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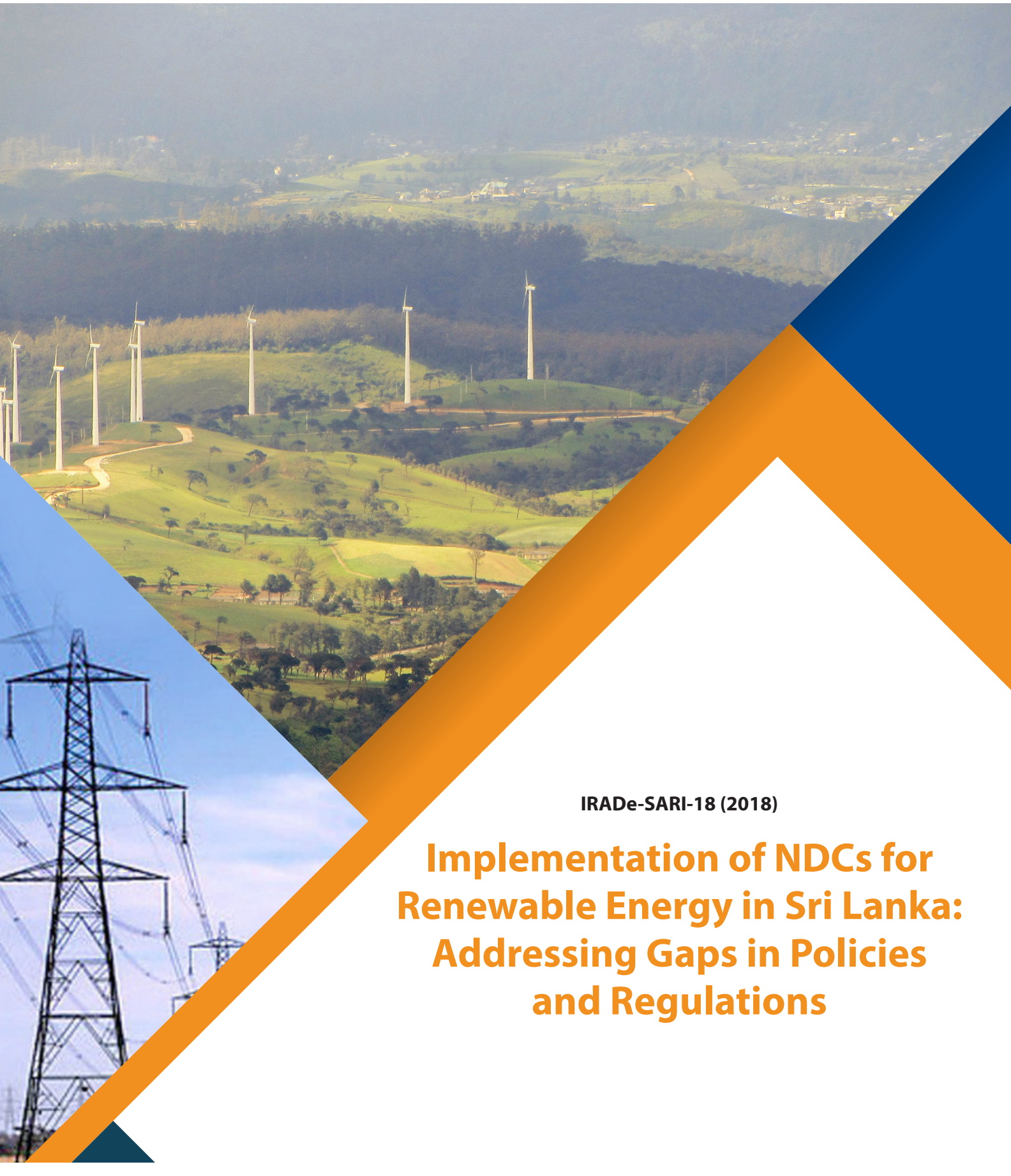

IRADe-SARI-18 (2018)

Implementation of NDCs for Renewable Energy in Sri Lanka: Addressing Gaps in Policies and Regulations

Prepared by
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15 YEARS
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Implementation of NDCs for Renewable Energy in Sri Lanka: Addressing Gaps in Policies and Regulations

FOREWORD

The U.S. Agency for International Development (USAID) has been working since 2000 to enhance regional energy cooperation in South Asia through its South Asia Regional Initiative for Energy (SARI/E) program. The program covers eight countries: Afghanistan, Bangladesh, Bhutan, India, Nepal, Pakistan, Sri Lanka and the Maldives. The first three phases of the program focused on awareness raising, building trust and assessing potential transmission interconnections. The 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.

Under the program, a Think Tank Forum (TTF) has been established comprised of leading civil society organizations from the participating South Asian countries. The role of the TTF is to initiate a discourse on the importance of cross-border electricity trade (CBET) in meeting the energy demands of each country. Local think tanks can be an important channel for positioning CBET in the national priorities of the respective South Asian country, and play a key role in engaging politicians, government institutions, media and civil society in shaping the country's priorities. The TTF has undertaken several studies, and organized events and campaigns to create consensus around the need for regional energy integration.

The TTF report on **"Implementation of Nationally Determined Contributions (NDCs) for Renewable Energy in Sri Lanka: Addressing Gaps in Policies and Regulations"** developed by Sylcan Trust analyzes how the expansion of renewable energy and regional cooperation can contribute to achieving Sri Lanka's NDCs. The report was prepared in a very consultative manner, with interaction among stakeholders including policy makers, academics, research organizations, energy experts, and others. I hope the findings and recommendations of this study will help highlight the renewable energy potential at national and regional levels, and will contribute to building regional energy cooperation.

I would like to take this opportunity to acknowledge the excellent work done by IRADe and the Sylcan Trust in successfully carrying out the study. I am confident that this assessment will be useful to inform decision-making and create consensus around power trade among civil society in the region

Thank you

Julia Kennedy
Director (A)
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Preface

Nationally Determined Contributions (NDCs) were introduced in 2015, at the 21st Conference Parties of the UNFCCC through the Paris Agreement. NDCs could be seen as a link for incentivizing and creating momentum to initiate knowledge sharing hubs at regional level for developing and promoting technology transfer, energy trade, energy conservation and energy efficiency in the South-Asian region and to focus developing hydropower, renewable and alternative energy and developing common ambition to raise incentives for the energy trade.

Integrated Research and Action for Development (IRADe) is the implementing partner of the South Asia Regional Initiative for Energy Integration (SARI/EI) programme supported by the United States Agency for International Development (USAID).

Under this initiative, Slycan Trust, one of the think tanks in SARI/EI think tank forum and the region, has undertaken the study "Implementation of NDCs for Renewable Energy in Sri Lanka: Addressing Gaps in Policies & Regulations". The objective of the study was to explore the opportunities that lies for developing the energy sector in Sri Lanka, and the opportunities for enhancing renewable energy generation in the country.

This study has provided analysis and needs for policy enhancement, or creation of new policies or laws to implement the NDCs and CBET as a potential outcome of the increase of energy production through NDC commitments, as well as already existing initiatives taken by the SAARC in the previous years.

The study also recommends that NDCs could be a mechanism to promote and develop regional cooperation, through fostering of partnerships for capacity building, technology transfer and knowledge sharing.

I hope the research paper developed by the study "Implementation of NDCs for Renewable Energy in Sri Lanka: Addressing Gaps in Policies & Regulations" will be helpful in increasing the potential of renewable energy in the South-Asian region, and building regional partnerships for the implementation of NDCs, and SAARC energy cooperation.

Jyoti Parikh

Dr. Jyoti Parikh

Executive Director

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Acknowledgment

SLYCAN Trust wishes to thank our partners United States Agency for International Development and Integrated Research and Action for Development for their valuable contribution to support the research. We thank Mr. Rohit Magotra, Deputy Director, IRADe for his contribution, guidance and technical support, and for greatly assisting the research. Our thanks are due to Ms Asha Kaushik, Senior Research Associate, IRADe for co-ordination and project support.

We express our gratitude to Dr. Anura Batagoda, Secretary to the Ministry of Power and Renewable Energy for his insights and comments to develop the research.

We would also like to express our gratitude to Dr. Sunimal Jayathuga, Director of Climate Change Secretariat under the Ministry of Mahaweli Development and Environment for the insights,expertise and leadership provided to organize the multi-stakeholder consultations for presenting research findings. We also thank Ms. Dakshini Perera, Assistant Director of Climate Change Secretariat of Sri Lanka, and the staff of the Climate Change Secretariat of Sri Lanka for the immense support extended to the research.

We thank Namiz Musafer, Technical Consultant to the United Nations Development Programme in Sri Lanka, and Mr. Jagathdeva Vidanagama,Technical Coordinator for Mitigation of the Third National Communication to the UNFCCC of Sri Lanka, for their comments on the manuscripts which has greatly contributed in improving and refining this research.

Vositha Wijenayake
Executive Director, SLYCAN Trust

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Abbreviations

ADB	Asian Development Bank
BAU	Business as Usual
BPC	Bhutan Power Corporation
BPDB	Bangladesh Power Development Board
CAR	Central Asian Republics
CASA	Central Asia -South Asia
CBET	Cross-Border Electricity Trade
CDM	Clean Development Mechanism (Bhutan)
CEA	Central Environmental Authority
CEB	Ceylon Electricity Board
CEYPETCO	Ceylon Petroleum Corporation
CG	Central Government
CO2	Carbon dioxide
DSM	Demand Side Management
ECF	Energy Conservation Fund
EFL	Environmental Foundation Limited
EIA	Environmental Impact Assessment
GCP	Green Climate Fund
GDP	Gross Domestic Product
GHG	Green House Gases
GOSL	Government of Sri Lanka
GOI	Government of India
HVDC	High Voltage Direct Current
IASPA	International Agency for Solar Policy and Application
INDC	Intended Nationally Determined Contributions
IRADe	Integrated Research and Action for Development
JICA	Japan International Cooperation Agency
kWh	Kilo watt hour
LCLTGEP	Least Cost Long Term Generation Expansion Plan

LECO	Lanka Electricity Company Ltd
LNG	Liquefied Natural Gas
LTGEP	Long Term Generation Expansion Plan
MMDE	Ministry of Mahaweli Development and Environment
MOU	Memorandum of Understanding
MPRE	Ministry of Power and Renewable Energy
NEP	National Energy Policy
NDC	Nationally Determined Contributions
OTEC	Oceanic Thermal Energy Conversion
PC	Provincial Council
PCL	Provincial Council List
PGCB	Power Grid Company of Bangladesh Limited
PGCIL	Power Grid Corporation of India Limited
PPA	Power Purchase Agreement
PROS	Petroleum Resources Development Secretariat
PTL	Powerlink Transmission Limited
PUCSL	Public Utilities Commission of Sri Lanka
RE	Renewable Energy
RGOB	Royal Government of Bhutan
SA	South Asia
SAARC	South Asian Association for Regional Cooperation
SAR	South Asian Region
SARI/EI	South Asia Regional Initiative for Energy Integration
SARSO	South Asian Regional Standards Organization
SASEC	South Asia Sub Regional Economic Cooperation
SDG	Sustainable Development Goals
SLSEA	Sri Lanka Sustainable Energy Authority
TNC	Technical Needs Assessment
TPCL	Trincomalee Power Company Limited
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
WAPDA	Water and Power Development Authority (Pakistan)

Executive Summary

Energy sector plays a key role in a country's development. In a region like South Asia where development is key, the resources for energy is vital to be utilized in a sustainable manner, while the countries play a role in cooperation for technology and resource sharing. Many initiatives have been taken at the regional level to highlight the need for sharing of resources. This is due to lack of sufficient resources to develop energy in some countries, while for others, sharing of energy could be deemed as a form of economic development.

However, in developing energy resources it is important that the countries adopt a sustainable approach. The Paris Agreement on climate change provides the opportunity to countries, under the Nationally Determined Contributions (NDCs), the means of cutting down emissions, as well as technology and capacity building opportunities that could lead to regional cooperation. Further, the NDCs provide the opportunity for the region to work together for accessing finance for climate change related actions, and to facilitate the enhancement of the renewable energy sector.

This research paper explores the opportunities that lie for developing the energy sector in Sri Lanka, and the opportunities for enhancing renewable energy generation in the country. It focuses on the NDCs related to solar and wind energy that have been developed for Sri Lanka, and the activities the country has planned out for achieving the NDCs during the readiness phase (2017-2019) for the implementation of NDCs. This is with the aim to contribute in enhancing the potential for renewable energy in the country, and the link it provides for promoting regional cooperation.

Further, the research provides recommendations on private public partnerships for enhancing the renewable energy potential at the national and regional level, partnerships at the South Asian level for climate finance and technology transfer, and capacity building of countries for generating and sharing renewable energy which builds on the SAARC energy cooperation.

1 Introduction and Methodology

South Asian region and its economic development is highly dependent on the energy sector. To ensure that the development aimed for is sustainable, it is important that the actions taken to enhance and improve the energy sector are based on renewable energy sources. In achieving developmental targets, regional cooperation is vital. This will contribute to collective development through sharing of resources and avoiding regional conflicts based on natural resources.

One of the key threats to the region's development are climate change impacts that are felt across the region. These impacts create and aggravate social and economic vulnerabilities that the countries of South Asia are already experiencing. Climate threats impact the countries' energy sector, which hinders national and regional economic development.

NDCs which are commitments under the Paris Agreement focus on country commitments to reduce greenhouse gas emissions, and provide an opportunity to countries to shift to renewable energy, as well as to take collective action for exchanging technical and capacity building support, as well as developing collective initiatives to access climate finance as regional initiatives. These efforts would contribute to regional development through the focus on developing and enhancing the potential for renewable energy generation. To facilitate these efforts, it would be necessary to understand the laws, policies and regulations relating to renewable energy in the region, and the implementation of NDCs.

Taking into account the importance of the commitments made by countries as parties to the Paris Agreement, this research focuses at the national level for Sri Lanka the gaps and constraints that need to be addressed to facilitate the implementation of NDCs for renewable energy in the country for solar and wind energy. At the regional level, the research focuses on avenues that could be created for regional cooperation for the implementation of NDCs, and enhancing cross border electricity transfer through the implementation of NDCs on renewable energy.

The methodology adopted for the preparation of this research paper is a combination of analytical research and field research. The selection of the research topic was prioritized based on the relevance of the topic to the country context, and the utility of the research outcomes, while aligning the thematic focus on renewable energy and regional cooperation. Given the importance of the implementation of NDC related actions in the energy sector and the recognized need to enhance regional cooperation for energy based on a common focus, it was decided that the research be conducted aligning the two areas NDC implementation, and cross border electricity transfer.

Research activities conducted were based on desk research of relevant laws, policies and regulations in existence, followed by analysis aimed to identify gaps and constraints that exist for the implementation of NDCs. The analysis was further enhanced through field research which included expert interviews, and focused interviews for small groups of experts to identify the relevant information which would need inclusion for a comprehensive analysis.

Following the data collection, and the field research conducted the paper was drafted based on sub-themes of the research which were converted into chapters focusing on national context, and the regional approach to renewable energy i.e. Sri Lanka's energy sector, NDC and regional cooperation, regional cooperation on cross border energy transfer.

The findings of the draft paper were then presented to multiple stakeholder groups such as policy makers, experts in the field of renewable energy and academia, and the private sector engaged in renewable energy (primarily on solar energy). The input received through the filed research was incorporated into the draft research paper, and the final

findings of the paper was presented to key stakeholders of the energy sector in Sri Lanka through a national workshop for experts and stakeholders. The workshop succeeded in providing further input to the research from line ministries, and implementing agencies relevant to the energy sector, and the edits suggested were incorporated to the paper prior to finalizing. The edited version of the report has thereafter been circulated among peers for review, prior to being finalized for publication.

2 Sri Lanka's Energy Sector

2.1 Introduction

Sri Lanka is an island with approximately 1000 km of sea boundary and land area of 65,000 sq.km. Geographically, it is located near the southern tip of India between 60 and 100 North Latitude and between 790 and 820 East Longitude. The country receives a satisfactory rainfall amounting to 5,000 mm in the wet zone and 1,000 mm in the dry zone averaging about 2,000m.[1]

In the last five years (2011-2015), the real GDP growth in the Sri Lankan economy has varied from 8.4% in 2011 to 4.8% in 2015. In 2015, Sri Lanka has achieved a growth rate of 4.8%. Details of some demographic and economic indicators are given in Table 1.[2]

Table 1: Demographic and Economic Indicators of Sri Lanka

	Units	2010	2011	2012	2013	2014	2015
Mid-Year Population	Millions	20.68	20.87	20.42	20.58	20.77	20.97
Population Growth Rate	%	1.0	1.0	0.4	0.5	0.9	0.9
GDP Real Growth Rate	%	8	8.4	9.1	3.4	4.9	4.8
GDP/Capita (Market prices)	US$	2,744	3,129	3,351	3,610	3,853	3,924
Exchange Rate (Avg.)	LKR/US$	113.06	110.57	127.60	129.11	130.56	135.94
GDP Constant 2010 Prices	Mill LKR	6,413,668	6,952,720	7,588,517	7,846,202	8,228,986	8,622,825

Source: Annual Report 2015, Central Bank of Sri Lanka

Research data indicates the co-relation between the electricity demand and the economic situation in Sri Lanka and has been illustrated in the Long Term Generation Plan for Sri Lanka (2018 – 2037) in Figure 1.[3]

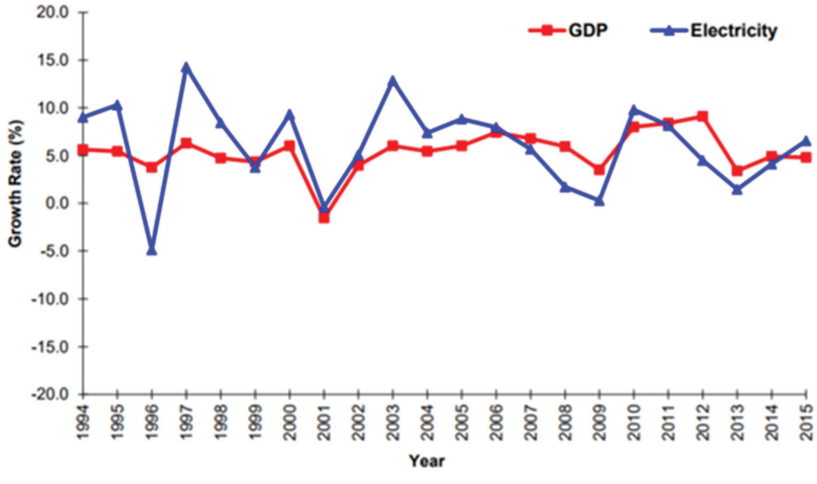


Figure 1: Growth Rates of GDP and Electricity Sales

1 http://www.ideasrilanka.org/PDFDownloads/Srilanka-sust-energy-poverty.pdf
2 Long Term Generation Plan of Sri Lanka 2018 - 2037
3 Ibid

With the increasing demand for energy in order to address the country's economic and social development, the total primary energy demand is expected to increase to about 15,000 kTOE by 2020 at an average annual growth rate of about 3%.[4] Electricity and petroleum sub-sectors are likely to record higher annual growth rates of about 7- 8%.[5]

Hydro electricity production and biomass-based energy supplies, which are the only large-scale indigenous primary energy resources available in Sri Lanka, are expected to increase only marginally in the near future.[6] This means that the country's incremental primary energy requirements need to be fulfilled mainly by imported fossil fuels in the medium term. In the longer term, possible development of indigenous petroleum resources and accelerated development of non-conventional renewable energy are likely to make a significant change in Sri Lanka's mix of primary energy resources.[7]

2.2 Energy Sector in Sri Lanka

Biomass or fuel wood, petroleum and hydro are the major primary energy supply sources, which caters to Sri Lanka's energy demand, with a per-capita consumption of about 0.5 tons of oil equivalent (TOE). At present, biomass or fuel wood, which is mainly a non-commercial fuel, fulfills approximately 40 percent of the country's total energy requirement.[8] Further, other sources such as petroleum, has become a main source of commercial energy and represents 40 percent of the energy demand. There is also an increase in the percentage of biomass which is also commercially grown and traded.[9] Hydropower, which covers 9% of the total primary energy supply, is the main indigenous source of primary commercial energy in Sri Lanka. Estimated potential of hydro resource is about 2000MW, of which more than half has already been harnessed.[10] Further, impacts on the environment through the development of large scale hydro plants prevent the exploitation of generating a higher amount of hydro-power in the country. The already developed major hydro schemes are associated with Mahaweli and Kelani river basins. Samanala, Kukule and Upper Kotmale are the other hydro power generating units. In addition to these, there are Inginiyagala, Uda Walawe and Nilabemini hydro plants which are small and dependent on irrigation water.[11] Sri Lanka has developed 1115 MW of major hydro capacity capable of providing 3858 GWh of energy per year.

Renewable energy sources in Sri Lanka are not limited to hydro power alone. Sri Lanka has a high potential to develop wind and solar power. The first commercial wind power plants were established in 2010 and the total capacity of wind power plants by end of 2016 is 127MW. A100MW wind farm at Mannar Island is at the implementation stage. Further, steps have been initiated to harness the economical wind and solar potential in Sri Lanka in an optimal manner.[12]

Addressing the development of renewable energy in Sri Lanka, the first commercial solar power plants were commissioned in year 2016 and the total capacity of commercial solar power plants by the end of 2016 was 21 MW and nearly 50MW of solar roof tops were also connected by end of 2016. Scattered developments of small scale solar power plants and feasibility studies have already been initiated to develop solar power plants in park concept. A small quantity of Peat has been located in the marshy lands to the North of Colombo. However, the Long Term Generation Plan for 2018 – 2037 provides that the quality and extent of the reserve is not commercially viable for extraction and use as a source for power generation.[13]

[4] http://powermin.gov.lk/english/?page_id=1394
[5] ibid
[6] ibid
[7] ibid
[8] Draft Long Term Generation Plan 2018 – 2037 of Sri Lanka (2017)
[9] Ibid
[10] Ibid
[11] "Environmental Impacts of Electricity Generation", by W.J.L.S. Fernando, DGM, CEB
[12] Ibid
[13] Ibid

Sri Lanka at present imports crude oil as refined product for transport, power generation, industry and other commercial and household applications. Apart from this, initiatives have been launched towards oil exploration with the prime intention of harnessing potential petroleum resources in the Mannar Basin. Further, the Long Term Generation Plan provides that exploration license has been awarded with the objective of oil and natural gas exploration in the Mannar Basin, off the north-west coast, where test wells drilling has been carried out. So far, there has been a discovery of natural gas in Mannar Basin (off shore from Kalpitiya Pennisula) with a potential of 70 mscfd which empowers Sri Lanka to reduce their investment in foreign imports for their energy needs. Discoverable gas volume of this reserve is estimated at approximately 300 bcf with the potential to extend to 2 TCF with daily extraction rates of 100 mscfd.[14]

Sri Lanka's energy source distribution is illustrated in the figure 2 below.

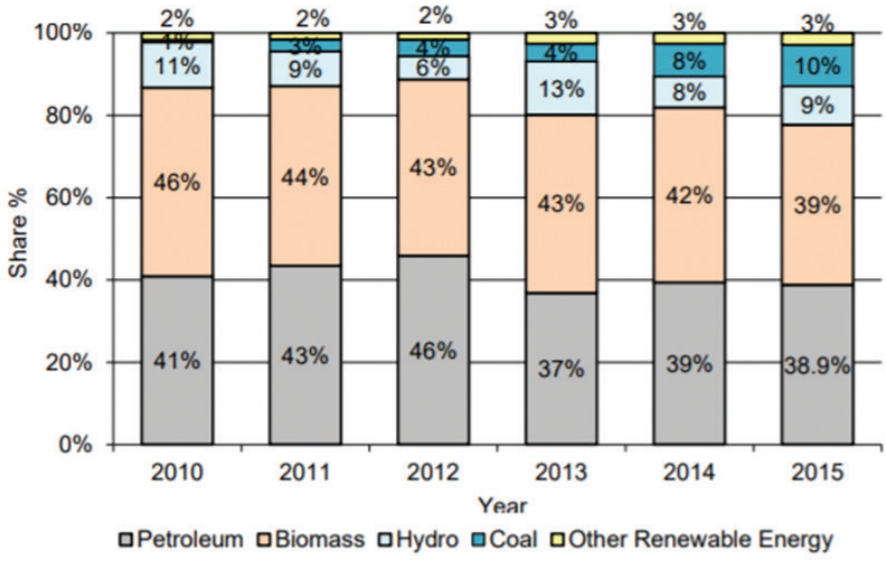


Figure 2: Energy Source distribution of Sri Lanka

Source: Sri Lanka Sustainable Energy Authority

In addition to the involvement of the government, private sector organizations and the general public are also stakeholders of the energy sector. Public and private sector organizations participate in both supply and demand sides of the energy industry whereas the domestic sector involvement is quite prominent in the biomass sector. Renewable energy development entered a new phase during 2015, with the commencement of competitive bidding for the first two 10 MW wind projects in Chunakam.[15] However, stakeholder interviews and consultations have indicated that competitive bidding is seen as a challenge by the investors, who indicate that they are de-motivated to invest in renewable energy projects due to this process. Further, construction activities of the first 10 MW solar power plant by the private sector also commenced in 2015 with the government led initiatives such as expansion of solar power generation through Soorya Bala Sangramaya in 2017.[16]

2.3 Energy Demand of Sri Lanka & Carbon Emissions

Household and commercial sector energy consumption is the largest traditional energy consuming sector (fig 3). The data for 2015 provides the consumption of different energy sources to be as biomass (4793 ktoe), petroleum (4093 ktoe), coal (55 ktoe) and electricity (1010 ktoe[16]).

[14] Ibid
[15] Sri Lanka Energy Balance 2015, An Analysis of Energy Sector Performance
[16] Ibid

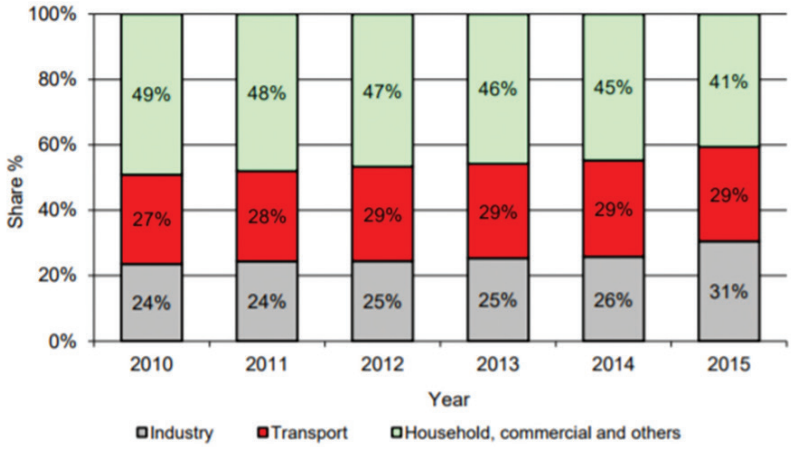


Figure 3: Sector Wise Energy Consumption in Sri Lanka

Source: Sri Lanka Sustainable Energy Authority

The total CO2 Emission levels of Sri Lanka amounts to 16.7 Million Tons (which is approximately only 0.05 % of the total CO2 emissions generated in the World.)[17] While electricity generation contributes to the CO2 emissions of Sri Lanka, it is the transport sector which provides the highest amount of contribution to Sri Lanka's CO2 emissions.[18]

2.4 Access to Electricity

By the end of June 2016, approximately 98.7% of the total population had access to electricity from the national electricity grid. When the planned electrification schemes are implemented it is expected to increase further.

The average solar insolation in most parts of the country exceeds 5120 watt hours/m2 per day.[19] Wind speeds of 12 km/hour (3.3 m/s) at 40 meters have been recorded in the southern coastal belt.[20] Approximately, 4,304.2 Ktoe of energy generated was provided by imported crude oil and finished petroleum products such as diesel and liquefied petroleum gas (LPG). Additionally, the non-conventional resources (mainly wind) provided 3.5 kTOE of primary energy, giving an aggregate primary energy supply of approximately 9,509.1 kTOE.[21] In 2004 primary energy contributions to national energy supply were 47.3% from biomass, 45.3% from crude oil and petroleum products and 7.4% from hydroelectricity.22 The use of non-conventional energy resources in Sri Lanka is of a relatively smaller scale and, therefore, its contribution presently is of low significance in the macro energy picture.

With the increasing demand for energy to provide for the country's economic and social development, total primary energy demand is expected to increase to about 15,000 kTOE by the year 2020 at an average annual growth rate of about 3%.23 Hydroelectricity production and biomass-based energy supplies, which are the only large-scale indigenous primary energy resources available in Sri Lanka, are expected to increase only marginally in the near future. This is mainly due to limitations in further hydropower development as exploiting the remaining large hydropower sites is of lower economic viability, and due to the limited use of biomass, with gradually increasing standards of living of the population.[24] This indicates that the country's incremental primary energy requirements need to be supplied mainly by imported fossil fuels in the medium term. In the longer term, possible development of indigenous petroleum

[17] Ibid
[18] Ibid
[19] ibid
[20] ibid
[21] ibid
[22] ibid
[23] ibid
[24] ibid

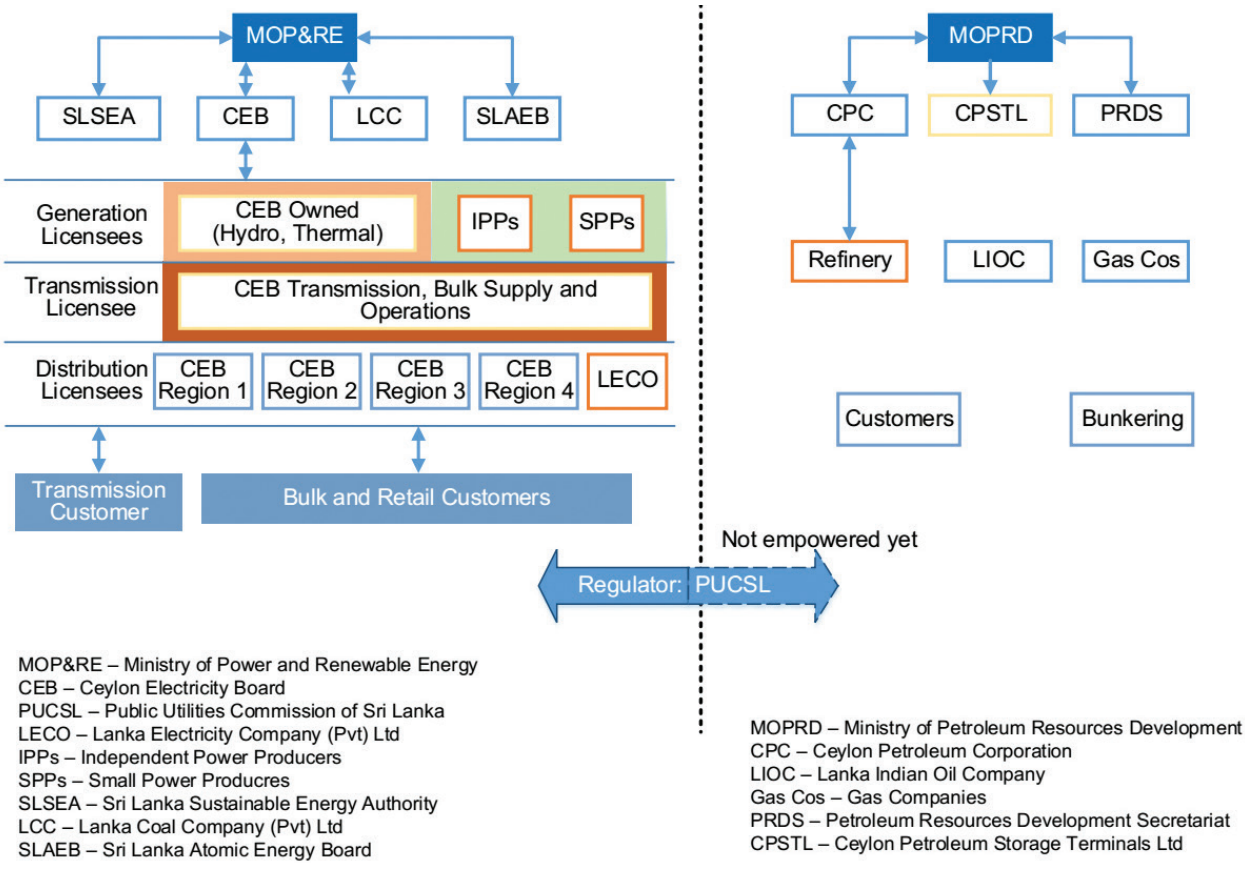
resources and accelerated development of non-conventional renewable energy are likely to make a significant change to Sri Lanka's mix of primary energy resources.[25]

2.5 Institutional Framework

Multiple ministries and related institutions have been set up in relation to the energy sector in Sri Lanka. Among these, Ministry of Power and Renewable Energy (MPRE) is primarily in charge of the energy sector.

Table 2 illustrates the institutions related to the energy sector in Sri Lanka. In addition to the ministries and the institutions listed in the table, the Ministry of Mahaweli Development and Environment(MMDE) plays a key role in addressing the renewable energy policies in the country, linked to international obligations of Sri Lanka under the Paris Agreement, and the UNFCCC. Further, there are other relevant institutional set ups which facilitate the provision of energy, and electricity, as well as implementing the laws and policies related to the energy sector. This will be discussed in detail in the following sections of the chapter.

Table 2: Institutions related to energy sector in Sri Lanka[26]



2.5.1 Ministry of Power and Renewable Energy (MPRE)[27]

The MPRE is the main body responsible for the management of the country's power sector. The Ministry comprises of several divisions, discharging its functions in planning and supervision of sub-sectoral state institutions. From time to time, the subject of energy has been combined with other themes such as Irrigation and Lands to facilitate the functioning of the Ministry.[28]

[25] Ibid6

[26] Presentation " Energy Costs and Prices, Impacts on the Economy" by Dr. Siyambalapitiya at University of Colombo (2017)

[27] Ministry of Power and Renewable Energy Website

[28] Sri Lanka Energy Balance 2015, An Analysis of Energy Sector Performance

The Ministry has its vision to oversee that energy security of the nation is assured and strive to provide quality, reliable, sustainable and affordable energy for economic prosperity of Sri Lanka. Several institutions fall under the purview of the MPRE including Ceylon Electricity Board (CEB) and its subsidiary companies; Lanka Electricity Company Ltd (LECO); Lanka Coal Company (Pvt) Ltd; LTL Holding (Pvt.) Ltd; Sri Lanka Sustainable Energy Authority; Sri Lanka Atomic Energy Board and Sri Lanka Atomic Energy Regulatory Council.

The mandate of the MPRE includes formulation of policies, programs and projects, monitoring and evaluation of subjects related to power, and renewable energy, and those subjects that come under the purview of the departments, the statutory institutions and the public corporations under the MPRE. It includes formulation of appropriate power policies for the control, regulation and utilization of power resources; investigation, planning, monitoring and development of activities related to generation of power from sources, such as water, heat, coal and wind; rural electrification; management of demand to ensure energy efficiency, and development of renewable power; development of renewable energy; supervision of institutions listed under the Ministry; and all other matters which fall within the purview of those institutions listed under the Ministry.

2.5.2 Ministry of Mahaweli Development and Environment (MMDE)

The MMDE[29] plays a key role in Sri Lanka's renewable energy policies through its work on climate change, and emission reductions. It remains committed to the management of environment and natural resources of the country, maintaining the equilibrium between the trends in rapid economic development and use of natural resource base. Further, the ministry has framed key policies for adoption in management of environment and natural resources of the country, with the participation of stakeholders including Government agencies, NGOs and communities, which relate to the energy sector in Sri Lanka.[30] Among such policies are the Nationally Determined Contributions (NDCs) of Sri Lanka to the UNFCCC, the Blue Green Policy of Sri Lanka, and other policies such as the Low Carbon Development Policy which is presently at the development stage.

2.5.3 Sri Lanka Sustainable Energy Authority (SLSEA)

The Sri Lanka Sustainable Energy Authority (SLSEA) was established in 2007 through the enactment of Sri Lanka Sustainable Energy Authority Act No. 35 of 2007. It comes under the purview of the MPRE.[31] With the increase of promotion and commitment towards sustainable energy, the Authority has taken the initiative for developing renewable energy and increasing energy efficiency. Soorya Bala Sangramaya (Battle for Energy) is one of the main projects, which focuses on community's access to renewable energy which is being implemented in collaboration with Sri Lanka Sustainable Energy Authority to promote the setting up of small solar power plants on the rooftops of households, religious places, hotels, commercial establishments and industries.[32]

2.5.4 Public Utilities Commission of Sri Lanka (PUCSL)

The Public Utilities Commission of Sri Lanka[33] (the Commission) (PUCSL) is one of the key institutions related to the regulation of the electricity industry in Sri Lanka. Among the services provided, the Commission ensures that the electricity sector in Sri Lanka has adequate investments, greater availability, efficient supply, and improved quality of services for electricity consumers. The Commission also regulates the generation, transmission, distribution, supply and use of electricity.[34] The Commission was established by the Public Utilities Commission of Sri Lanka Act No. 35 of

[29] Ministry of Mahaweli Development and Environment website
[30] Ibid
[31] ibid
[32] http://www.energy.gov.lk/surya_bala_sangramaya/index.php
[33] The Public Utilities Commission of Sri Lanka website
[34] Ibid

2002 by the Parliament of Sri Lanka, and plays the role of a multi-sector supervisory body regulating certain physical infrastructure industries in the country.[35]

Functions of the Commission include among others, exercising, performing, and discharging powers, functions and duties assigned to the Commission by the Act and any industry Act; to the extent deemed appropriate any person or group who or which may be affected, or likely to be affected by the decisions of the Commission; advising the Government as deemed appropriate on all matters concerning any industry falling within the purview of the Commission.[36]

2.5.5 The Act of Natural Resources, Energy and Science Authority of Sri Lanka No. 78 of 1981[37]

In order to develop the energy sector, the Act of Natural Resources, Energy and Science Authority of Sri Lanka No. 78 of 1981 was formed. One of the important duties included is the formulation of policy required to develop energy plans and programs in Sri Lanka, and to measure the optimum use and conservation of energy. It further includes the responsibility to govern, manage and direct the plans and programs pertaining to the exploitation and development of natural resources and energy, and the application and utilization of science and technology for the development of Sri Lanka. Fund allocation is possible for the development of natural resources and energy resources. Other granted powers include initiating, promoting, conducting and coordinating research, surveys and investigations regarding any aspect of the exploitation, use and development of energy resources.

The duties and functions of the Natural Resources, Energy and Science Authority are very important for further development and conservation of the energy sector, since these duties and functions aim to achieve the optimum use of energy. In terms of carrying out the duties, the powers include utilizing science and technology to implement research, surveys and investigations. Though the Act defines the optimal use of energy, wastage of energy in transferring energy from one place to another is not addressed in the Act. Therefore, it is important to specify, and understand the method in which the wastage of energy and ways to minimize it will be addressed.

2.5.6 Ceylon Electricity Board of Sri Lanka (CEB)

The CEB is the largest electricity company in Sri Lanka. It is a body corporate established under the Act of Parliament No. 17 of 1969. The Body is entrusted with the duties to developand maintain an efficient, coordinated, and economical system of electricity supply for Sri Lanka.[38] CEB's role includes development of the energy sector, as well as developing regulations and plans relevant to the energy sector. The Long Term Generation Plan of Sri Lanka 2018 – 2037 and other regulations have been developed with the contributions of CEB.

2.5.7 Lanka Coal Company (Pvt) Limited

Lanka Coal Company (Pvt.) Limited was incorporated under the Companies Act of 2007 following a Cabinet decision for the purpose of procuring and supplying coal for coal fired thermal plants of Sri Lanka. While it mainly focuses on power generation through coal power, and not linked to renewable energy generation, it is mentioned due to its supply of resources for the generation of energy in Sri Lanka.[39]

[35] Ibid
[36] Ibid
[37] Handbook of National Legislation and Institutions for Environmental Management in South Asia, Ministry of Environment and Natural Resources
[38] Section 38, Ceylon Electricity Board Act No. 17 of 1969
[39] www.lankacoal.lk

2.5.8 Ceylon Petroleum Corporation (CEYPETCO)

CEYPETCO was set up as a state enterprise under Act No. 28 of 1961 with the objectives of carrying on business as an importer, exporter, seller, supplier and distributor of petroleum products. It further has the power to carry on business of exploring for exploiting, producing and refining of Petroleum, and any other business conducive and incidental to such objectives.[40]

2.5.9 Petroleum Resources Development Secretariat (PRDS)

The PRDS was set up under the Petroleum Resources Act, No. 26 of 2003. Its mandate is based on tasks allocated by the Cabinet of Ministers, as well as to act for and on behalf of the State for all purposes related to Petroleum resources. The PRDS formulates policies related to promoting exploration of Petroleum resources in Sri Lanka.[41]

2.6 Laws, Policies and Plans on Energy in Sri Lanka

2.6.1 Constitutional Framework on Energy

Provincial Councils were established in Sri Lanka under the 13th Amendment to the Constitution. As per the 9th Schedule of the Provincial Council List (PCL), the power to deal with the issues that are listed in the PCL was granted to Provincial Councils (PCs). They are legally independent institutions and the powers are conferred upon them under the Constitution. The 9th Schedule of the Concurrent List further mentions the subjects which are under the Central Government. PCs have no authority over any of the subjects falling under the purview of Central Government (CG). As per the 3rd list, which is the Reserved List of the 9th Schedule, the CG and the PCs both can make declarations and act accordingly. According to the Article 34 of the 9th Schedule of the PCL, PCs are vested with the power to act upon energy related aspects except for those which are dealt with by the CG.

> *"34. Development, conservation and management of sites and facilities in the Province for the generation and promotion of electric energy (other than hydro-electric power and power generated to feed the national grid)"*

Also, under Article 32 of the concurrent list, the following is stated:

> *"32. Extension of electrification within the Province and the promotion and regulation of the use of electricity within the Province"*

Under the regulations mentioned above, the PCs have the authority over any energy source which does not contribute to the national grid. Also, since regulations regarding the national grid are listed under the Concurrent List, through declarations made by the PCs, they may act regarding the national grid as well. But regardless of the statutory power conferred on the PCs, difficulties may arise in practice in this regard. There are many challenges yet to be overcome.

Apart from the direct powers conferred upon PCs by the 13th Amendment regarding energy, there are many other sections in the PCL that can be used by the PCs regarding generating energy, developing energy sources, efficiency of the sources and conservation of energy. Regulations regarding the energy sources that are fed to the National Grid can also be made by the PCs after consulting with the Parliament, as this comes under the Concurrent List. The power conferred upon PCs can be exercised by enacting relevant statutes. The manner in which a PC establishes a Charter is stated in Article 154 (2) (1) of the Constitution as follows.

> *154 (2) (1) Subject to the provisions of the Constitution, each Provincial Council shall establish statutes in respect of any matter in the List I of the 09th Schedule, which shall apply only to the limits of the relevant Province.*

[40] http://ceypetco.gov.lk/about-us/
[41] http://www.prds-srilanka.com/

Also, according to Article 154, the Parliament can enact laws after consulting with all the PCs and/or a PC can make statutes that shall only apply to that particular Province, after consulting with the Parliament on matters listed in the Concurrent List.

Despite the fact that 20 years have passed since the establishment of PCs, only the Southern PC and the Western PC have created statutes regarding alternative energy. It was approved by the Governor on October 17th, 2007 and published in the Gazette of the Democratic Socialist Republic of Sri Lanka on January 11th, 2008. Accordingly, the present statutes are in force only in the Southern and Western Provinces, and the existing state law pertaining to alternative energy applies to all other provincial areas.

The Government's law applicable to alternative energy is the Sri Lanka Sustainable Energy Authority Act No. 35 of 2007 (SLSEA Act). This Act provides for the regulations regarding sources connected to/ not connected to the National Grid. This indicates that through the 13th amendment the Parliament has laid down rules on the subject of all the energy that is not fed to the national system, by conferring power to the PCs. Further, matters relating to the Rural Development Subjects are assigned to PCs under Section 5 (e) of the SLSEA Act. Accordingly, the SLSEA Act contains a mixture of tasks that have been assigned/not assigned to the PCs in regard to energy policies.[42] If this is not addressed in a very careful way, serious legal issues can arise.

The powers regarding energy sources that are not connected to the National Grid were conferred upon PCs in 1987. The SLSEA Act came into force in 2007. The steps that should be followed by the Parliament while enacting laws on subjects mentioned under PCL is stated under Article 154 (G) (3)

> *"(3) No Bill in respect of any matter set out in the Provincial Council List shall become law unless such Bill has been referred by the President, after its publication in the Gazette and before it is placed in the Order Paper of Parliament, to every Provincial Council for the expression of its views thereon, within such period as may be specified in the reference, and –*
>
> *(a) where every such Council agrees to the passing of the Bill, such Bill is passed by a majority of the Members of Parliament present and voting; or*
>
> *(b) where one or more Councils do not agree to the passing of the Bill, such Bill is passed by the special majority required by Article 82:*
>
> *Provided that where such references, some but not all the Provincial Councils agree to passing of a Bill, such Bill shall become law applicable only to the Provinces for which the Provincial Councils agreeing to the Bill have been established, upon such Bill being passed by a majority of the Members of Parliament present and voting"*[43]

The actions that can be taken by PCs under the powers conferred upon them by the Constitution are: encouraging, promoting and developing non-conventional and indigenous energy sources; encouraging, promoting and developing energy sources that are not connected to the National Grid, like biogas, biomass solar, wind, ocean waves and waste; generating electricity from energy sources like biogas, biomass solar, wind, ocean waves and waste to fulfill the energy requirement within the Province; regulating electricity usage within the Province; establishing and maintaining energy crops and biomass projects within the Province; conducting awareness programs to educate people on energy efficiency and saving energy; issuing regulations to minimize energy wastage from street lights; generating indigenous energy and non-conventional energy and conducting experiments to maximize their usage.

[42] Sustainable Energy Authority Act No. 35 of 2007

[43] Article 154 (G) (3) Ibid

2.6.2 Sri Lanka Sustainable Energy Authority Act (SLSEA)[44]

In view of the present global energy and environmental crises, the integration of sustainable concepts in economic development, especially in the energy sector, has become an essential requirement for the future existence of human society. The development of renewable energy resources for energy generation and the rational use of energy via conversion efficiency improvement, conservation and management are considered to be the two main aspects of sustainable energy solutions.[45] The SLSEA was established on October 1st, 2007, under the SLSEA Act as the apex institution for the purpose of leading the country towards a new level of sustainability in energy development and usage through increasing the share of indigenous renewable energy as well as improving energy efficiency.[46]

According to the strategies laid out in the National Energy Policies and Strategies of Sri Lanka,renewable energy development is carried out in the country with the aim of 10% increase in the share of renewable energy in power generation by 2015, and 20 % increase by 2020.[47] Till now, the new renewable energy resources exploited in the country include small hydro, wind, biomass (fuel wood, biomass residues and municipal solid waste) and solar, covering both grid and off-grid electricity generation. Although several other resources; such as geothermal, ocean thermal, and sea wave, do exist; detailed assessments required for facilitating the project development and implementation are yet to be carried out.[48]

The powers, duties and functions of the SLSEA[49] include assisting the Minister in formulating national energy policy; identifying, conserving, and managing all renewable energy resources and technologies;developing long term renewable energy plans; mobilizing and financing grants for pilots; credit enhancement and concessionary funds and technical services related to projects.

2.6.3 Energy Conservation Fund Act 1985[50]

Use of Biomass in Dendrothermal plant energy from wave, OTEC and other solar thermal application are also prominent but in the demonstration stage. The Energy Conservation Fund (ECF), which was established in 1985, is undertaking studies on Dendrothermal plant energy, as it has been mainly set up to promote energy conservation and development of renewable energy. ECF has initiated actions to lay down policies for energy conservation and the propagation of renewable energy technologies. The ECF Act was introduced to identify the available technologies for improving efficiency in the use of energy in various sectors and productions, processing, conversion, storage and transportation of energy.

Based on these objectives, it hopes to identify policy measures such as economic incentives and disincentives, education, and information services and institutional arrangements. It is also expected to create active managerial level personnel to formulate and develop action oriented energy conservation programs which are relevant to national needs for energy conservation. The Act also refers to the necessity of promoting programs on energy efficiency, demand management and conservation as well as providing funds for energy development. It is the responsibility of the ECF to initiate, promote, conduct and coordinate research, surveys and investigations on energy efficiency demand management and conservation.

[44] Sri Lanka Sustainable Energy Authority
[45] https://www.parliament.lk/uploads/documents/paperspresented/annual_report_srilanka_sustainable_energy_authority_2011.pdf
[46] Sri Lanka Energy Balance 2015, An Analysis of Energy Sector Performance
[47] https://www.parliament.lk/uploads/documents/paperspresented/annual_report_srilanka_sustainable_energy_authority_2011.pdf
[48] ibid
[49] http://www.stoffstrom.org/fileadmin/userdaten/dokumente/Veranstaltungen/KWK11/11.00_5_Sri_Lanka.pdf
[50] Handbook of National Legislation and Institutions for Environmental Management in South Asia, Ministry of Environment and Natural Resources

The ECF is also responsible for organizing seminars, workshops and courses on energy efficiency, demanding management or conservation and providing information and education to the public. Further responsibilities are to specify standards, norms, codes and other criteria to maintain the quality of the energy and to reduce wastage through energy conservation techniques and energy labeling of appliances.

2.6.4 The National Energy Policy 2006

The National Energy Policy (NEP) was approved in October 2006 and consists of energy basics, implementation strategies, existing targets and institutional responsibilities. The NEP includes among others the principles of providing basic energy needs; ensuring energy security; promoting energy efficiency and conservation; promoting local resources; proper pricing policies; expansion of the management capacity of the power sector; improving the quality of energy services; protection against adverse environmental impacts from energy use. The Policy is in the process of being amended, and the draft version has been submitted to public for comments by the MPRE in 2017.

2.6.5 The Energy Supply (Temporary Provisions) Act No 02 of 2002

The purpose of this Act is to ensure the availability of electricity, petroleum supplies, and utilization of energy resources in order to provide for the provision of electricity, oil supplies and the regulation of energy use. The Act has granted powers for purchasing electricity and energy products, handling a variety of renewable energy resources and promoting energy resources. The main tasks of the Energy Supply Committee, established under the Act, are the preparation of a National Plan for the provision of adequate energy supply, the establishment of a specific cost control system and the promotion of alternative energy systems.

2.6.6 Blue – Green Development Strategy[51]

The Blue Green Development Strategy of Sri Lanka was initiated in 2016 to address the growing need to address global warming. It focuses on oceanic energy, and green energy. The Strategy provides many areas of renewable energy which includes generating energy using sea waves and offshore wind power and Oceanic Thermal Energy Conversion (OTEC). Under green energy, the Strategy focuses on utilizing environment friendly tools to encourage production of green energy for the social and economic development of Sri Lanka. In addition, the Strategy focuses on creating awareness, and building the capacity of the Sri Lankan population to address climate change and global warming through its activities.[52]

2.6.7 Least Cost Generation Expansion Plan 2018-2037[53]

Section 43 of the Sri Lanka Electricity Act No. 20 of 2009 as amended by section 13 of Sri Lanka Electricity (Amendment) Act No. 31 of 2013, requires the Transmission Licensee to prepare and submit the Least Cost Long Term Generation Expansion Plan (LCLTGEP) for approval of the PUCSL. Accordingly, CEB has submitted their plan on 5th May 2017. The draft LCLTGEP was published for stakeholder comments from 9th May 2017 to 15th June 2017, and the oral session for comments was held on 15th June 2017. Elements of the Plan will be discussed in different sections of this paper, where applicable.

At the time of preparation of this paper, the LCLTGEP is considered as approved, though the approved version is deemed as not completely accepted by the CEB.

[51] http://www.srilankanext.lk/pdf/a-blue-green-era_english.pdf
[52] Ibid
[53] http://www.pucsl.gov.lk/english/wp-content/uploads/2017/07/Decision-on-LTGEP-2018-2037.pdf

2.7 International Commitments

2.7.1 Sustainable Development Goal Number 07 – Affordable, Reliable, Sustainable and Modern Energy for All

The Sustainable Development Goals (SDGs), otherwise known as the Global Goals, are a universal call toend poverty, protect the planet and ensure that all people enjoy peace and prosperity.[54] The Sustainable Development Goals (SDGs), officially known as "Transforming our world: the 2030 Agenda for Sustainable Development" is a set of seventeen aspirational "Global Goals" with 169 targets and 244 indicators between them by April 2017.[55] SDG 7 includes 5 targets and 6 indicators.

Goal 7 focuses on ensuring access to affordable, reliable, sustainable and modern energy for all[56] by 2030, ensuring universal access to affordable, reliable, and modern energy services; increasing substantially the share of renewable energy in the global energy mix; doubling the global rate of improvement in energy efficiency and enhancing international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology. The Goal also relates to expanding infrastructure and upgrading technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries, small island developing States, and land-locked developing countries, in accordance with their respective programs of support.[57]

2.7.2 Nationally Determined Contributions under the Paris Agreement

At the United Nations Climate Change Conference, the 21st session of the Conference of the Parties (COP21) held in Paris, in 2015, achieved significant progress, in that most developed and developing countries made emission reduction and adaptation commitments in the form of intended nationally determined contributions (INDCs).[58] INDCs outline the countries' post-2020 climate actions to contribute toward the 2°C global warming limit. For most countries, they cover greenhouse gas (GHG) emission reduction targets in energy, industry, agriculture, waste, land use and forestry, and transport— the sectoral focus varies from country to country.[59]

Upon the ratification of the Paris Agreement at the domestic level, Sri Lanka's INDCs were converted to Nationally Determined Contributions (NDCs). The energy sector of Sri Lanka has a 20% GHG emission reduction target which amounts to 39,383 Gg of the total GHG emissions (196,915 Gg for the period 2020-2030 as per the BAU scenario of the Long Term Generation Expansion Plan 2013-2032 published in October 2013).[60] The reduction of emissions includes 4% (9,173 Gg) unconditional and 16% (30,210 Gg) conditional reduction.[61]

The NDCs 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 hydropower plants; introduction of Demand Side Management (DSM) activities; strengthening sustainable

[54] http://www.statistics.gov.lk/sdg/application/publications/book.pdf
[55] ibid
[56] ibid
[57] Ibid
[58] UNFCCC. INDCs as Communicated by Parties. http://www4.unfccc.int/Submissions/INDC/Submission%
[59] https://www.adb.org/sites/default/files/publication/189882/sdwp-044.pdf
[60] http://www4.unfccc.int/ndcregistry/PublishedDocuments/Sri%20Lanka%20First/NDCs%20of%20Sri%20Lanka.pdf
[61] http://www4.unfccc.int/ndcregistry/PublishedDocuments/Sri%20Lanka%20First/NDCs%20of%20Sri%20Lanka.pdf

energy related policies with a view to increase the share of renewable energy from the existing 50% to 60% in 2020; converting existing fuel oil based power plants to LNG.[62] The MMDE has developed a Readiness Action Plan for the Implementation of INDCs of Sri Lanka with a time frame of 2017 – 2020. The Plan lists out the different activities to be undertaken to implement the INDCs submitted to the UNFCCC, and identifies the implementing agencies for each activity.

NDCs of Sri Lanka focusing on the energy sector and renewable energy will be further discussed in the next chapter, which focuses on NDCs of the South Asian region.

[62] Ibid

3 Nationally Determined Contributions & Regional Cooperation

3.1 Introduction

NDCs were introduced through the Paris Agreement which was agreed to in 2015, at the 21st Conference Parties of the UNFCCC.[63] According to Article 4 paragraph 2[64] of the Agreement, each party is required to prepare, communicate and maintain successive NDCs that each party intends to achieve their set GHG emission reduction targets by 2030. Further, it adds to the collective contribution to the reduction of emissions through pursuing domestic mitigation measures with the aim of achieving the objectives that they intended to contribute. At a regional level such as in the SAARC, this could contribute to the overall increase of ambition at the domestic and the international level. In the next sections of this chapter, the research will analyze how countries of South Asia have addressed the commitments under the Paris Agreement through their NDCs, and how these contributions could be contributing to regional cooperation in emission reduction.

3.2 NDCs & South Asia's Energy Sector

NDCs submitted by the countries of South Asia reflect a high focus on the energy sector, in the mitigation component.[65] It is identified as the most prominent sector to achieve emission reduction among their mitigation contributions. Further, the NDCs highlight the need for climate finance, and technology as part of the means of implementation related to them, which in turn promotes regional cooperation through the potential for South-South partnerships which could be developed among countries of South Asia. Further, NDCs could be seen as a link for incentivizing and creating momentum to initiate knowledge sharing hubs at regional level for developing and promoting technology transfer, energy trade, energy conservation and energy efficiency in the region and to focus developing hydropower, renewable and alternative energy and developing common ambition to raise incentives for the energy trade.

3.2.1 Afghanistan

Afghanistan's NDC presents a 13.6% reduction in GHG emissions by 2030, compared to the country's business as usual (BAU) 2030 scenario. This is conditional, and to be achieved based on external support.[66] The base year for the reduction is set at 2005, and the NDCs have its target years as 2020, and 2030. It also covers several sectors such as energy, natural resource management, agriculture, waste management and mining. The country has prepared an estimate of the financial needs to achieve the targets submitted to the UNFCCC. The estimated cost for mitigation section amounts to USD 6.62 billion (2020-2030).[67]

Afghanistan's gross electricity consumption was at 178 kWh per capita in 2013 and annual gross demand for the whole country is expected to increase from 3531 Gwh (2011) to 18,409 GWh by 2032. The annual peak demand is expected to increase from 742 MW in 2011 to 3502 MW by 2032, which results in Afghanistan requiring 5 times more electricity compared to 2011.[68] The country's electrification rate has been at 23.8% as of 2011 and it is expected to be

[63] Article 4, para 2, Paris Agreement (2015)
[64] Ibid
[65] Provide links to all the NDCs available for South Asia as reference.
[66] Afghanistan's 1st NDC, http://www4.unfccc.int/ndcregistry/PublishedDocuments/Afghanistan%20First/INDC_AFG_20150927_FINAL.pdf
[67] Ibid
[68] Ibid

increased up to 83% by 2032. The country is also expected to establish a centralized interconnected power system by 2032.[69]

The country is considered high in its renewable energy sources which include solar, wind, geothermal and bio-mass, and Afghanistan is considered to be a country described as a sunbelt country. Solar energy is mainly used for lighting purposes in the form of stand-alone systems. Largest Solar PV system in Afghanistan is identified as the 1 MW solar PV systems in the central province of Bamyan for villages in the region through mini grid.[70]

Executive Summary	
Base Year:	2005
Target Years:	2020 to 2030
Contribution Type:	Conditional
Sectors:	Energy, natural resource management, agriculture, waste management and mining
Gases Covered:	Carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O)
Target:	There will be a 13.6% reduction in CHG emissions by 2030 compared to a business as usual (BAU) 2030 scenario, conditional on external support.
Financial Needs:	Total USD 17.405 billion ▪ Adaptation: USD 10.785 billion ▪ Mitigation: USD 6.62 billion (2020-2030)

Figure 4: Executive summary of NDCs of Afghanistan[71]

Afghanistan's NDCs provides an interest to choose renewable energy options such as hydro power, solar systems, and wind as their main focus. With the introduction and the expansion of renewable energy to satisfy the needs of the energy sector in Afghanistan, the potential for expanding initiatives for CBET, as well regional cooperation on technology transfer for the implementation of NDCs in the country.

3.2.2 Bangladesh

The NDCs of Bangladesh provides for an unconditional contribution to reduce GHG emissions by 5% from Business as Usual (BAU) levels by 2030 in the power, transport and industry sectors, based on existing resources. Further, with external support, the country has a conditional contribution of 15% reduction in GHG emissions from BAU levels by 2030 in the power, transport, and industry sectors, subject to appropriate international support in the form of finance, investment, technology development and transfer, and capacity building.[72]

According to the available statistics, Bangladesh is the 134th ranked out of 144 countries on the quality of electricity supply. Bangladesh is experiencing a shortage of electricity supply and 42% of the population has no access to the electricity. Electricity consumption in the country is increasing rapidly and through 'Vision 2021' Bangladesh Government expected to ensure access to affordable and reliable electricity for all. In addition to that, irregular electric power supply causes load shedding in many areas of Bangladesh causing many issues to their daily lifestyle. In Bangladesh, Power generation is totally dependent on fossil fuel, gas and coal which comprises of a capacity share of 8709 MW.[73]

[69] Ibid

[70] https://www.hindawi.com/journals/jre/2017/5723152/

[71] Ibid

[72] Intended Nationally Determined Contributions of Bangladesh (2015), http://www4.unfccc.int/ndcregistry/PublishedDocuments/Bangladesh%20First/INDC_2015_of_Bangladesh.pdf

[73] Asif, Islam; Maidul, Islam; Sanchita, Ghose; et al, "A Review on Electricity Generation and Evacuation in Bangladesh,"

Bangladesh's mitigation contribution covers the power, transport and industry sectors. Under a BAU scenario, GHG emissions in Bangladesh in these sectors are expected to represent 69% of total emissions by 2030 (excluding LULUCF), an increase of 264% by 2030, from 64 MtCO2e in 2011 to 234 MtCO2e in 2030.[74]

Sector	Base year (2011) ($MtCO_2e$)	BAU scenario (2030) ($MtCO_2e$)	BAU change from 2011 to 2030	Unconditional contribution scenario (2030) ($MtCO_2e$)	Change Vs BAU	Conditional contribution scenario (2030) ($MtCO_2e$)	Change Vs BAU
Power	21	91	336%	86	-5%	75	-18%
Transport	17	37	118%	33	-9%	28	-24%
Industry (energy)	26	106	300%	102	-4%	95	-10%
TOTAL	64	234	264%	222	-5%	198	-15%

Figure 5: Projected reductions for mitigation sectors of Bangladesh[75]

Bangladesh in its NDCs expresses the intention to increase the penetration of wind power and implement grid-connected solar plants to diversify the existing energy generation mix by adding 400 MW of wind power generated by 2030 and 1000 MW of utility scale solar power plants.[76]

The country also has many activities which are aimed at facilitating emission reductions. This includes, a target to reduce energy intensity (per GDP) by 20% by 2030 compared to 2013 levels (E&CC Master Plan), establishing Energy Management Systems and energy audits for industry by accredited energy auditors, an energy efficiency labeling program to promote sales of high efficiency products in the market, energy efficiency measures for buildings, such as heat insulation and cooling measures, and a revised code on energy efficiency of new buildings. Bangladesh also has introduced a program titled Solar Home Program, providing off-grid electricity access to rural areas, and a target to deliver 5% of energy from renewable sources by 2015, and 10% by 2020 (2008 Renewable Energy Policy). There is also a solar roof top program which caters to 14 MW of solar installations on the vacant roof-tops of Government and private buildings. The country has set aggressive target to scale up the potential of Solar Irrigation Pumps, Solar mini and nano grids to address the energy access issue of off-grid population.[77]

Under the conditional contribution, Bangladesh lists out the potential for expanding wind based energy generation, as well as the implementation of a grid-connected solar plant to diversify the existing electricity generation mix.[78] Such targets would be facilitated with regional cooperation on climate action in the energy sector, as well as sharing of knowledge and technology across the region.

3.2.3 Bhutan

Bhutan's NDCs (INDCs which were rendered NDCs through the ratification of the Paris Agreement) highlight different strategies to address emission reductions. Bhutan is a net sink for greenhouse gases. The estimated sequestration capacity of the forests is 6.3 million tons of CO2 while the emissions for year 2000 is only 1.6 million tons of CO2 equivalents. This is largely due to huge areas of forest cover, low levels of industrial activity and almost 100% electricity generation through hydropower.[79] Further, export of electricity from hydropower projects form a major source of

Energy and Power: academic research, 10.5923/j.ep.20150501.02, Dhaka, Bangladesh, 2015.

[74] Ibid

[75] Table 2, Ibid

[76] Ibid

[77] Ibid

[78] Ibid

[79] INDCs of Bhutan, http://www4.unfccc.int/submissions/INDC/Published%20Documents/Bhutan/1/Bhutan-INDC-20150930.pdf

revenue for the Government and development activities.[80]

According to INDCs submitted by Bhutan, it maintains 100% electrification rate in urban areas of the country and 94% electrification rate in rural areas of the country. At the moment, Bhutan meets its electricity needs through Hydro-electricity and through commitments of INDCs, Bhutan expresses its interest to offset 22.4 million tons of CO2 per year by 2025. In addition to that, through its INDCs commitments under mitigation needs, Bhutan intends to promote renewable energy generation and pursue sustainable and clean hydropower development with support from Clean Development Mechanism (CDM) or other climate market mechanism to reduce emission within Bhutan and contributing to the region by trading surplus electricity produced. Furthermore, under the adaptation strategies of INDCs, Bhutan is expected to promote clean energy by diversifying energy supply mix through promotion of renewable energy such as solar, wind, small hydro, and biomass, other than large hydropower plants and to ensure energy security during the lean dry season through water storage and reservoirs. [81]

3.2.4 India

India accounts for 2.4% of the world surface area, with around 17.5% of the world population. It houses the largest proportion of global poor (30%), and around 24% of the global population without access to electricity (304 million). The average annual energy consumption in India in 2011 was only 0.6.[82] According to the country's first NDC, the per capita electricity consumption of the country is 917 kWh, which represents one third of the world's average consumption.[83]

India's NDCs include reducing the emissions intensity of its GDP by 33 to 35 percent by 2030 from 2005 level, and achieving approximately 40 percent cumulative electric power installed capacity from non-fossil fuel based energy resources by 2030 with the help of transfer of technology and low cost international finance including from Green Climate Fund (GCF). Further, they consist of NDCs relevant to means of implementation such as mobilizing domestic and new, and additional funds from developed countries to implement the above mitigation and adaptation actions in view of the resource required and the resource gap.[84]

Further, entering the Paris Agreement on November 4th, 2016, India announced its pledge to cut GHG emissions intensity by 33 to 35 percent relative to 2005 levels by 2030. This was built on a platform where India pledged to cut its intensity by 20 to 25% by 2020 at the Copenhagen Climate Change Conference.[85]

Renewable Energy initiatives are highlighted as a key component of India's emission reduction strategy. NDCs promote the use of energy generation mainly focusing on solar and wind power across the country. Initiatives highlighted by the NDCs include among others introducing new, more efficient and cleaner technologies in thermal power generation; promoting renewable energy generation and increasing the share of alternative fuels in overall fuel mix; reducing emissions from transportation sector; promoting energy efficiency in the economy, notably in industry, transportation, buildings and appliances and reducing emissions from waste.[86]

The NDCs further highlights the current initiatives and provides examples such as the largest renewable capacity expansion programs in the world existing in India, which has allowed to increase the share of renewable grid capacity to increase over 6 times, from 2% (3.9 GW) to around 13% (36 GW) between 2002 and 2015. The program is to be scaled up with the aim to achieve 175 GW of renewable energy capacity in the next few years. In addition, India has also

[80] Ibid
[81] Ibid
[82] India's First NDC, http://www4.unfccc.int/ndcregistry/PublishedDocuments/India%20First/INDIA%20INDC%20TO%20UNFCCC.pdf
[83] Ibid
[84] Ibid
[85] Ibid
[86] Ibid

decided to anchor a global solar alliance, International Agency for Solar Policy & Application (IASPA), of all countries located between the Tropic of Cancer and the Tropic of Capricorn, with the wind energy also being a predominant contributor to the renewable energy growth in India accounting for 23.76 GW (65.2%) of the renewable installed capacity. This in turn makes India the 5th largest wind power producer in the world, possessing a potential of more than 100 GW.[87]

With the technology on renewable energy that India possesses, and the knowledge and experience in different renewable energy related initiatives being implemented for years, the country is equipped with the capacity to lead the knowledge sharing and technology transfer initiatives in South Asia for building regional cooperation, and increasing the ambition through NDCs at the regional and the international level.

3.2.5 Maldives

Maldives communicated that it intends to reduce unconditionally 10% of its Greenhouse Gases (below BAU) by the year 2030, and that it could be increased up to 24% in a conditional manner, in the context of sustainable development, supported and enabled by availability of financial resources, technology transfer and capacity building.[88]

The country's efforts focus on actions and undertakings in reducing its GHG emissions in the energy sector. These will be based on strategies and sectoral action plans designed, amongst others in the sectors of energy, tourism, waste, water, and building sectors.[89]

The NDCs on the energy sector for Maldives focus on fuel switching to alternative energy options. This is stated as including solar irradiance which is available in the country throughout the year. Further, another potential renewable energy source which is listed out is the waves which surround the islands.

However, for both solar and wave based energy generation, Maldives notes the lack of technological capacity, and the need for technology transfer and capacity building. It would be an opportunity for cooperation at the regional level, to build relationships between countries of the region to address such needs.[90] This would be an option for further developing the renewable energy based regional cooperation, and increase the reduction of emissions capacity higher in the South Asian region.

3.2.6 Nepal

Nepal's energy use is dominated by traditional sources of energy, and the renewable energy contributes to only 1 percent of the total energy use.[91] Access to energy of the population is at 56 % and the country faces regular power shortages. Despite a huge potential for renewable energies such as hydropower, solar power and wind energy, these resources have not been sustainably captured due to many reasons, which among others include geographical, technical, political and economic reasons.[92]

However, Nepal does prioritize on the generation and utilization of clean energy, particularly through hydro-electricity at a larger scale. This includes promoting the Subsidy Delivery Mechanism for renewable energy since 2006 to ensure disbursement of subsidy in a cost effective and easy access manner in rural areas. Recent initiatives have been taken to promote solar energy, renewable energy technologies and energy-efficient technologies in urban areas.[93]

[87] Ibid
[88] Maldives First NDC, http://www4.unfccc.int/ndcregistry/PublishedDocuments/Maldives%20First/Maldives%20INDC.pdf
[89] Ibid
[90] Ibid
[91] Nepal's First NDC, http://www4.unfccc.int/ndcregistry/PublishedDocuments/Nepal%20First/Nepal%20First%20NDC.pdf
[92] Ibid
[93] Ibid

Under the NDC Nepal is expected to generate clean energy which consists of 4,000 MW of hydroelectricity by 2020 and 12,000 MW by 2030; 2,100 MW of solar energy by 2030 with arrangements to distribute it through the grid; additional 220 MW of electricity from bio-energy by 2030 and additional 50 MW of electricity from small and micro hydropower plants.

The country while possessing a high potential for renewable energy cooperation, does also suffer from political reasons which have arisen since 2015 that presents difficulties in the energy supply sector.[94] While the NDC remains without fixed percentages for emission reductions, the country expresses its commitment to reduce emissions and increase access to energy through the increase of renewable energy generation.

3.2.7 Pakistan

Pakistan is undergoing an energy crisis, which is two-fold, one is due to the lack of access to sustainable energy sources and products (energy poverty) and the other due to the gap in the demand supply in the power sector (electricity). The current energy mix of Pakistan is predominantly tilted towards the thermal generation based on imported fuels, while there remains a need to shift towards the domestic sources of energy.[95]

Pakistan's NDC provides for a conditional reduction of emissions to reduce 20% of its 2030 projected GHG emissions, subject to availability of international grants to meet the total abatement cost for the indicated 20 percent reduction, amounting to about US$ 40 billion at current prices.

Key initiatives regarding renewable energy promotion listed out in the NDC include interest-free loans to farmers for installation of solar tube wells; abolishing tax duty for import of solar equipments and promoting other renewable technologies in meeting the energy needs of the country.

[96]Further, there is also the construction of 1,000 MW Quaid-e-Azam solar park in Punjab, which is provided as a sub-national level ongoing action to address the energy crisis in the country. The NDCs also illustrate plans for large scale and distributed grid connected solar, wind and hydroelectricity as options for addressing the energy crisis of the country.

In order to achieve the answers to the energy crisis, it is important that Pakistan exploit its potential for renewable energy, including solar and wind. In order to generate such energy supply, it would be important that the country builds on the capacity building needs that have been assessed by the NDC, and are being assessed through the UNEP led Technical Needs Assessment (TNA). Through identification of such needs, it would open avenues for efficient and effective technology trainings, and capacity building through resources mobilized from the South Asian region.

3.2.8 Sri Lanka

Sri Lanka's NDCs under mitigation provide for a reduction of 20% of the GHG emissions against BAU scenario 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.[97]

The energy sector of Sri Lanka has realized almost 100% electrification through the national grid. Current total installed power generation capacity of the country is 3,888 MW. This includes 900 MW from coal power, 1,128 MW through oil generated thermal power and 1,860 MW from renewable energy. The contribution from renewable energy is 1377 MW

[94] Ibid

[95] Pakistan First NDC, http://www4.unfccc.int/ndcregistry/PublishedDocuments/Pakistan%20First/Pak-INDC.pdf

[96] Ibid

[97] Sri Lanka's First NDC, http://www4.unfccc.int/ndcregistry/PublishedDocuments/Sri%20Lanka%20First/NDCs%20of%20Sri%20Lanka.pdf

from large hydro, 328 MW from small hydro, 128 MW from wind, 25 MW from biomass and 1.36 MW from solar power.[98] Sri Lanka generates over 50% of its power through renewable energy resources. The solar rooftop systems operated under the net-metering scheme amounts to a capacity of 28 MW.[99]

Energy sector NDCs are expected to play a key role in contributing to the emission reductions in Sri Lanka. The 20% GHG emission reduction target in the NDCs for the energy sector amounts to 39,383 Gg of the total GHG emissions (196,915 Gg for the period 2020-2030 as per the BAU scenario of the Long Term Generation Expansion Plan 2013-2032 published in October 2013). The NDCs 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.[100]

Sri Lanka has initiated activities focusing on enhancing renewable energy, as part of which solar and wind resources form the larger part of future expansion of renewable energy based power generation. Current interventions in renewable energy generation include developing hydro power base to its maximum potential through large hydro power plants (Uma Oya, Ginganga, Broadlands) and small hydro power plants, of which the overall potential will be in the range of 500 MW. Further the Government is focusing on building wind parks, which mainly focuses on the Mannar islands, a location recognized to be one of the sites with the best potential in the South Asian region for generating energy through wind power.[101]

In addition to this, increasing the potential for solar power generation has been initiated through different modalities such as solar rooftops and solar parks. This will provide approximately 500 MW in the short term and has the potential to expand to a considerably high level by 2030.[102] Further, the promotion of solar power has been given a priority through the introduction of different modalities such as introducing the community-based power generation program named as "Soorya Bala Sangramaya" (Battle for solar energy,) solar rooftops, and solar parks expecting 500 MW in short term.

"Soorya Bala Sangramaya", the project on solar power, has introduced three categories for community-based power generation programs which include Net Metering, Net Accounting and Net plus. It also has the intention of adding 200MW to the national grid by 2020 and further 800MW by 2025.[103] Further, the latest policy publication by the Government titled "Vision 2025 - A Country Enriched" refers to the project, focusing on the enhancement of renewable energy generation in the country.[104]

NDCs of Sri Lanka highlight the need for capacity building and technology transfer for achieving the targets on renewable energy. It provides that investing time and resources in capacity building to address the adverse impacts of climate will ensure a higher degree of deviation from the BAU emission projections and increase resilience.[105] In addition to this, the NDC highlights the need for institutional set up, and the engagement of multiple stakeholders.

Further, multi-stakeholder consultations provided information to deduce that in terms of implementation capacity, the integration of line-ministries was considered as essential in order to develop a coherent policy framework for

[98] Ibid
[99] Ibid
[100] Ibid
[101] Ibid
[102] Ibid
[103] Battle of Solar Energy, Sri Lanka's Ministry of Power and Energy, powermin.gov.lk/bfse
[104] Vision 2025 – A Country Enriched, Government of Sri Lanka, https://www.news.lk/images/pdf/2017/sep/Vision_2025_English.pdf
[105] Sri Lanka's First NDC, http://www4.unfccc.int/ndcregistry/PublishedDocuments/Sri%20Lanka%20First/NDCs%20of%20Sri%20Lanka.pdf

implementation of development targets. Moreover, establishing co-ordination between government institutions and regional projects is needed while integrating the country's development priorities into NDCs on energy. Matching government's implementation of NDCs with the relevant policies and ensuring coordination with local economic development through building a competent workforce, technology transfer and the use of locally available expertise for renewable energy development, were identified as measures to integrate Sri Lanka's development priorities to NDCs on energy sector.

As previously mentioned, the country could contribute to developing capacity, and benefit from capacity building initiatives at regional level which could be set up to address the capacity needs related to renewable energy expansion in Sri Lanka.

4 Regional Cooperation on Cross-Border Energy Trade

4.1 Introduction

The countries of South Asia (SA), comprising Afghanistan, Bangladesh, Bhutan, India, the Maldives, Nepal, Pakistan, and Sri Lanka, are home to one-fifth (23 percent) of the world's population. Over the last two decades, South Asia has been one of the fastest growing regions in the world, with an average annual growth rate of 6% as measured by GDP per capita.[106] South Asia is demarcated by developing economies with robustly growing key economic sectors including the industrial, agricultural and services, thereby driving the exponentially increasing demand for energy in the region. India, Pakistan and Bangladesh account for the major share of natural gas and coal resources in the region. However, these countries are also large in terms of area as well as population and thus, the higher resource base does not necessarily indicate sufficiency to meet energy needs.[107]

Table 3: Percentage of population with access to electricity (2014 World Bank data)

Country	% of population with electricity access
Afghanistan	89.5%
Bangladesh	62.4%
Bhutan	100%
India	79.2%
Maldives	100%
Nepal	84.9%
Pakistan	97.5%
Sri Lanka	92.2%

Given the link between economic growth and energy demand, access to adequate, affordable, reliable and high-quality energy services, energy is considered one of the key inputs needed to sustain and accelerate economic growth in the region.[108] All the South Asian countries, barring Maldives and Bhutan, have not reached a 100 percent electrification rate and are yet to provide electricity access (Table 3) to the entire country's population. These countries suffer from the inability to meet the increasing demand and consumption patterns arising from increased commercial energy demand due to lack of adequate infrastructure for generation, transmission and distribution of electricity.[109] In order to maintain the fast paced annual average GDP growth of the region, which is projected to grow at a CAGR of 7.4 per cent[110], the energy sector needs to develop in ways that can match the projected growth in demand for electricity in a sustainable manner.

[106] "Cross-Border Electricity Trade in South Asia: Challenges and Investment Opportunities, South Asia Investor's Workshop on 'Cross-Border Electricity Trade at New Delhi, India.'" South Asia Regional Initiative for Energy Integration (SARI/EI), 24 Sept. 2014.

[107] Wijayathunga, Priyantha, and P.N. Fernando. "An Overview of Energy Cooperation in South Asia." South Asia Working Paper Series, Asian Development Bank, No 19, May 2013

[108] Hafeez, Sultan, et al. "Energy trade in South Asia: Opportunities and challenges."Asian Development Bank, 2012

[109] Firoz Alam1, Quamrul Alam2 and Rashid Sarkar3. "A Review of Power Sector by Energy Types in SAARC Countries ". 2015

[110] Parikh, Jyoti,. V.K. Kharbanda, and Rajiv Ratna Panda. "Cross-Border Electricity Trade in South Asia: Key Policy, Regulatory Issues/ Challenges and the Way Forward". IRADe.2016

Table 4: Installed Capacity (MW) from different sources in South Asian Region till Jan,2016

Country/Installed capacity from different sources (MW)	Coal	Oil/Diesel	Gas	Renewable	Hydel	Nuclear	Total
Afghanistan	0	268	0	0	254	0	522
Bangladesh	0	17	0	0	1,488	0	1,505
Bhutan	250	3,463	7,509	0	230	0	11,452
India	170,738	994	24,473	37,416	42, 623	5,780	282,024
Maldives	0	79	0	0	0	0	79
Nepal	0	53	0	5	730	0	788
Pakistan	6,330	7,107	2,178	355	6,893	750	23,613
Sri Lanka		1,419	0	86	1,602	0	3,107
Total	177,318	13,400	34,160	37,862	53,820	6,530	323,090

In terms of energy security, resources used and required to generate power is a major consideration. The installed capacity (MW) from different sources (Table 4) depicts that the energy sector of the region is predominantly governed by certain characteristics. The dominance of single fuel in energy, limited exploitation of renewable energy resources and a high dependence on traditional fuel are common features applicable to all the individual domestic energy sectors of the region.[111] These are oil for Afghanistan (78%), Maldives (100%), Nepal (67%), and Sri Lanka (79%); hydropower for Bhutan (50%); and natural gas for Bangladesh (74%).[112]

Another key factor which characterizes the region's energy sector is the dependence on fossil fuel and coal, with imports ranging from 25% of commercial energy consumption in the case of Bhutan to 100% in the case of Maldives.[113] The oil consumption growth rate is expected to be around 6% in all SAARC countries. India with 5,700 million barrels has the highest crude oil reserves in South Asia. In comparison, Pakistan and Bangladesh have 341 million barrels and 28 million barrels respectively. At current levels of production, India is projected to exhaust its crude oil reserves in 30 years unless new reserves are discovered.[114] An increasing proportion of oil import is being used to run diesel-based grid-connected generation capacity (especially the Maldives and Sri Lanka) affecting energy security due to oil price fluctuations, unpredictability and import dependability resulting in challenge of passing on an increasing oil cost to the ultimate consumers of electricity. Sri Lanka remains most vulnerable to energy security due to a high dependence on energy imports.[115] This not only has adverse repercussions on the economies of the countries with rising dependence and expenditure on imports, but also entails an environmental impact on the overall energy security of the region.

The domestic resource development pace in the South Asian Countries, together with existing regional bilateral energy trade arrangements, cannot match the growing commercial energy supply required in the region.[116] Hence, it is evident that these countries are in need of enhancing their regional energy transfer, and to increase their access to

[111] "SAARC Energy Trade Study". SAARC Secretariat. 2010

[112] Hafeez, Sultan, et al. "Energy trade in South Asia: Opportunities and challenges."Asian Development Bank, 2012

[113] Firoz Alam1,Quamrul Alam2 and Rashid Sarkar3. "A Review of Power Sector by Energy Types in SAARC Countries ". 2015

[114] Firoz Alam1,Quamrul Alam2 and Rashid Sarkar3. "A Review of Power Sector by Energy Types in SAARC Countries ". 2015

[115] Parikh, Jyoti,. V.K. Kharbanda, and Rajiv Ratna Panda. "Cross-Border Electricity Trade in South Asia: Key Policy, Regulatory Issues/ Challenges and the Way Forward". IRADe.2016
Parikh, Jyoti,. V.K. Kharbanda, and Rajiv Ratna Panda. "Cross-Border Electricity Trade in South Asia: Key Policy, Regulatory Issues/ Challenges and the Way Forward". IRADe.2016
ard

[116] Wijayathunga, Priyantha, and P.N. Fernando. "An Overview of Energy Cooperation in South Asia." South Asia Working Paper Series, Asian Development Bank, No 19, May 2013

energy resources (from outside the region) and leverage economies of scale in energy procurement through a more vibrant intra and inter regional energy trade structure.[117]

4.2 Cross Border Electricity Trade in South Asia

Energy interconnections in the region have become a major focus in the sustainable development of the energy sector of South Asian countries. Regional cooperation on energy and Cross Border Electricity Trade (CBET) is considered as a tool, complementary to purely national programs and policies, in pursuing national goals[118] and has given rise to several frameworks such as bi-lateral trade agreements as seen between, and other multilateral agreements manifest in the SAARC Framework Agreement of Energy (Electricity) Cooperation to which eight countries are Party to.

4.2.1 Drivers of CBET in South Asia

Amongst the factors that facilitate regional cooperation in South-Asia, the most important characteristic of the region is the variation in the energy demand and supply situation. Diversity in demand profiles of South Asian countries with the non-coincident demand peaks across the year and difference in the daily load curve provides opportunities for optimizing the load-generation balance across the region through a mutually beneficial power exchange mechanism among the region.[119] Given the limitations in the capacity of reserves in the region leading to supply shortages, CBET would benefit the region by reducing costs of maintaining the reserves through inter-connected power systems across the region. Smaller economies of the region gain an opportunity to reach economies of scale in generation and investment by the integrated resource development.[120]

Country/Fuel sources	Coal	Oil	Natural Gas	Biomass	Hydropower*
	(million tonnes)	(million barrels)	(trillion cubic feet)	(million tonnes)	(MW)
Afghanistan	440	NA	15	18-27	25,000
Bhutan	2	0	0	27	30,000
Bangladesh	884	12	8	0.08	330
India	90,085	5,700	39	139	150,000
Maldives	0	0	0	0.06	0
Nepal	NA	0	0	27	83,000
Pakistan	17,550	324	33	-	59,000
Sri Lanka	NA	150	0	12	2,000
Total	**108,961**	**6,186**	**95**	**223-232**	**349,000**

Source: ADB (2012)

**Note: As per ADB (2012), the estimated hydor-electric potential of the region was only 294.33 GW due to lower estimates for Nepal and Pakistan. The above estimate is based on SAARC Secretariat (2010) for Bangladesh, Bhutan, India, Nepal, Sri Lanka; CWC (2005) for Indian States and WAPDA (2011) for Pakistan.*

Figure 6: Energy endowments of South Asian Countries

[117] Wijayathunga, Priyantha, and P.N. Fernando. "An Overview of Energy Cooperation in South Asia." South Asia Working Paper Series, Asian Development Bank, No 19, May 2013

[118] Hafeez, Sultan, Rahman Priyantha D. C. WijayatungaHerathGunatilake and P. N. Fernando E." Energy Trade In South Asia Opportunities And Challenges". ADB.2011

[119] Parikh, Jyoti,. V.K. Kharbanda, and Rajiv Ratna Panda. "Cross-Border Electricity Trade in South Asia: Key Policy, Regulatory Issues/ Challenges and the Way Forward". IRADe.2016

[120] Parikh, Jyoti,. V.K. Kharbanda, and Rajiv Ratna Panda. "Cross-Border Electricity Trade in South Asia: Key Policy, Regulatory Issues/ Challenges and the Way Forward". IRADe.2016

In addition, the region is bestowed with diverse energy sources including limited capacity of conventional energy resources, but also a huge capacity of untapped renewable energy potential such as solar and wind (Figure 7) renewable energy sources, which are not realized due to lack of requisite technological capacitates, high capital cost of infrastructure and higher energy prices from these sources.[121] The cumulative hydropower potential of the region is 294,330 MW which is more than the present total installed capacity of the region. Country specific potential stated as; Afghanistan 25,000 MW, Bhutan 30,000 MW, India 150,000 MW, Nepal 42,000 MW and Pakistan 45,000 MW; which when added works out to 292,000 MW. This is more than the present total installed capacity of the region.[122]

Renewables	Bangladesh	India	Nepal	Bhutan	Pakistan	Sri Lanka
Solar power (kWh/sq. m per day)	3.8 - 6.5	4 - 7	3.6 - 6.2	2.5 - 5	5.3	NA
Wind (MW)	Very limited potential	151,918	3,000	4,825	24,000	25,000 MW

Figure 7: Renewable Energy Resource Endowment in South Asia

With the ratification of the Paris Agreement on climate change, the South Asian governments have submitted their Intended Nationally Determined Contributions (INDC) to the United Nations Framework Convention on Climate Change (UNFCCC), which will determine the pathway for the energy sector development. Through regional cooperation in energy, the untapped potential for renewable energy in the region can be harnessed. Solar and wind power potential in the region could be effectively exploited for the optimum utilization of clean energy sources. CBET would benefit countries with limited resources to meet its seasonal electricity requirements in sustainable manner through an effective exploitation of renewable energy potential via cross-border integration of the electricity systems and energy cooperation can help tap the available hydro and renewable resources, and improve the system's efficiency by exploiting opportunities to trade electricity. This will reduce the overall emissions from the sector at the regional level and help in achieving the INDC targets as well as spur the development of sustainable and clean energy in the SAR.

4.2.2 Benefits of CBET

CBET encompasses a wide range of technical, operational, environmental, financial, economic and social sector benefits including improved energy security and reliability, optimized transmission network, increased economic efficiency in system operation, and reduced environmental impacts; industrial productivity gains, revenue gains, and GDP gains.[123] The Study on Cross-Border Electricity Trade in South Asia[124] lists the benefits of CBET under three broad categories such as operational, economic and environmental.

4.2.2.1 Operational Benefits

Operational benefits would arise through the optimization of the available resources through robust system integration based on rational planning and execution.

The key operational benefits would include:

- Achieving the optimal capacity utilization factor of a country's thermal and hydropower plants that would be independent of the seasonal/daily demand variations in the country owing to their utilization for meeting the regional electricity demands.

[121] SAARC regional Energy Trade study.SAARC Secretariat 2010.

[122] Review of Electricity Laws and Regulations of SAARC Member States

[123] SAARC energy trade study .SAARC Secretariat.2010

[124] Parikh, Jyoti,. V.K. Kharbanda, and Rajiv Ratna Panda. "Cross-Border Electricity Trade in South Asia: Key Policy, Regulatory Issues/ Challenges and the Way Forward". IRADe.2016

- Achieving economies of scale by consolidating the additional requirements of smaller countries to develop a single generation plan of larger size.
- Enhanced reliability through multiple transmission links among generation pockets and demand centers in the region.
- Optimized transmission capacities through setting up high voltage high capacity inter-regional transmission systems, thereby minimizing land requirements for multiple intra-country transmission systems in a non-CBET regime.

4.2.2.2 Economic Benefits

CBET can provide significant economic benefits and, in fact, drive the economies of South Asian countries. Some of the economic benefits are;

- Power availability at competitive price
- High export income due to power export
- Less exposure to volatile international energy prices leading to a reduction in the buying of energy from outside.

4.2.3 Environmental Benefits

Environmental sustainability would be a key outcome from enhanced CBET in the SAR. Some of the major benefits to the environment include:

- Lower impact on the environment by tapping the significant untapped hydropower capacities in the region.
- Enhanced electricity access would help minimize the usage of kerosene for cooking and domestic lighting, thereby reducing indoor air pollution.
- Fast tracking of the development of other renewable energy generation resources in the region through sharing of industry practices among the CBET members would help preserve the conventional sources for the future.

4.2.3 Present Initiatives of CBET in South Asia

CBET is a fast developing concept in the region with wide stakeholder engagement ranging from governments, to private sector and CSO actors, and improved policy and institutional frameworks driving the potential for enhancing CBET initiatives. In addition, the studies reveal that the scope of CBET in the future will be more market-oriented which will require inter-regional transmission capacities which could be 7,200 MW by 2033-34.

At present, CBET initiatives identified in the region include Bhutan-India additional grid reinforcement; India-Nepal 400 kilovolt transmission link under construction; proposed India-Sri Lanka high voltage direct current transmission link which includes a submarine cable component; Bangladesh - India high voltage director current transmission link which was commissioned in October 2013; and India-Pakistan 400 kilovolt transmission link coupled with CASA 1000 transmission link.[125]

Ongoing initiatives on energy trade in South Asia[126]

- *Electricity Trade between Afghanistan and Central Asian Republics (CARs)*
  Afghanistan meets a major part of electricity demand through imports from Iran, Turkmenistan, Uzbekistan and Tajikistan. The import volumes rose from 110 million kWh in 2000 to 150 million kWh in 2005 and reached a level of 608 million kWh in 2009

[125] Wijayathunga, Priyantha, and P.N. Fernando. "An Overview of Energy Cooperation in South Asia." South Asia Working Paper Series, Asian Development Bank, No 19, May 2013

[126] Review of Electricity Laws and Regulations of SAARC Member States

- *Electricity Trade between Bhutan and India*
  As per discussions with PTC ltd.; India imports 1,100-1,200 MW from Bhutan. New plants are under implementation in Bhutan to enhance the power exports to 5,000 MW by 2020. An agreement concerning co-operation in the field of hydroelectric power was signed between Government of India (GoI) and Royal Government of Bhutan (RGoB) on 28.7.2006. In this agreement, it was decided that for the projects to be implemented jointly by the two Governments. Through Joint Ventures or Government owned agencies, a suitably Empowered Joint Group would be set up. It was also decided that the Govt. of India agrees to a minimum import of 5,000 MW electricity from Bhutan by the year 2020 which was subsequently enhanced to 10,000 MW in the protocol signed in the year 2009 between the two Governments.[127]

- *Electricity Trade between India and Nepal:*
  Fourteen transmission interconnections along Nepal-India border help exchange 50 MW between the two countries in a radial mode, and at present India exports around 300 MW to Nepal.[128]

- *Electricity Trade between Pakistan and Iran:*
  Pakistan imports electricity from Iran to serve the demand in Baluchistan province. The system is operated in a radial mode. As per the 2002 agreement between the two countries, Pakistan can import up to 39 MW. The actual import recorded was 25 MW in December 2005. In June 2006, WAPDA has signed an MOU with Iran to increase the supply by 100 MW to meet the demand in the Gwadar port area.

- *Electricity Interconnection between India and Bangladesh:*
  The 400 kV HVDC Bangladesh-India transmission interconnection with a capacity to transmit 1,000 MW was built in 2012. Bangladesh is importing 660 MW electricity from India through 400 kV HVDC sub-station in Behramara, Bangladesh and 47 km double circuit transmission line linking the power grid at Suryamaninagar in Tripura to the Comilla power grid in eastern Bangladesh.

- *Proposed Electricity Interconnection between India and Sri Lanka:*
  The India–Sri Lanka transmission interconnection will link the national grids of India and Sri Lanka. The project involves the construction of a HVDC interconnection between Madurai (India) and Anuradhapura (Sri Lanka) through the Palk Strait. The link will measure 285 km in length, including 50 km of submarine cables. It will take more than three years to build. The system will have a carrying capacity of 1,000 MW.

- *Proposed Inter-Regional Power Trade between Central Asia and South Asia:*
  Central Asian Republics have a large potential to export electricity to South Asia. Tajikistan, Kyrgyzstan, Afghanistan and Pakistan have entered into an agreement to build the CASA-1,000 transmission system to help Afghanistan and Pakistan import 1,300 MW.[129]

These models enable access to regional energy markets thereby creating competitive supply to the domestic energy market structures ensuring energy security in the region.

4.3 Key Initiatives of Regional Cooperation and CBET in South Asia

4.3.1 South Asian Association for Regional Cooperation (SAARC)'s Framework Agreement for Energy Cooperation (2016)

SAARC developed the Framework Agreement for Energy Cooperation (2016) which enable its member states to conduct cross border electricity trade. This Agreement allows among others for authorized entities of the SAARC member states

[127] http://www.cea.nic.in/reports/monthly/hydro/2017/bhutan-06.pdf
[128] http://www.cercind.gov.in/2017/draft_reg/Expl7.pdf
[129] http://projects.worldbank.org/P145054?lang=en

to buy and sell electricity within the region,[130] to negotiate the terms and conditions,[131] payment security mechanism and tenure of the electricity trade, subject to regulation by the laws of the concerned member states to[132] consider exempting export and import duties and other fees for cross border trade and exchange of electricity.

The Agreement will further provide non-discriminatory access to the regional transmission grids in their respective countries.[133] Negotiations—through bilateral, trilateral, or regional agreements—will be conducted among member states in installing cross-border transmission lines and cross-border interconnections for cross-border electricity trade. It also envisages setting up of system operations and settlement mechanism, a regulatory mechanism, and a dispute settlement mechanism.[134] The member states will be provided with the opportunity to review the commitment to the Agreement on a 5 year basis,[135] from the date of entry into force. The Agreement also provides for knowledge sharing and joint research in Electricity Sector Member States which may enable and encourage knowledge sharing and joint research including exchange of experts and professionals related to, inter alia power generation, transmission, distribution, energy efficiency, reduction of transmission and distribution losses.[136]

4.3.2 South Asia Sub-regional Economic Cooperation 2016 - 2025[137]

The SASEC focuses on different aspects which contribute to the country's development. In its component on the energy sector, the SASEC addresses issues such as the dominance of a single fuel for electricity generation and increasing import dependence; the need for capacity expansion and diversification of energy sources to meet energy needs; poor energy infrastructure that limits the potential for cross-border trade; lack of harmonious policy frameworks that could enable the development of a regional power market; limited use of renewable energy potential; weak institutional and co-ordination capacities; and lack of funds in the public sector to undertake capital intensive projects.

It also focuses on easing of supply constraints through improving energy trade infrastructure. This includes the expansion and diversifying of energy sources to meet increasing demand resulting from economic growth and rising per capita incomes. It also focuses on energy trade infrastructure which is needed to enable the SASEC countries to access commercial energy sources. Further, the strategy relates to developing the regional power markets in South Asia as a long-term goal. This is expected to build on the expansion of bilateral energy trade arrangements between Bhutan and India, India and Nepal, and Bangladesh and India, into a multilateral trade arrangement within a regional framework. However, developing a regional power market would require developing legal and regulatory aspects, transmission systems, security and stability standards, and coordinating power generation scheduling and dispatch procedures. There would also be the need for harmonizing legal and regulatory frameworks, as well as technical and institutional procedures.

In addition to the above, the SASEC energy strategy has its focus on developing low-carbon alternatives, and energy efficiency and conservation measures. The countries of the region process abundant renewable energy resources like wind and power and have taken initiatives to develop them on a commercial scale.

However, wind and solar capacity do not serve as a replacement for conventional energy with the hourly variation of output in a day making it difficult to forecast wind and solar generation, for which the technology is still being developed. Further constraints faced include high transmission charges and difficult to afford net cost for renewable

[130] Article 1, SAARC Framework for Energy Cooperation
[131] Article 3, Ibid
[132] Article 2, SAARC Framework for Regional Energy Cooperation (2016)
[133] Article 6 & 7, Ibid
[134] Article 7, 8, 9 Ibid
[135] Article 20, Ibid
[136] Article 14, Ibid
[137] https://www.adb.org/sites/default/files/institutional-document/193351/sasec-operational-plan2016-2025.pdf

generation. In order to address this, SASEC Plan proposes sharing of the renewable energy development practices for technology and knowledge transfer.

In order to diversify the energy mix for each of the countries, the SASEC energy sector further proposes on operational priorities such as improving interconnections to access large-scale electricity and natural gas sources, harnessing unused regional indigenous hydropower potential, developing low-carbon alternatives including wind and solar, and facilitating bilateral and regional co-ordination mechanisms and knowledge sharing, such as technology transfer development practices towards the regional power trading market.

4.4 Sri Lanka and CBET

The draft Long Term Generation Expansion Plan of the CBE 2018 – 2037 speaks of CBET between India and Sri Lanka.

Figure 8: Proposed interconnection between India and Sri Lanka

The MOU on a Feasibility Study for India- Sri Lanka Electricity Grid Interconnection was signed on the 9th June 2010, to conduct a feasibility study for the interconnection of the electricity grids of the two countries. A pre-feasibility study was conducted by Nexant Inc./ Power Grid Corporation of India with the assistance of USAID in 2002 and a review of the prefeasibility study was carried out in 2006 with the main objective of providing to provide the necessary recommendations for implementation of 1,000 MW HVDC interconnection project. In accordance, various route options were analyzed in the prefeasibility pre-feasibility stage and the route selected consisting of 130 km 400 kV HVDC overhead line segment from Madurai to Indian sea coast, 120 km of 400 kV under-sea cable from Indian sea coast to Sri Lankan Sea coast, 110 km Overhead line segment of 400 kV from Sri Lankan sea coast to Anuradhapura and two converter stations at Madurai and Anuradhapura.[138]

The plant capacity is 2 x 250 MW and the MoA has provision for the extension of up to a total of 1,000 MW. All agreements, such as PPA, implementation agreement, land lease agreement, and coal supply agreement, were signed in October 2013. The total estimated cost is USD 512 million and the project is expected to be commissioned in 2017-18. Further, Sri Lanka has plans to import power (~500 MW) from India via the proposed HVDC link.[139]

[138] LTGEP 2018-2037. CEB. 2017

[139]

Scope of Project

Configuration of the Interconnection- High voltage direct current (HVDC), operating at ±400 kV Length - 387 km - overhead line 337 km (India 197 km Sri Lanka 140 km) - submarine cable 50 km, Interconnection capacity – stage I - 500 MW, stage II - 500 MW, investment 500 - 700 MUSD (CEB, 2014). The feasibility study has considered the technical, economical, legal, regulatory and commercial aspects in trading electricity between India and Sri Lanka and is yet to be finalized.[140]

At a meeting between India and Sri Lanka, it has been decided that the project cost has to be reduced to make it economically viable. The following measures are to be studied for reducing the cost of the project: Reduction in length of the submarine cable (~75 km) by changing termination points (Talaimannar instead of Thirukketiswaram and Dhanushkodi instead of Panaikulam). Explore possibility of reduction of HVDC terminal cost. Consider multilateral funding for carrying out cost estimate (JICA funding being tried).[141]

Several studies have been conducted since 2002 to explore the feasibility of CBET between India and Sri Lanka. In 2002, NEXANT with the assistance of USAID carried out the Pre-Feasibility Study for Electricity Grid Interconnection. In 2006, POWERGRID, India reviewed and updated the study with USAID assistance. Various Line route options and connection schemes were analyzed during the pre-feasibility studies. Following these studies the route option was selected for the feasibility study consisting of 130 km 400kV HVDC overhead line segment from Madurai to Indian sea coast, 120km of 400kV under-sea cable from Indian sea coast to Sri Lankan Sea coast, 110 km overhead line segment of 400kV from Sri Lankan sea coast to Anuradhapura and two converter stations at Madurai and Anuradhapura.[142]

The Broad Scope of Work is identified as follows: 1000MW HVDC bipole line from India (Madurai) to Sri Lanka (New Anuradhapura) : 360 km Indian Territory: Overhead Line: Madurai to Panaikulam : 130 km Sea Route: Submarine Cable: Panaikulam (India) to Thirukketiswaram (SL) : 120 km Sri Lankan Territory: Overhead Line: Thirukketiswaram to New Anuradhapura : 110km. The interconnection has been envisaged to be implemented with 2x500MW VSC based HVDC terminal in two stages. Stage-I : 1 x 500 MW Monopole Stage- II : 2 x 500 MW Bipole.[143]

Further the draft version of the National Energy Policy and Strategies[144] published in February, 2017, includes strategies of implementation to address energy security which advocate "viable cross-border electricity transfer and cooperation" with countries in the region.

However, discussions with multiple stakeholders on the CBET between India and Sri Lanka expressed mixed feelings and reservations. Many CSO representatives indicated that the actions for CBET between the two countries would need to be implemented with caution.[145]

4.4.1 Other initiatives on CBET in Sri Lanka

4.4.1.1 Trincomalee Coal Power Project

In 2006, a Memorandum of Agreement (MOA) was signed between the Government of Sri Lanka (GOSL) and Government of India (GOI) to develop a coal power plant in Trincomalee as a joint venture between CEB and National Thermal Power Corporation Ltd. of India. The Trincomalee Power Company Limited (TPCL), which was established as a joint venture has a total generation capacity of 500 MW and the MOA has provision for the extension of up to a total of 1,000 MW. All agreements, such as PPA, implementation agreement, land lease agreement, and coal supply

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141

142 Ibid

143 Ibid

144 Draft National Energy Policy of Sri Lanka (2017)

145 Input of Consultation of Civil Society Organisations, National Steering Committee of Climate Action Network South Asia

agreement, were signed in October 2013. The total estimated cost is USD 512 million and the project was expected to be commissioned in 2017-18. However, the project which was situated in Sampoor, was not granted approval by the PUCSL in the Long Term Generation Expansion Plan 2015-2034, as per the letter sent by the Secretary to the MOPRE for the undertaking given to the Supreme Court Case No. SCFR 179/2016.

Despite gaining environmental approval for the Environmental Impact Assessment (EIA) by the Central Environmental Authority (CEA) and after being rejected twice on prior occasions, the project faced strong criticism from environmental activists in Sri Lanka. The project was seen to have implications on the air, soil, water and ecosystems of the area, causing long-term impacts in the environmental integrity. Following these concerns, a Fundamental Rights Application was filed by Environmental Foundation Limited (EFL). The petition had cited long term health impact to the people living in the area, and the long term environmental repercussions along with certain discrepancies to the EIA.

4.5 Challenges and Way Forward in CBET initiatives

Despite its largely economic, operational and environmental benefits, CBET pose several challenges and risks. Broadly, development of CBET face an array of challenges in terms of the geopolitical situation of the region affecting bi-lateral or multilateral trade interconnection agreements between countries. More significantly, the barriers for regional cooperation on energy include the lack of coordinated legal and regulatory framework in the region where domestic energy systems lack provision for the development of energy trade. To enhance CBET within two or more countries in South Asia, there is a need to have common/coordinated set of regulations which facilitates/addresses the mechanism of cross border interconnection.[146]

Another challenge is that the lack of robust framework for systems planning and operation to maintain flexibility in the setting up of a viable, multi-country, institutional structure to leverage the individual and collective capabilities of transmission. Lack of commercial framework for Energy Exchanges or a clear, transparent, and harmonized set of "Commercial Rules of Practice" to be put in place and adhered to by the interconnected national power utilities, with attention pricing principles, technical standards for metering etc. and arbitrate between and among power utilities.[147] The lack of a comprehensive and reliable energy database for the region, and coordinated grid codes and regional operating mechanisms all lead to the barriers in creating and enabling environment to attract large energy infrastructure investments and the complementary regional energy trade.

In terms of the Sri Lankan context, challenges and risk in engaging in regional cooperation on energy can be connected to these overarching issues in energy trade. Among the concerns are the cost incurred for price of electricity, at point of investment and operation of the interconnection, transmission fees to be paid for transfers. In addition, concerns also arise from the lack of knowledge and technological capacities in handling new technology as in the case of operation and maintenance of 400 kV HVDC interconnection is challenging.[148] Stemming from lack of a cohesive regulatory and legal framework, the issue of ownership remains an issue for the development of energy trade. Regulatory and bilateral trade issues experienced in Sri Lanka also include legal and regulatory framework related to the project, amendment of vested powers in the institutional structure pertaining to energy transfer, as well as other trade related issues and concerns.

Recommendations from multiple stakeholder consultations identified that in terms of implementation capacity, the integration of line-ministries is essential in order to formulate a coherent policy framework for the implementation of development targets. Moreover, establishing co-ordination between government institutions and regional projects

[146] Parikh, Jyoti,. V.K. Kharbanda "Cross-Border Electricity Trade in South Asia: Key Policy, Regulatory Issues/ Challenges and the Way Forward". IRADe.2016

[147] Ibid

[148] Jayasekera, Kamani. "Status of Sri Lanka Cross Border Interconnection with India & Expected Benefits". 2014

is needed when integrating the country's development priorities into NDCs on energy. Matching government implementation of NDCs with the relevant policies and ensuring co-ordination with local economic development through building a competent workforce, technology transfer and the use of locally available expertise for renewable energy development, were identified as measures to integrate Sri Lanka's development priorities to NDCs on energy sector.

CBET initiatives in Sri Lanka have wide ranging benefits in terms of providing opportunities to enter into India Power Exchange for energy trading, access to electricity from cheaper sources of power generation in the South Asian Region, reduction in operational cost through better resource management, meeting growing power demand with imported power, improved load profile - valley filling, and improved system reliability and security.[149]

It would be important to address issues which would hinder the CBET such as the need for social acceptability, management of political risk, economic viability, technical feasibility of interconnection, and security of the transmission corridors. Further, institutional factors such as scheduling and power dispatch systems, tariff setting mechanisms, and mutually acceptable dispute resolution arrangements, among others need to be established. In addition, expanding CBET, financing of the required infrastructure for CBET is crucial. In order to address the need, it would be important that multiple stakeholders engage in the regional cooperation on energy in South Asia, and link national priorities on energy needs, actions on climate change and sustainable development with international commitments to attract investment to South Asian countries from international financial mechanisms to develop initiatives on CBET.

[149] Jayasekera, Kamani. "Status of Sri Lanka Cross Border Interconnection with India & Expected Benefits". 2014

5 Conclusion

South Asia is a region having a high potential for developing renewable energy, which in turn could address the need for reducing emissions of CO_2, and the adverse impacts of climate change. With multiple actions already being taken in the energy sector in all countries of South Asia, as part of the country's development planning or as commitments under the UNFCCC, there is a shift towards renewable energy that is vibrant in the region.

The political commitment towards renewable energy in countries of South Asia could be seen through the initiatives such as the International Solar Alliance of which South Asian countries are members. Sri Lanka signed the Framework Agreement on International Solar Alliance in February, 2018, demonstrating the country's commitment to expand the renewable energy potential and the solar energy development.[150]

Further, the actions under the Paris Agreement and SDGs, provide further avenues for expanding the energy sector, renewable energy generation and scope at the regional level, for which ample financial and technical support will be needed for implementation, allowing South-South cooperation at the regional level.

Through the observations of this paper, which was prepared through multi-stakeholder participation allowing inputs from various stakeholders on the best ways to move forward for implementation of the NDCs in South Asia and how it would lead to regional cooperation in the energy sector in the region, the following recommendations could be identified:

NDCs could be a mechanism to promote and develop regional cooperation, through fostering of partnerships for capacity building, technology transfer and knowledge sharing. NDCs are a common element of implementing the Paris Agreement for all countries that are parties to the Agreement. South Asian countries are all Parties to the Paris Agreement which presents the opportunity for regional initiatives that would be linked to the NDCs, and the Agreement, allowing possibility to increase the ambition in the region for the implementation of NDCs. Further, with the global stock take that happens every 5 years under the Paris Agreement, it would also allow a way to enhance the renewable energy generation, through which emissions could be reduced at the regional level.

Even though within the UNFCCC process, the countries of South Asia negotiate under different country groups, the countries would be able to develop a higher level of momentum for taking climate action at a regional level with a common element such as the NDCs. And the earlier mentioned International Solar Alliance, to which many countries are turning for renewable energy expansion, could provide avenues to enhance and increase the ambition of countries' NDC targets.

There is a need to understand how regional cooperation could impact the sovereignty of countries, and sharing of resources, CBET and technology transfer should not be impacting the political context and sovereignty of the country.

A fear that is existent while speaking on regional cooperation on energy and the transfer of energy is understandable as to how the political influence will be for smaller countries of the region when partnerships are created for sharing and transfer of energy resources. This could be deemed as justified, with different instances of political tension existing in the region.

[150] Sri Lanka Signs Framework Agreement on International Solar Alliance, The Sunday Leader, retrieved from: http://www.thesundayleader.lk/2018/02/01/sri-lanka-signs-framework-agreement-on-international-solar-alliance/

In order to address these fears and doubts, it is important that there is an increased understanding on how the countries would be impacted through the options for expanding regional cooperation on energy, as well as how the resources are utilized. The process for this needs to be inclusive and multi-stakeholder driven so as to facilitate the public to have a better understanding of the CBET process in South Asia, and to avoid misunderstandings, which could lead to political tensions based on issues related to energy sector and the energy sources.

The South Asian Regional Standard Organization (SARSO) could introduce the opportunity for regional cooperation in standardizing the regional renewable energy generation. It is observed that there are multiple options are available for expansion of renewable energy. However, it is important that there is standardization for renewable energy, and SARSO could contribute to establishing this standardization for the regional level.

SARSO is a Specialized Body of the SAARC, which was established to achieve and enhance coordination and cooperation among SAARC Member states in the fields of standardization and conformity assessment and is aimed to develop harmonized Standards for the region to facilitate intra-regional trade and to have access to the global market.[151]

NDCs could be considered a common ground for raising climate finance for renewable energy projects, and the countries of the SAARC could work towards raising funds together from different funding sources, in order to implement NDCs of countries, and achieve the targets related to the energy sector.

Under NDCs, there are different forms of contributions as explained in the previous section of this paper. Under these contributions, the countries have chosen to set emission targets at conditional and unconditional levels. In order to implement the conditional targets, there is a need to mobilize external support for finance, technology and capacity building. It would be beneficial for countries of the region to collaborate in raising finance and support for the implementation of NDCs collectively, which would allow for regional renewable energy expansion. This would benefit to increase the capacity for the implementation of NDCs, and also to increase the exchange of technology transfer on renewable energy development in South Asia.

While regional cooperation is to be promoted, it is important that the countries focus on developing renewable energy generated electricity at the national level, and also facilitate the NDC implementation through policy analysis and gaps identification. While accepting the importance of regional cooperation, it is equally important that the countries address the needs of their citizens, and not to implement regional cooperation at the cost of respecting the needs of their citizens.

This reiterates the previous findings, and the recommendations highlighting that CBET should not be the cause for political tensions, or treated as a scapegoat as a cause of political tensions in the region. In order to ensure that this would not be the case, it is important that the countries demonstrate that the priority is given to the needs of the country's population which will eliminate many criticisms which may be addressed towards CBET.

Thus, it would be important to conduct concrete and accurate environmental impact assessment prior to engaging in CBET, and knowledge and experience sharing at the regional level.

[151] South Asian Regional Standards Organisation, retrieved from: http://www.sarso.org.bd/

About SARI/EI

Over the past decade, USAID's South Asia Regional Initiative/Energy (SARI/E) has been advocating energy cooperation in South Asia via regional energy integration and cross-border electricity trade in eight South Asian countries (Afghanistan, Bangladesh, Bhutan, India, Pakistan, Nepal, Sri Lanka and the Maldives). This fourth and the final phase, titled South Asia Regional Initiative for Energy Integration (SARI/EI), was launched in 2012 and is implemented in partnership with Integrated Research and Action for Development (IRADe) through a cooperative agreement with USAID. SARI/EI addresses policy, legal and regulatory issues related to cross-border electricity trade in the region, promote transmission interconnections and works toward establishing a regional market exchange for electricity.

About USAID

The United States Agency for International Development (USAID) is an independent government agency that provides economic, 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 economic 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 most profound results to a greatest number of people.

About IRADe

IRADe is a fully autonomous advanced research institute, which aims to conduct research and policy analysis and connect various stakeholders including government, non-governmental organizations (NGOs), corporations, and academic and financial institutions. Its research covers many areas such as energy and power systems, urban development, climate change and environment, poverty alleviation and gender, food security and agriculture, as well as the policies that affect these areas.

For more information on the South Asia Regional Initiative for Energy Integration (SARI/EI) program, please visit the project website:

www.sari-energy.org