trade between the two countries.

As part of the project, the World Bank has provided financing for the construction of 400 KV Dhalkebar – Muzaffarpur cross border transmission lines, Hetauda-Dhalkebar-Inarwa Transmission Line and Substations and a few related activities. More than 80 million USD of financial assistance has been disbursed so far.[82] The 400 KV Dhalkebar – Muzaffarpur cross border transmission line played a key role in solving the energy deficit of Nepal, by allowing it to import energy from India. World Bank has also undertaken a study on how cross-border electricity will trade stimulate hydropower development in South Asia[83].

World Bank is also financing the Central Asia South Asia Electricity Transmission and Trade Project (CASA-1000), with grants and loans of over USD 500 million.[84]

7.5 USAID's SARI/EI program

Over a decade, the US Agency for International Development (USAID) has been consistently striving for the promotion of energy security and regional energy integration in the South Asian nations. The USAID launched the South Asia Regional Initiative for Energy (SARI/E) program in 2000 covering eight countries of Afghanistan, Bangladesh, Bhutan, India, The Maldives, Nepal, Pakistan and Sri Lanka. The first three phases of the program focussed on the areas of:

1. Cross-border energy trade (CBET)
2. Energy market formation and
3. Regional Clean Energy development

The South Asia Regional Initiative for Energy Integration (SARI/EI) Phase IV, the final phase was launched in 2012 to advance regional energy integration and increasing CBET. The program is implemented by Integrated Research and Action for Development (IRADe).

The SARI/EI program is working towards promoting integration of energy systems and enhance Cross Border Energy Trade among the participating South Asian countries. Some of the key areas of focus of SARI/EI relating to regional energy integration are listed below.

Table 15: Key areas of focus of USAID's SARI/EI program

Coordination of Policy, Legal and Regulatory Issues	Defining ground rules for allocation of cost and risks, and creating an enabling environment for investors both in generation and transmission
Advancement of Transmission Systems Interconnection	Technical and operational aspects related to implementation of sub-regional bilateral transmission interconnections in the eastern sub-region of South Asia.
Establishment of South Asia Regional Electricity Markets	Exploring market-driven commercial practices in power trading (including long term contractual instruments and short term power trade in exchanges)
Other activities	Macroeconomic studies and modelling on benefits of CBET Compilation of country energy data Organization of workshops, study visits and trainings

Source: SARI/EI - https://sari-energy.org/about-sariei/sariei-phase-iv/

Figure 35: A few study reports of SARI/EI

All the study reports of SARI/EI are available at https://sari-energy.org/

7.6 Other US led initiatives

In 2018, the U.S. Government (USG) launched the Asia Enhancing Development and Growth through Energy (Asia EDGE) initiative to support the growth of sustainable and secure energy markets across the Asia-Pacific region. Asia EDGE has four strategic objectives:

(1) Strengthen the energy security of regional partners;

(2) Create open and transparent energy markets (gas and electricity);

(3) Improve free, fair, and reciprocal energy trading relationships; and

(4) Expand access to affordable, reliable energy.

To achieve a comprehensive approach towards Asia EDGE, the initiative consists of four technical pillars:

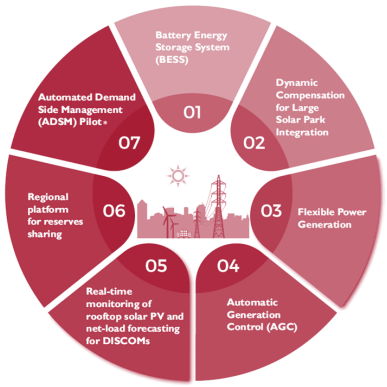
Enhanced regional energy markets and integration	Increased deployment of advanced energy solutions and systems	High performing modern utilities	Private sector investment and services mobilized (including transparent, best value procurement

Asia EDGE is a whole-of-government endeavour, supported by USAID; Departments of State, Energy, Commerce and Treasury; Export Import Bank; U.S. Trade & Development Agency; and Overseas Private Investment Corporation.

To accelerate the implementation of Asia EDGE in South Asia, USAID/India has tasked the U.S. Energy Association with launching a series of inception activities that will establish a regional energy cooperation platform – the South Asia Regional Energy Hub (SAREH). SAREH will promote the development of economical, reliable and clean energy access across South Asia, while supporting U.S. strategic interests and growing private sector engagement in the Indo-Pacific to create investment opportunities for U.S. companies. SAREH will engage a suite of stakeholders across the region and will coordinate interventions with USAID bilateral and regional missions, other USG agencies supporting the initiative, private sector entities national governments, international donors and financial institutions, and civil society organizations. SAREH will include three program areas: (1) coordination, (2) communication, and (3) technical support.

USAID has also supported various pilot projects and initiatives, which in the longer term could support the development of sustainable energy infrastructure. For example, USAID, under its "Greening the Grid" program have supported the implementation of seven pilot projects, which could contribute immensely towards growth of sustainable energy.

Figure 36: Pilot projects under USAID's Greening the Grid program



1. BESS	Test the technoeconomic effectiveness of grid connected BESS in providing balancing and other ancillary services
2. Dynamic compensation	Identify specific dynamic compensation measures including design enhancements to inverters and deployment of grid level compensation such as STATCOMs
3. Flexible power generation	Improving flexibility of coal power plants, in terms of ramp rates and technical minimum operation
4. Automatic generation control	Evaluating secondary response through AGC
5. Real-time monitoring of rooftop solar	Test efficacy of smart meters for real-time monitoring of distributed rooftop solar PV generation
6. Regional reserve sharing	Test and implement a platform and mechanisms for day-ahead and intra-day sharing of reserves between utilities in a region
7. ADSM	Use of ADSM to balance the power grid as the proportion of RE increases, and to address the power quality issues

Source: Greening the Grid[85]

8. Summary and way forward

8.1 Key findings

South Asia is a region which is highly vulnerable to adverse impact of climate change. Maldives and Sri Lanka are islands, which get directly impacted due to rising sea levels. Bangladesh, India, and Pakistan also have long coast lines. Even the landlocked countries of Nepal and Bhutan are in the ecologically sensitive Himalayan region, where the risk of impact of global warming, though melting of snow is higher. At the same time, availability of energy is also to be ensured, as it is linked with the overall socio-economic development. Thus, the energy infrastructure being planned and developed for the region should be sustainable, from environmental, social and commercial perspectives.

Regional energy cooperation in the South Asian region is driven by aspects such as:

- Access to electricity and demand-supply gap;
- High and growing dependence on fossil fuel import;
- Demand diversity and resource complementarity;
- Climate change and need for sustainable power sector development;
- Synergies in power system development and operation and renewable energy integration and regional grid balancing;
- Clean and sustainable energy technology transfer;
- Clean and sustainable energy technology research and development; and
- Regional political stability and welfare.

There are various international experiences, within and outside South Asia, on how cross border energy trade supports the development of sustainable energy infrastructure. These international experiences can serve as an inspiration for South Asian countries and can serve as a reference point for deriving the key learning to apply in the South Asian context. The most important success factors identified from the international experiences can be summarized to four points:

Need for inter-governmental agreements, or understanding	**Joint ownership: Allows ensuring support on both buying and selling side**	**Cost sharing: Common understand on the manner of cost sharing for the project**	**Role of development financing institutions - improving project viability through grants and low interest loans**

Based on the experience of development of sustainable energy technologies in South Asia, the following key success factors / drivers can be found relating to the policy and regulatory frameworks:

1. Government policy on fiscal incentive, such as those in the form of Accelerated Depreciation benefits drives the initial years of growth of sustainable technologies.
2. The early stage of sustainable energy technology development was also supported by the feed-in-tariffs determined by the regulators, which provided an assured tariff to developers. Once there is a minimum scale achieved, the regulatory framework was able to transition to an auction based mechanism for RE development.
3. The RE development was almost entirely driven by private sector, due to the unrestricted participation allowed for private sector IPPs.
4. Long term certainty matters. For example, in India, this was brought through the lifetime inter-state transmission charge and loss exemption for solar and wind power plants at inter-state level; and long term RPO trajectory.
5. The practice of indexing the tariff with inflation components, foreign exchange variation etc. has been comfortable to the developers, in terms of reducing their risks.

Advancing the CBET framework requires a coordinated effort by countries in SA for establishing a supporting regulatory and policy framework. Examples of successful regional power pools internationally provide similar insights with countries entering into inter-governmental agreement/ MoU, and a set of detailed agreements/ procedures/ guidelines/ rules governing the power trade. Similarly, regional institutions can play an important role in providing advisory and coordination support and can also act as market operators/power exchanges. Efforts to create such regional institutions mechanism have proved to be successful in enhancing regional power trade.

Based on a review of various international examples of trilateral/multilateral power trade, the following key enablers can be identified to support the transition of South Asian power market from bilateral trade to trilateral and multilateral modes:

- Strong political support, to undertake regional cooperation expressed through entering into a binding treaty, and the follow-on activities;
- Dedicated institutional frameworks for regulatory coordination and harmonization;
- Permanent and well-equipped regional institution for operational and commercial coordination;
- Availability of a market platform such as power exchange to support multilateral power trade; and
- Availability of regional master plans on energy cooperation.

Meanwhile, to protect the investments in sustainable energy technologies, de-risking strategies, risk mitigation instruments, and innovative financing instruments may have to be utilized. This includes risk mitigation through dedicated instruments such as MIGA's political risk insurance, World Bank's Guarantees and through use of innovative financing mechanisms such as green bonds, yieldcos and fund-of-funds.

8.2 Way forward for development of regional sustainable energy infrastructure and CBET

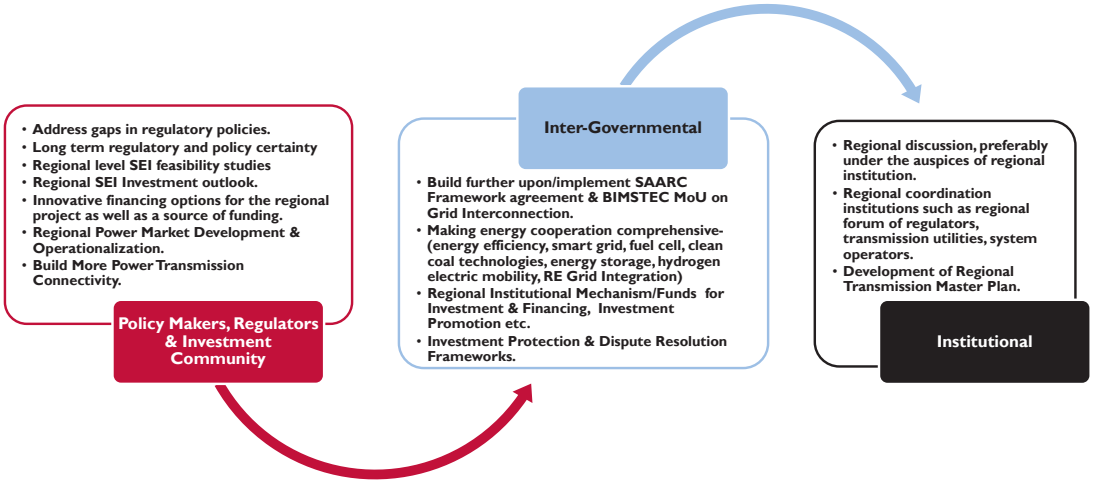
The existing success stories in CBET, energy efficiency measures and renewable capacity additions need to be replicated across the region. To materialise these investments, a conducive and cooperative political, economic and investment friendly environment is required in the South Asia region. There are certain initiatives which can be taken up for enhanced energy cooperation in the region, such as:

1. Plan follow-on protocols and agreements to implement the SAARC Framework Agreement, creating more binding provisions, and providing support for creation of new institutions.
2. Development of an Action Plan for Comprehensive Energy Cooperation in South Asia.
3. Development of detailed master plans for energy cooperation, identifying the regional level projects and implementation modalities. This could also be in the nature of outlook documents. SARI/EI has been working with developing Energy Outlook for BIMSTEC, with a future vision of up to 2030. In the context of South Asia, an "South Asia Investment Outlook" study may be considered, that can identify the key potential projects for regional sustainable energy infrastructure.
4. In line with international examples such as that of transmission plan development by ENTSO-E, develop mechanisms to undertake regional level feasibility studies for cross border electricity transmission lines in South Asia and sharing cost models.
5. Member countries to start developing investment memorandum and investment fact sheets and organize regional and international investment road shows for the regional sustainable energy infrastructure projects, in line with international leading practices.
6. To support, protect and manage investments in regional energy assets, an investment forum or investment coordination agency may be considered for South Asia. This agency can perform its duty in close coordination with similar national level authorities/departments of member countries; and
7. Set up regional coordination institutions such as regional forum of regulators, and regional institution for technical and commercial coordination.

Once these basic aspects are implemented, the next phase of regional coordination, including the development of a seamless energy market will be easier to get adopted and implemented, as

supporting policy, institutional and physical framework will already be available. In parallel to the efforts for South Asian energy grids and energy markets, the South Asian countries can also cooperate among each other on sharing of leading practices and successful strategies for implementation of energy efficiency measures, distributed generation, smart grid initiatives, fuel cell, clean coal technologies, energy storage, electric mobility and renewable energy integration.

Figure 37: Regional cooperation strategies and roadmap



While the potential opportunities and key questions regarding sustainable energy infrastructure are considered by the policy makers, the institutional aspects will also require attention. The regulators and utilities may start discussions with their governments on the need to support regional institutions and regional agreements that can promote regional sustainable energy infrastructure.

8.3 Key areas for discussion

The policy makers, regulators, utilities, governments and investors in the region may focus on the following areas of discussion, while speaking about the ideas behind this document:

Policies and regulations for sustainable energy infrastructure

While CBET has been gradually increasing in South Asia, there are several challenges that post as barriers to scaling up to its full potential. This includes problems related to development of cross border transmission lines, and absence of multilateral regional institutional frameworks. The investments in the region also face issues of lack of long term policy and regulatory certainty, including certainty in tariff frameworks, benefits, environmental compliance and taxation. Considering these aspects, the following discussion points emerge:

1. How can South Asia scale up the development of sustainable energy infrastructure, by learning from the leading practices of other countries?
2. How can policy and regulatory frameworks support the investors of regional sustainable energy infrastructure?
3. What is the role of regulator in the development for sustainable energy infrastructure?
4. Considering the learnings from South Asia, whether it is time to start discussions on setting up regional cooperation entities such as the South Asia Forum of Electricity Regulators (SAFER).

Transitioning to trilateral/multilateral trade

Since most of the power trade in South Asia is bilateral, this unlocks only a limited trading regime. However, the regional power trade market is expected to transition to a trilateral model, with a third

country offering wheeling facilities for the buyer and seller countries, who are otherwise not directly interconnected. Considering this, the following key questions emerge:

1. What type of inter-governmental agreements / MoU will need to be set in place to support the trilateral / multilateral power trade?
2. Will South Asia require regional forums / new entities to support the development of trilateral/ multilateral power trade?
3. Will the availability of access to a market platform such as power exchange support multilateral power trade?

Greening the South Asia Energy/Power System Infrastructure

Various South Asian countries have set ambitious capacity addition targets for sustainable energy infrastructure. The recent history indicates that bulk of such clean energy investments are mobilized through private investments. However, efforts to support such investment leads us to the following questions:

1. How can policy makers adopt an optimum risk sharing between Government/utility and the private sector investment projects?
2. How can various risk mitigation strategies and instruments to be dealt with?
3. What kind of innovative financing mechanisms are suitable for development of sustainable energy technology in the region?

Once the answers to these questions are in place, the regulators, policy makers and investors in South Asia can debate internally on the strategy for regional cooperation, including the potential creation of regional coordination institutions.

9. Abbreviations

ADB	Asian Development Bank
ADSM	Automated Demand Side Management
AEDB	Alternative Energy Development Board
AFD	French Development Agency
AfDB	African Development Bank
AGC	Automatic Generation Control
AIMS	ASEAN Interconnection Master Plan Study
APAEC	ASEAN Plan of Action for Energy Cooperation
APG	ASEAN Power Grid
APGCC	ASEAN Power Grid Consultative Committee
AREP	Alternative Renewable Energy Policy
BEA	Bhutan Electricity Authority
BERC	Bangladesh Energy Regulatory Commission
BESS	Battery Energy Storage System
BOOT	Build, own, operate and transfer
CASA	Central Asia-South Asia
CASAREM	CASAREM Regional Electricity Market
CERC	Central Electricity Regulatory Commission
DABS	Da Afghanistan Breshna Sherkat
DGPC	Druk Green Power Corporation
DOE	Department of Energy
DRE	Department of Renewable Energy
EDGE	Enhancing Development and Growth through Energy
EDL	Electricité du Laos
EGAT	Electricity Generating Authority of Thailand
EGCO	Energy Generating Company
EIB	European Investment Bank
ERC	Electricity Regulatory Commission
EU	European Union
FERC	Federal Energy Regulatory Commission
FPA	Federal Power Act
GCC	Gulf Cooperation Council
GCCIA	Gulf Cooperation Council Interconnection Authority
GMS	Greater Mekong Subregion
HAPUA	Heads of ASEAN Power Utilities/Authorities
IADB	Inter-American Development Bank
KFW	Kreditanstalt Für Wiederaufbau
ISO	Independent System Operator
LPG	Liquified Petroleum Gas
MER	Regional Electricity Market
MOU	Memorandum of Understanding
MTOE	Million Tonnes of Oil Equivalent
MTP	Market Trading Platform
NDC	Nationally Determined Contribution

NEA	Nepal Electricity Authority
NEC	National Environment Commission
NEPRA	National Electric Power Regulatory Authority
NTDC	National Transmission and Despatch Company
NVVNL	NTPC Vidyut Vyapar Nigam Ltd.
ONEE	Morocco's National Office of Electricity
PSU	Public Sector Undertaking
PUCSL	Public Utilities Commission of Sri Lanka
REDF	Renewable Energy Development Fund
REE	Red Eléctrica de España
RGoB	Royal Government of Bhutan
RERA	Regional Electricity Regulators Association of Southern Africa
RMER	Regional Electricity Market Regulations
RPCC	Regional Power Coordination Center
RPTCC	Regional Power Trade Coordination Committee
RPTOA	Regional Power Trade Operating Agreement
RGO	Renewable Generation Obligation
RPO	Renewable Purchase Obligation
SADC	Southern African Development Community
SAPP	South African Power Pool
SAREH	South Asia Regional Energy Hub
SARI/EI	South Asia Regional Initiative for Energy Integration
SIEPAC	Sistema de Interconexión Eléctrica para los Países de América Central
SPV	Special Purpose Vehicle
STATCOM	Static Synchronous Compensator
TAPI	Turkmenistan-Afghanistan-Pakistan-India
TSO	Transmission System Operator
TTC	Total Transmission Capacity

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About SARI/EI

The US Agency for International Development (USAID) initiated the South Asia Regional Initiative for Energy (SARI/E) program in the year 2000 to promote Energy Security in the South Asia region, working on three focus areas: Cross Border Energy Trade (CBET); Energy Market Formation; and Regional Clean Energy development. The program covers the eight countries in South Asia, viz. Afghanistan, Bangladesh, Bhutan, India, The Maldives, Nepal, Pakistan and Sri Lanka. The fourth and current phase of the program, called South Asia Regional Initiative for Energy Integration (SARI/EI), is aimed at advancing regional grid integration through cross border power trade. This phase is being implemented by Integrated Research and Action for Development (IRADe), leading South Asian Think Tank. SARI/EI program was recently extended to 2022 and is a key program under USAID's Asia EDGE (Enhancing Growth and Development through Energy) Initiative. In its extended phase, SARI/EI will focus on moving the region from bilateral to trilateral and multilateral power trade, and establishing the South Asia Regional Energy Market (SAREM).

About USAID

The United States Agency for International Development (USAID) is an independent government agency that provides economics, development and humanitarian assistance around the world in support of the foreign policy goals of the United States. USAID's mission is to advance broad-based economics growth, democracy, and human progress in developing countries and emerging economies. To do so, it is partnering with governments and other actors, making innovative use of science, technology, and human capital to bring the profound results to a greatest number of people.

About IRADe

IRADe, located in Delhi, is a non-profit and fully autonomous institute for advance research. IRADe's multidisciplinary research and policy analysis aid action programs. It is a hub for a network of diverse stakeholders. Established in 2002, the institute is recognized as an R&D organization by the Department of Scientific and Industrial Research and Ministry of Science and Technology of the Government of India. The Ministry of Urban Development has accorded IRADe the status of Centre of Excellence for Urban Development and Climate Change. Through the SARI/EI program, IRADe is pushing the envelope for sustainable energy access through experts and members from South Asia.

For more information, please visit the SARI/EI project website:

https://sari-energy.org/