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IRADe-SARI-23 (2018)

Assessment of Socio-economic Impacts of CBET in Bangladesh

Prepared by
SARI/EI Secretariat

List of Contributions

Study and Research Team:
ICCCAD
Dr. Saleemul Huq
Ms. ShababaHaque
Mr. Bodrud-doza Zion
Ms. Naznin Nasir
Mr. Mahid Yusuf
Mr. Saqib Huq

Research Guidance &Technical Support
IRADe
Mr. Rohit Magotra
Ms. Asha Kaushik

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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 carried out an assessment of the socio-economic impacts of CBET in Bangladesh. It documents case studies of the socio-economic impacts of electricity in the villages of Bangladesh bordering India that were electrified after import of electricity began. The assessment is an attempt to create an evidence-based narrative for how cross-border power trade is improving life at the ground level.

I would like to take this opportunity to acknowledge the excellent work done by Independent University, Bangladesh and Integrated Research and Action for Development (IRADe) in successfully carrying out this assessment. 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)
Clean Energy & Environment Office
USAID/India

Preface

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 programme IRADe has undertaken the study with ICCCAD Bangladesh, to understand the impacts of Cross-Border Electricity Trade (CBET) between India and Bangladesh, from the perspective of Bangladesh.

Cross-border electricity imports between Bangladesh and India started in 2013 through Baharampur (India) and Bheramara (Bangladesh). A 400 KV double circuit line passes through the two substations in two countries and allows Bangladesh to import 500 MW through this connection. After CBET was initiated, research was done to understand how gaining access to electricity has made socio-economic impacts on the lives of people residing in the Bhangapara village in the Ramkrishnapur union in Bangladesh. In order to better understand the impacts of grid electricity, another village, Chilmari, in the same Upazila was selected as a control village.

Survey results reported that electricity has widened the horizons of the people. The study also showed how electricity can significantly improve the quality of life for both men and women, but especially women since they are now able to expand their usual chores throughout the day and be able to engage in more activities.

I hope this researchreport on "Assessment of Socio-Economic Impacts of CBET in Bangladesh" will provide new insights about socio–economic impacts of expanding grid electricity in rural Bangladesh.

Thank you,

Jyoti Parikh

Prof. Jyoti Parikh
Executive Director
Integrated Research and Action for Development

Acknowledgement

The International Centre for Climate Change and Development (ICCCAD) would like to express their gratitude to both United States Agency for International Development, and Integrated Research for Action and Development for providing the opportunity to conduct this project and develop a research paper. We thank Mr. Rohit Magotra, Deputy Director IRADe for his contribution and guidance and technical support, and for greatly assisting the research. We would like to thank Ms Asha Kaushik, Senior Research Associate, IRADe for co-ordination and project support.

We would like to thank all the relevant officials of the Bangladesh Power Development Board and the Rural Electrification Board for taking the time to provide us with information that was needed to better plan the overall project. We would like to thank all the respondents from the two villages who took time to answer the survey questionnaires and provide us with a rich perspective of the issue.

We would also like to express our utmost gratitude to the director of the Bangladesh Energy Regulatory Committee (BERC) for taking the time to review the paper.

Sincerely,

On behalf of Dr. Saleemul Huq

Researchers

Ms. ShababaHaque

Mr. Bodrud-doza Zion

Ms. Naznin Nasir

Mr. Mahid Yusuf

Mr. Saqib Huq

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Abbreviations

APSCL	Ashuganj Power Station Company Limited
BCCSAP	Bangladesh Climate Change Strategy and Action Plan
BPDB	Bangladesh Power Development Board
BREB	Bangladesh Rural Electrification Board
CPGCBC	The Coal Power Generation Company Bangladesh Limited
CBET	Cross Border Electricity Trade
DESCO	Dhaka Electric Supply Company Limited
DPDC	Dhaka Power Distribution Company
EA &EI	Electrical Advisor and Chief Electrical Inspector
EGCB	Electricity Generation Company of Bangladesh
EPRC	Bangladesh Energy and Power Research Council
FGD	Focus Group Discussion
FYP	Five Year Plan
GDP	Gross Domestic Product
GOB	Government of Bangladesh
HVDC	High Voltage Direct Current
IDCOL	Infrastructure Development Company Limited
IPP	Independent Power Producer
LNG	Liquified Natural Gas
MPEMR	Ministry of Power, Energy and Mineral Resources
MMCFD	Million Cubic Feet Per Day
NDC	Nationally Determined Contributant
NESCO	Northern Electric Supply Company
NWZPGC	North West Zone Power Generation Company Limited
PSPM	Power Sector Master Plan
PBS	Palli Bidyut Samity
RE	Renewable Energy
RPCL	Rural Power Company Limited
SIPP	Small Independent Power Producer
SREDA	Sustainable And Renewable Energy Development Authority
TCF	Trillion Cubic Feer
WZPDC	West Zone Power Distribution Company

Executive Summary

Over the past decade, Bangladesh has made an immense amount of progress when it comes to economic growth and development. The country is on course for graduating from its least developed country (LDC) status and becoming a middle income country in the near future. It has already met the three necessary criteria for this and can expect to make this remarkable change by 2024. While there is still time before all the changes that will be brought through this implementation, the country needs to prepare its economy for this graduation and boost its development further.

This would result in increased industrialization and technological advancement, leading to a significant increase in the demand for electricity. Considering that the supply of natural gas—the country's prime source of energy at present—is predicted to decrease by the year 2021,Bangladesh will have to brace for a shift in its energy mix. During this transition period, there is a need for exploring viable energy sources to meet the demands of a growing population. At present, coal plants and other forms of primary energy are being contemplated, but the issue of planning and constructing large infrastructure is a time consuming process. Not to mention the debates that follow the plan processing stages. Bangladesh gives the utmost priority to enhancing its renewable energy (RE) sector in an attempt to produce clean energy. However, there are many limitations to this expansion, with the geography of the country and land constraints being some of the main problems.

There is huge potential in exploring CBET opportunities. Experts suggest that South Asian countries such as Bangladesh should broaden their engagement with CBET and take advantage of the opportunities presented through this. Bangladesh shares its border with India and Myanmar, and is currently importing 660 megawatts(MW) electricity from India through CBET. This new addition to the country's electricity supply allows the country to provide electricity to remote corners that were previously left in darkness. Rapid increase in electricity supply without engaging in the lengthy process of electricity production means immediate attention can be given to villages that were previously not prioritized for electrification.

The study aims to better understand CBETin Bangladesh. The objectives include evaluating the energy and power sector of Bangladesh through stages of policy analysis and stakeholder mapping, keeping in line with the context of CBET. The study also focuses on the assessment of some of the socio-economic impacts of electricity in bordering villages of Bangladesh that got electrified after the import of electricity from India began. This will help shed light on some of the key impacts CBET can have on a micro scale, on the lives of the cornered and previously deprived population.

However, it should be mentioned that the electricity supplied to these villages cannot directly be traced to CBET since Bangladesh has a single buyer system and all of the electricity produced and imported are added to the central grid. But it is still true that the increase in electricity from CBET since 2013 has increased the number of rural villages being electrified. Since it is not possible to identify the exact villages or cities that receive the electricity imported through CBET, for the purpose of this study we selected villages on the basis of electrification post- CBET with India.

For this project, a bordering village through which the electricity line from India entered Bangladesh was studied to understand the role electricity plays in the everyday lives of the residents. The majority of the population in this village got access to electricity after CBET was initiated in 2013. Contrasting discussions with respondents from this recently electrified village and a neighboring village—which is still deprived of grid electricity—revealed some of the benefits people received from having access to facilities that are only available through grid electrification. Assessing the socio-economic impacts of electricity in these villages show how electricity can significantly improve the quality of life, for both men and women—and especially women since they are now able to expand their usual chores throughout the

day and engage in more activities, often income generating activities. This enables them to not only contribute to their family but also become more self-sufficient and independent.

In recent years, the GoB has been considerate of these off-grid remote villages and provided Solar Home Systems (SHS) for them. However, discussions with such SHS consumers in the non-electrified village disclosed that although having access to solar energy has certainly improved their lives, SHSs are usually insufficient or just enough for the households, and there is no community growth through this. There are no large scale solar grid systems available in Bangladesh at present and, due to land constraints and lack of private financing, this will not change anytime soon. One of the needs of rural villages to flourish is community development through streetlights, hospitals, schools and improved opportunities for businesses. All of these are possible through enhanced grid electrification.

Trading Electricity from neighboring countries has many perks since no country is fully self-sufficient and being able to tap into another's resources can help boost the country's economic growth and development. Establishing electricity trade also opens the door for other trade opportunities and helps improve bilateral and, in some cases, multi-lateral relations between neighboring countries, which is crucial for building solidarity and enhancing global cooperation.

But excessive dependence on another country for electricity supply may leave the country vulnerable and inhibit its own self growth in terms of electricity production. Caution must be exercised in this process since political relations are volatile and needs constant tending. Bangladesh should use this opportunity to learn better practices from neighboring countries to enhance its own energy production in the future.

For improved access to electricity through CBET, a strong and reliable set of cross-border electricity trade policies should be developed, which will allow both countries to reduce risks from such measures. It is expected that such research will highlight the benefits of CBET between India and Bangladesh and result in instigating enhanced policy support, allowing improved trading between the two countries.

1 Introduction and Methodology

Energy is a major determinant for accessing vital necessities such as food, water, health care and education (Department for International Development, DFID, 2002). Research has proven that access to modern energy is a key factor contributing to rural development (Chaurey et al., 2004), which is why the livelihood struggles of poorer communities is often instigated by their inability to access modern energy services. Despite the need for energy access for all, it is estimated that approximately 1.3 billion people still do not have access to electricity (International Energy Agency, IEA, 2014), making energy poverty a major factor affecting development.

Bangladesh, a low-income country in South Asia, has made significant strides in GDP growth and economic development in the past few years. The country has made substantial progress in electricity production. Despite these achievements Bangladesh still has one of the lowest per capita electricity consumption rates in the South Asia. The majority of the country still lives in rural villages and a significant portion of the overall population in the country still struggles to get access to electricity. Nearly 26 per cent of the population and nearly 13 million rural households do not have access to electricity. Recent data from 2015 showed a wide disparity between urban areas (99 percent) and rural areas (36 percent) in terms of energy access (Sustainable and Renewable Energy Development Authority, SREDA, 2015). Furthermore, those with access to electricity in the rural areas have poor electricity supply and routinely experience supply disruptions.

The GoB recognizes the country's need for expanding the energy sector and has commitments to provide universal electricity access to its citizens by 2021. One of the main challenges for meeting the electricity demand is the lack of energy diversity. At present, Bangladesh is majorly dependent on natural gas; in fact, more than 60 per cent of the natural gas is used for power generation. The current demand for natural gas already exceeds the country's supply capacity. It is predicted that by 2030, the demand for natural gas will make a significant leap and the gap between demand and supply will further increase. Apart from, this it is also known that the available supply of natural gas under its current usage rate is expected to run out by 2030 (Hossain, 2018).[1] In regard to this drastic change in its primary energy source and the country's growing need for electricity, Bangladesh will have to make significant efforts to redesign its overall power and energy sector.

In order to compensate for the shortage of natural gas, the country also plans on importing LNG, considering that the international market for LNG fluctuates and this will likely affect the local gas prices in Bangladesh.[2]

Apart from LNG, in the near future, the Government of Bangladesh intends to increase dependency on coal for energy. It has been decided that imported coal will be used for power generation. According to the Power Sector Master Plan (PSMP) by 2030 around 50 per cent of electricity in Bangladesh will be generated using imported coal. This strategy holds practical risks such as financing and construction of coal power plants, as well as the many associated environmental impacts. It is without doubt that the expansion of coal-based energy in Bangladesh will lead to an increase in carbondioxide emissions and add to the country's carbon footprint. The location of building large

[1] http://www.thedailystar.net/supplements/building-modern-economy/where-do-we-stand-1536487

[2] https://bdnews24.com/economy/2018/03/02/bangladesh-moves-to-hike-gas-prices-as-it-readies-for-lng-import

infrastructures for using as coal-fired power plants will also instigate debate amongst the community members and other stakeholders.

Bangladesh, while struggling to meet its energy needs, is also one of the most vulnerable country to climate change and has made global pledges to reduce its carbon dioxide emissions. The GoB is highly involved in global climate negotiations and intends to go beyond climate change adaptation measures and also take actions for climate change mitigation. The country has already made investments to expand its RE sector, but at present, due to constraints such as land availability, political will and financial resources, the contribution made through RE will not be enough to meet the country's existing energy needs.

Therefore, it is now time to diversify the electricity supply in Bangladesh and consider alternatives that can help provide the country with electricity at a faster pace. In this regard, it is important to acknowledge the potential of exploring CBET opportunities with neighboring countries. Experts suggest that South Asian countries such as Bangladesh should broaden their engagement with CBET and avail the untapped resources presented to them through this opportunity. Bangladesh shares its borders with India and Myanmar, and is currently engaged in bilateral electricity trade with India.

At present, Bangladesh imports 660 MW electricity from India through CBET using two different transmission lines located in two different parts of the country. The cross-boundary electricity imports between Bangladesh and India began in 2013 through Baharampur (India) and Bheramara (Bangladesh): a 400 Kilovolt (KV) double circuit line passes through the two substations in the two countries and allows Bangladesh to import 500 MW through this connection. However, this substation has the capacity to export another 500MW and is open for upgrading in the near future.[3] The second initiative is through the 47-km double circuit transmission line linking the power grid at Suryamaninagar in Tripura to the Comilla power grid in eastern Bangladesh. Initially, 100 MW electricity was imported by Bangladesh, but in March 2016, the country started importing a further 60 MW through this line. There is potential to enhance the electricity import through this portal as well.[4]

This new addition to Bangladesh's electricity supply allows the country to provide electricity to the corners that were previously left in darkness. Rapid increase in electricity supply without engaging in the lengthy process of electricity production means immediate attention can be given to villages that were previously not prioritized for electrification.

The following study aims to better understand CBET between Bangladesh and India. The objectives include evaluating the energy and power sector of Bangladesh in the context of CBET. The study focuses on the assessment of some of the socio-economic impacts of electricity in selected bordering villages of Bangladesh that got electrified after the import of electricity from India began. This will help shed light on some of key impacts CBET can have on a micro scale, on the lives of the previously deprived population.

However, Bangladesh has a single model buyer profile when it comes to electricity. All the electricity produced or imported is added to the central grid, from where it is distributed throughout the country. Since it is not possible to identify the exact villages or cities that receive the electricity imported through CBET, for the purpose of this study, we selected villages on the basis of electrification post-CBET with India.

[3] http://www.livemint.com/Industry/09JxXydD03nikymTYGFZSK/NTPC-to-supply-extra-300MW-to-Bangladesh.html

[4] http://www.power-technology.com/news/newsindia-bangladesh-inaugurate-cross-border-electrical-grid-interconnection-project

1.1 Methodology

The methodology followed for this project study is given in the figure 1 below and elaborated further in this section:

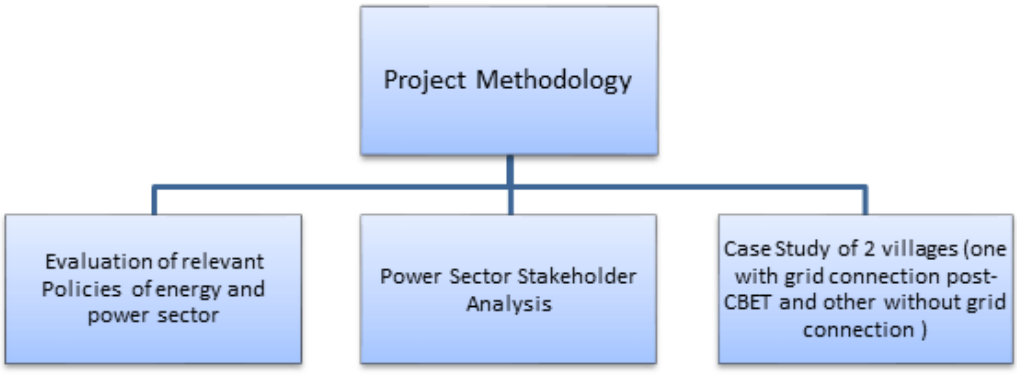

Figure 1: Project Methodology

1.1.1 Energy and Power Sector in Bangladesh

A desk-based review of existing policies was conducted in order to understand the current energy and power sector scenario in Bangladesh. A series of policies relevant to national development, energy and climate change were assessed in the process. The policies studied for this include:

1. The Power System Master Plan (PSMP) (2016)
2. The Seventh Five Year Plan (FYP) (FY 2016-FY2020)
3. Renewable Energy Policy (2008)
4. Sustainable and Renewable Energy Act
5. Intended Nationally Determined Contributions (2015)
6. Bangladesh Climate Change Strategy and Action Plan (BCCSAP)

The aforementioned policies were reviewed to acknowledge the existing goals and targets set by the government to achieve energy security in Bangladesh. The literature review sheds light on the availability of primary energy sources and means to avail the required amount of power needed to fulfil the country's goals.

1.1.2 Power Sector Stakeholder Analysis

An assessment of the structure of the power sector within the government of Bangladesh is crucial for understanding the role played by various stakeholders in the chain. Having a clear idea of the engagement of different parties involved in the decision making stages of the power sector will help target the right people to share recommendations that can feed into the national plans and policies related to the power sector in Bangladesh.

The stakeholder analysis was conducted a desk-based review of secondary literature resources as well as informal discussions with government officials engaged in the energy and power sector in Bangladesh.

1.1.3 Case-Study Methodology

The following case study has been designed in order to understand some of the impacts of grid electrification in rural Bangladesh. The prime focus of the case study is to capture the experiences and impacts from the beneficiary's point of view. The justification of selecting the two sites used for this study is explained in detail in section 4.1.

The case study was conducted in two villages, one with access to grid electricity (Bhangapara, Ramkrishnapur) and one without access to grid electricity (Chilmari Union). In each of the sites, a survey was conducted with a sample size of fifty people. The selection process was random as long as respondents represented different households. Special attention was given to ensure that the sample size had a good mix of male and female respondents. Gender diversity allows better understanding of the impacts of electrification on separate genders. The case study methodology is shown in figure 2 below:

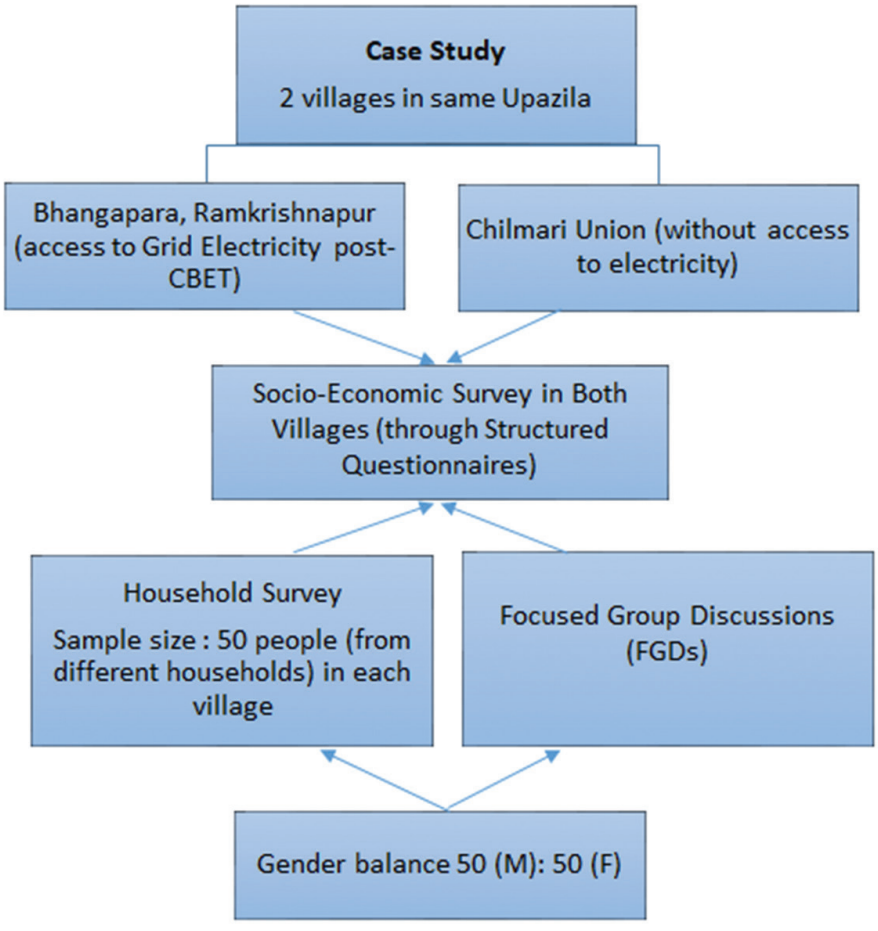

Figure 2: Case Study Methodology

The questionnaire was customized to extract information regarding socio-economic conditions of the respondents' household as well as the role played by electricity in their lives. A standardized set of questionnaire was used for surveys in both sites to ensure better comparison. A pilot testing of the questionnaire was conducted prior to the field visit to help reduce any errors and ensure that the questions can easily be understood. A sample questionnaire is provided in Annex I.

The questions aimed to discover the opinion and experience of the beneficiaries regarding key issues that will provide a better understanding of the usefulness of grid electricity and identify any existing gaps and barriers in the system.

The surveys were also supported by Focus Group Discussions (FGDs) in both villages. The aim of the FGDs is to facilitate open discussions beyond the scope of the questionnaire. This methodology was used to extract qualitative data in the form of personal experiences and opinions to better understand the overall experience of the community as a whole.

Information was extracted from the surveys and the FGDs; this information was then analyzed and presented within the analysis section of the report (chapter 4).

2 The Energy and Power Sector in Bangladesh

2.1 Current State of Energy and Power Sector in Bangladesh

In recent years, Bangladesh has made remarkable strides in economic growth and development. According to the Perspective Plan of Bangladesh (2010-2021)[5] the country aims to become a middle income country by 2021 (General Economics Division, GED, 2012). Despite its achievements, poverty is still deeply rooted in some of the poorest corners of Bangladesh. The country still suffers from energy poverty as many of the remote corners are still living without access to electricity. According to the Seventh FYP (Fy2016-FY2020), the GoB has recognized power supply as a barrier to GDP growth, private investment and economic development.[6] The Sixth FYP of Bangladesh has given utmost priority to improving the supply of electricity. Around 2008-2009, when the Sixth FYP was formulated, there was a crisis of power outages in the country. Since then, the country has made substantial progress. The Global Competitive Index (GCI) measured the overall infrastructure progress of Bangladesh in comparison to other countries and the most significant change is its rise in electricity supply from 1.8 (in 2008-2009) to 2.5 (in 2014-2015). As of November 2017, the total installed generation capacity has reached 16043 MW (SREDA 2017).

Despite its recent progress, Bangladesh with 321 kWh/capita/year production has one of the lowest per capita electricity consumption rates worldwide (*The Daily Star*, 2016).[7] A study conducted by the Asian Development Bank (ADB)[8] found that with around 65 power outages a month, Bangladesh is still topping the list of Asian countries facing the most frequent power outages. This indicates the shortage in power supply and a lack of proper infrastructure for electricity production in the country (De and Iyengar, 2014).

However, the GoB, under Prime Minister Sheikh Hasina, plans on taking responsibility for those who are deprived of their basic energy needs by providing electricity to all its citizens by 2021 (GED, 2012).

While this is an inspiring goal, it will be extremely difficult to fulfill considering the country's current electricity production and its demand. Over the coming years, as the country plans on meeting its development targets, the need to expand sectors and industries promoting economic growth will increase and this will add to the existing demand for electricity. The PSMP (2016)[9] estimates that the maximum power demand for 2020 and 2030 will be 12,949 MW and 27,434 MW respectively. In the business-as-usual scenario, the energy production at its current pace will be unable to meet the country's growing energy needs unless expansion of the energy sector is prioritized.

At present the country relies mainly on domestic natural gas: approximately 53.74 per cent of the energy mix is dominated by natural gas (Figure 3).

5 http://bangladesh.gov.bd/sites/default/files/files/bangladesh.gov.bd/page/6dca6a2a_9857_4656_bce6_139584b7f160/Perspective-Plan-of-Bangladesh.pdf
6 http://www.plancomm.gov.bd/wp-content/uploads/2015/11/7FYP_after-NEC_11_11_2015.pdf
7 http://www.thedailystar.net/25th-anniversary-special-part-1/feed-tarrif-fits-rays-hope-renewable-green-energy-210454
8 https://www.adb.org/sites/default/files/publication/162073/developing-economic-corridors.pdf
9 http://powerdivision.portal.gov.bd/sites/default/files/files/powerdivision.portal.gov.bd/page/4f81bf4d_1180_4c53_b27c_8fa0eb11e2c1/%28E%29_FR_PSMP2016_Summary_revised.pdf

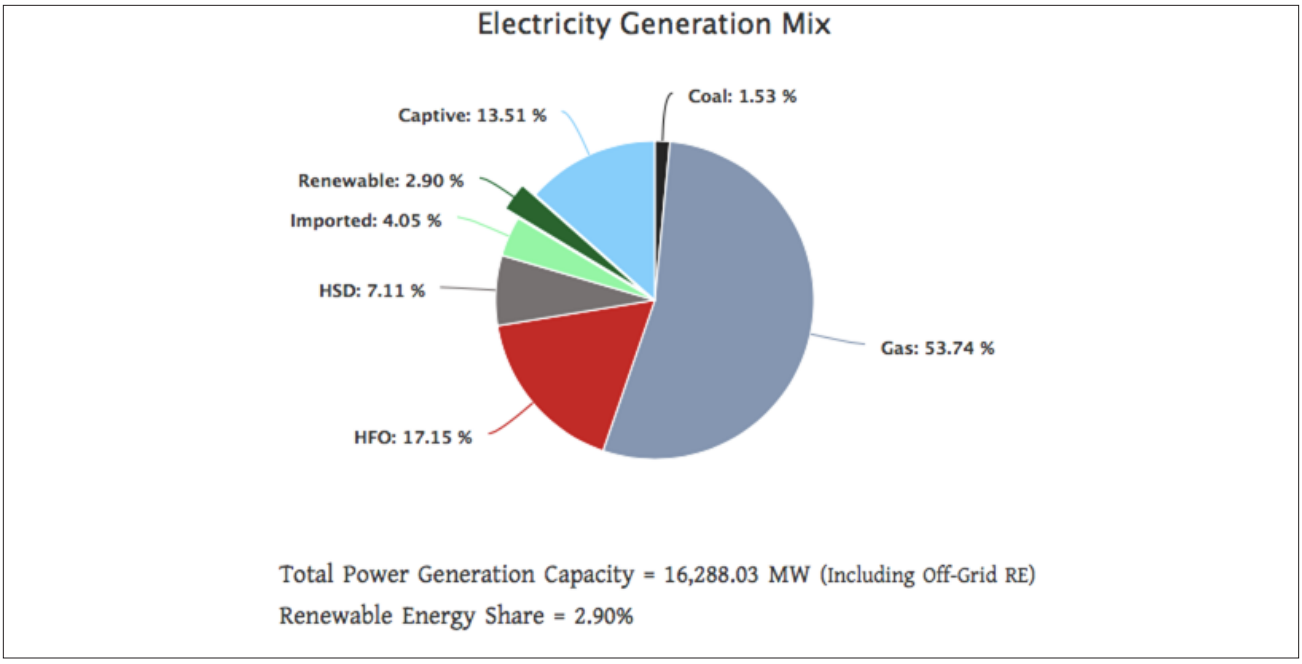

Figure 3: Bangladesh's Electricity Generation Mix (SREDA, 2017)

However, considering that natural gas is a limited resource and there are no new major gas field discoveries, at the rate of its current consumption, the country's natural gas is likely to run out. According to the Seventh FYP, as of June 2015, Bangladesh already used up 13.032 TCF[10] of natural gas from its recoverable reserve of 27.12 TCF. Despite the increase in demand for gas according to the PSMP domestic gas production was 2500 mmcfd[11] in 2015 and is predicted to reach approximately 2700 mmcfd in 2017, after which it will start declining (Figure 4).

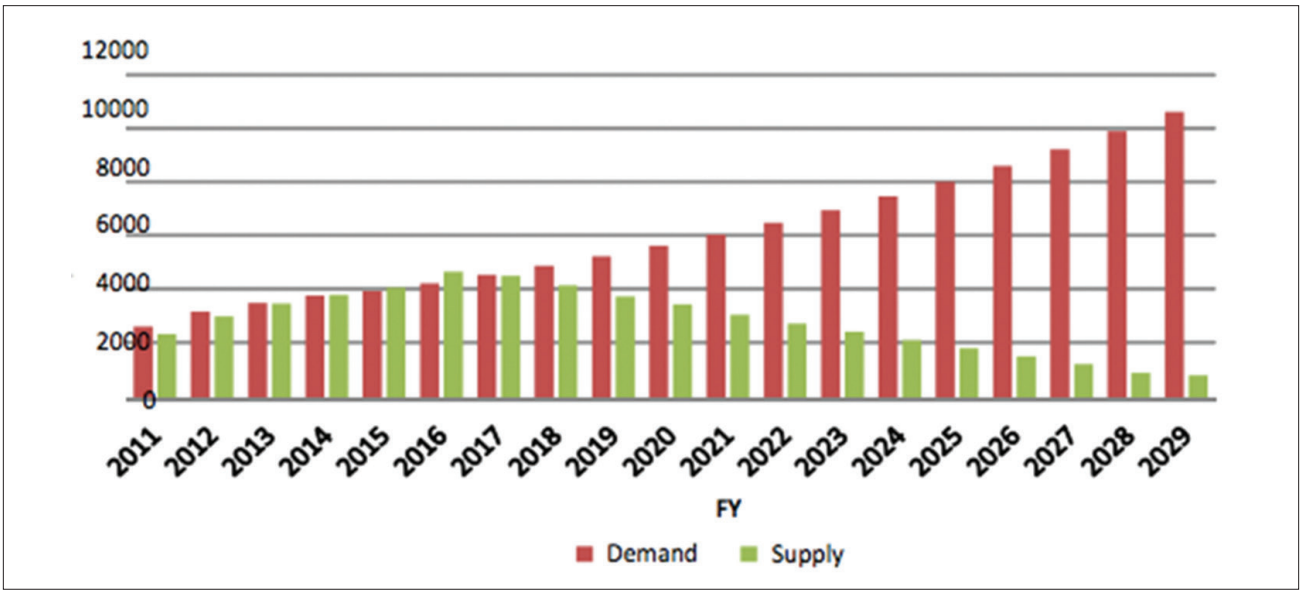

Figure 4: Gas Demand and Supply Balance 2010-2029 (*Source: Petro Bangla*)

According to the Seventh five-year plan, unless there are new gas field discoveries or gas imports, if the demand for gas continues at its current rate of 7 per cent per annum, the existing gas reserve will be exhausted by the Fiscal Year 2023.

[10] TCF- Trillion Cubic Feet

[11] mmcfd- Million Cubic Feet per Day

2.2 Beyond Natural Gas—Options for Diversifying Energy Sector

Considering the decline in natural gas, the country is expected to have a radical shift in its energy mix.

2.2.1 Imported LNG

According to the Seventh FYP, in order to meet this increasing gas demand the country has already started taking steps for importing LNG (GED, 2015). A floating storage and re-gasification unit (FSRU) has been installed at Maheshkhali Island near Chittagong district. This is Bangladesh's first FSRU terminal and is developed by a U.S.-based company called Excelerate.

It is expected that approximately 500 mmcfd gas can be supplied through this portal by the beginning of 2018. The second FSRU terminal, with the same gas import capacity as the first, is being developed by Bangladesh's Summit Corporation Limited in Maheshkhali Island and is expected to be completed by the end of 2018.[12] The Maheshkhali Floating LNG Terminal will provide the necessary infrastructure for the country to access natural gas from the global market. The government is also planning on establishing two land-based LNG portals in the near future to expand LNG import; at present, feasibility studies are being conducted to decide possible sites for these infrastructures.

Although LNG is considered a cleaner source of energy in comparison to coal, Bangladesh's dependency on imported LNG has its own risks. At present, the country relies on domestic gas, which is priced quite low. The Seventh FYP narrates that importing LNG will expose Bangladesh to international gas trading prices. A drastic shift in the weighted average of Bangladesh gas tariff can be expected to jump from the current 1.7 USD/gigajoule (GJ) to at least 3.1 USD/GJ as soon as LNG import begins. This is without considering the costs associated with transmission, distribution and other infrastructure related issues. This increase in price, still much lower in comparison to the international gas price, would have an impact on the country's manufacturing industry and also the overall economic growth from these industries (GED, 2015). Considering this new source of gas cannot be used as freely as domestic gas once was, there will be a need for subsidies from the government and new policies need to be formulated on gas allocation (Power Division, 2016).

2.2.2 Shift towards Coal

Bangladesh is at a cross-roads and needs to diversify its energy mix while also expanding the power supply to meet the growing energy needs to continue the current development momentum. For Bangladesh, coal is the cheapest form of energy and due to its high reserve and low cost it is likely that it will be the primary source of energy in the future.

The Seventh FYP forecasts coal to be the main source of power by 2030. This statement is backed by the views shared in the PSMP (2016), where a significant increase in the usage of coal is predicted. The estimated projection demonstrates a rise in the share of coal; going up from only 3 per cent at the end of FY2015 to 21 per cent by the end of the Seventh FYP. It is also shown that by 2030, the share of coal will rise up to almost 50 per cent of the energy mix. The final draft of the PSMP (2016) conducted an analysis of different energy mix scenarios for ensuring optimum energy security, economic and environmental benefit in 2041. This analysis showed that the best results were obtained for balanced gas and coal mix (each at 35 per cent of the total energy share).

While coal seems to be an economically favorable option at present, there are two things that should be considered. First, as the number of coal-fired power stations in South Asia continues will increase, there will be a strain in the supply of coal. This could lead to a situation where the quality and price of coal will become extremely unstable.

[12] https://www.platts.com/latest-news/natural-gas/dhaka/petrobangla-and-qatars-rasgas-sign-bangladeshs-26773069

Secondly, as the threat of climate change is real, the need to divest from fossil fuels will increase. This results in investment in technologies surrounding alternative energy sources, so that RE becomes more available and affordable in the future. At present, there is a high potential for solar energy to become cheaper and more accessible in the near future (Coren, 2016).[13]

This means that in the future the prices of coal-based power plants might not be the best solution from a global perspective. It should also be noted that coal is a fossil fuel and burning coal in large quantities will result in increasing the nation's carbon footprint and contributing to the existing pollution and greenhouse gas (GHG) emissions, ultimately adding to factors contributing to climate change.

2.2.3 The Potential of Renewable Energy (RE) in Bangladesh

In terms of energy access there is a wide disparity between urban and rural households in Bangladesh. With approximately 13 million rural households still living without access to electricity the country must take an active effort to reach out to the remotest corners (SREDA, 2015). By the end of 2020, the GoB plans on providing electricity to seven million new customers, while most of this is to come from expanding the grid distribution network, the remotest corners will be covered using off-grid interventions such as RE.[14]

As of October 2017, the total capacity of RE in Bangladesh is 2.82 per cent of the total energy mix; the division of the RE share is shown in figure 5. Hydropower (50.9 per cent) covers the majority of the RE mix followed closely by the solar energy percentages (48.2 per cent). The power generated by the remaining forms of RE is negligible. Figure 6 shows the amount of electricity installed through RE sources in Bangladesh (both off-grid and on-grid). It can be seen that hydropower still generates the highest MW electricity and electricity generated from hydropower feeds into the national grid system, while 202.88 MW electricity installed through solar power contributes towards off-grid electricity generation of the country (SREDA, 2017).[15]

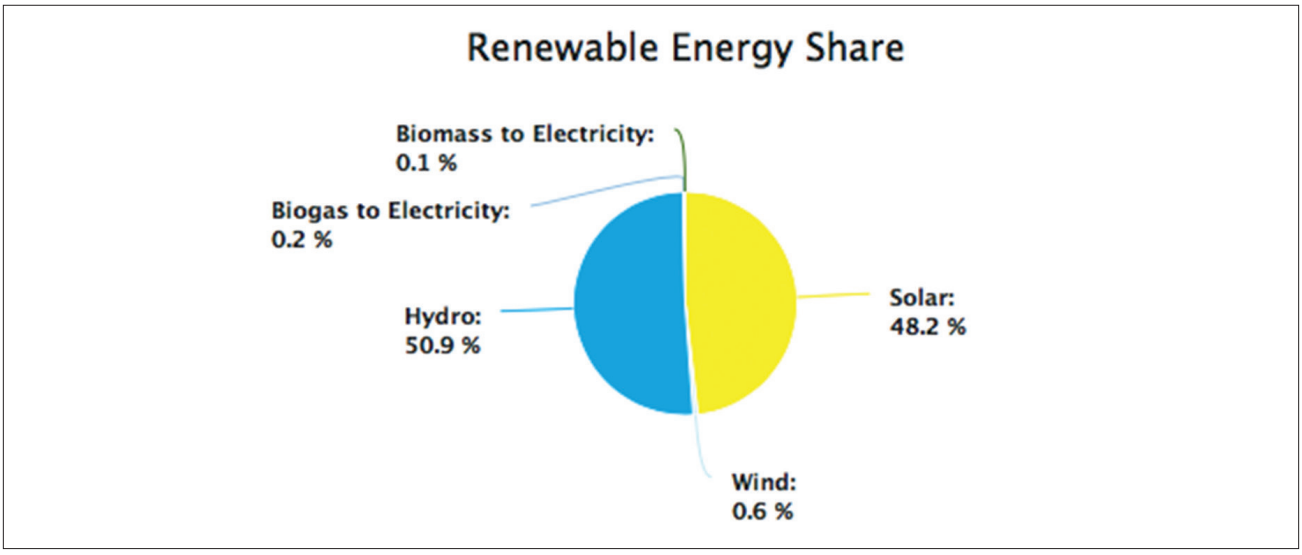

Figure 5: Renewable Energy Mix of Bangladesh (October 2017). *Source: SREDA*

Bangladesh's geography and topography is the reason for low-wind speeds, making it unsuitable for generating sufficient electricity from wind energy, which is a prime source of RE for most developed regions. However, the government is still conducting studies to gather wind speed data to better understand the potential. In terms of

[13] https://qz.com/871907/2016-was-the-year-solar-panels-finally-became-cheaper-than-fossil-fuels-just-wait-for-2017/
[14] SREDA 2015. Scaling Up Renewable Energy in Low Income Countries(SREP)-Investment Plan for Bangladesh.
[15] http://www.sreda.gov.bd/index.php/site/re_present_status

hydropower—since most areas are lower than 9 m above sea level—the potential for energy through hydropower is also limited. The hilly terrain of Chittagong region shows some potential where Bangladesh's only hydropower plant is situated. The Karnaphuli Hydropower plant uses the water from Kaptai Lake and has an installed total capacity of 230 MW (Power Division, 2016).

Technology	Off-Grid	On-Grid	Total
Solar	202.88	14.95	217.83
Wind	2	0.90	2.90
Hydro	-	230	230
Biogas to Electricity	0.68	-	0.68
Biomass to Electricity	0.40	-	0.40
Total	**205.96**	**245.85**	**451.81**

Figure 6: Electricity Installed through RE in MW (2017). *Source: SREDA*

Bangladesh has, however, made remarkable progress in terms of solar energy. The country has installed more than four million solar home systems (SHS) and is one of the leaders in Solar PV systems worldwide[16] (Molla, 2017). This is the largest off-grid initiative bringing light to some of the most isolated parts of the country. The SHS initiative has been implemented by Infrastructure Development Company Limited (IDCOL)—a state owned financial institution. IDCOL is supported by development partners and works with numerous partner organizations consisting of local non-governmental organizations (NGOs) who can reach out to and implement the program in the remotest corners of the country. According to the International Renewable Energy Agency (IRENA) (2016), this program saves approximately 242,000 tons of fossil fuels per year and has created thousands of new jobs.[17] The program aims to install six million SHSs across the entire country by 2018.

Bangladesh's geographical location as well as its socio-economic conditions make it one of the most vulnerable countries when it comes to the impacts of climate change. Considering its position in the climate scenario, Bangladesh is deeply involved in global climate negotiations. According to the country's Intended Nationally Determined Contribution (NDC) document (2015)[18], Bangladesh's GHG contribution being less than 0.35 per cent of global emissions does not require focus on mitigation, the country is still taking active measures for working toward mitigating climate change.

Bangladesh's 2015 NDC outlines actions the country would be taking to reduce its GHG emissions from the power, transport and industry sectors by 2030. Bangladesh's NDC has set an unconditional goal of a 5 per cent reduction in GHG emissions and a conditional goal of 15 per cent, dependent on investment, technology transfer and capacity building.

According to the Renewable Energy Policy (REP, 2008)[19], Bangladesh has set a target of obtaining 10 per cent of its total energy through renewable sources by 2020. As part of the Climate Vulnerable Forum, Bangladesh has also vowed to be 100 per cent reliant on renewable energy sources by 2050.

Although expanding the renewable energy sector is a sustainable and environmentally conscious way to develop a country and there are several policies in Bangladesh setting ambitious targets to promote this growth, the country is still struggling to meet its renewable energy targets. The PSMP (2016) outlines some of the key barriers that prevent expansion of the RE sector in Bangladesh. Firstly, scarcity of land is a major concern. Bangladesh has a policy where

[16] http://www.thedailystar.net/frontpage/bangladesh-leads-clean-energy-use-1418806
[17] https://www.huffingtonpost.com/adnan-z-amin/offgrid-renewables-a-rout_b_12305182.html
[18] http://www4.unfccc.int/ndcregistry/PublishedDocuments/Bangladesh%20First/INDC_2015_of_Bangladesh.pdf
[19] https://www.iea.org/media/pams/bangladesh/Bangladesh_RenewableEnergyPolicy_2008.pdf

large infrastructure for generating renewable energy cannot be developed in arable agriculture land. The country is already densely populated and, with limitations of land availability, the scope of developing RE plants to generate a large quantity of electricity is extremely difficult. Secondly, there is a lack of financial incentives for promoting renewables in Bangladesh and there is a huge gap when it comes to private sector investments.

The PSMP (2016) predicts that if the maximum potential of power generation through RE sources is 3700 MW, and if the technologies in practice are pushed to its maximum potential and connected to the grid, Bangladesh can generate approximately 4200 GWh per year. But this is still quite a small percentage when compared to the projected total grid energy generation of 82,000 GWh in 2020 and 307000 GWh in 2040 (Power Division, 2015).

2.3 Benefits of CBET in Bangladesh

Bangladesh has a significant power demand to meet in the coming years and considering the costs and limitations of the primary energy sources currently in use, the country needs to explore options beyond primary energy production. There is increasing demand for energy in South Asia and a noticeably disproportionate distribution of energy availability amongst countries. Considering the current energy dynamics, it is essential to strengthen cooperation amongst South Asian countries and enhance CBET opportunities between neighboring countries. An analysis conducted by Toman and Timilsina (2016) states that regional electricity trade and integration could lead to cost savings of upto US$ nine billion/year (relative to status quo).[20]

Bangladesh acknowledges its present energy situation and in order to supply the required amount of electricity to the country's population and enhance its economic growth and development, the country is already engaged in importing electricity from neighboring countries such as India. The benefits of this electricity trade have been widely recognized and the country is in the process of negotiating more electricity trade possibilities for the future.

An analysis on the economic benefits of the Bangladesh-India electricity trade conducted by IRADe, SARI/EI and USAID[21] shared some of the major benefits of CBET as experienced by Bangladesh. Some of the key points include the enhancement of the power sector, the reduced cost of electricity supply and the many socio-economic improvements that resulted from this trade. For Bangladesh, one of the key benefit is that power import through CBET will reduce the country's dependency on imported gas, which has a volatile market and would eventually lead to an increase in the local price of gas. The study revealed that importing electricity from India is one of the most economical choices for Bangladesh and since this prevents the country from having to exploit its natural resources and developing fossil fuel-based power plants, it reduces the country's carbon dioxide emissions and has notable environmental benefits. The funds saved from not having to invest in new infrastructure for the power sector can now be invested in other sectors and help boost the country's economic growth. Importing electricity instead of producing electricity through primary energy sources will also expedite the process of providing electricity to the target population: remote villages that were previously un-electrified can be given electricity without having to go through a long waiting period.

2.3.1 Policy Support for Importing Power in Bangladesh

The GoB recognizes the need for regional cooperation for enhancing its electricity production. Some of Bangladesh's key development and power sector plans and policies mention importing power as a crucial part of expanding the country's power and energy sector in the near future.

[20] https://www.iaee.org/en/publications/newsletterdl.aspx?id=331

[21] https://sari-energy.org/wp-content/uploads/2018/01/Executive-Summary-Report-Economic-Benefits-of-Bangladesh-india-Electricity-Trade.pdf

Bangladesh's PSMP (2016) reflects five viewpoints:

1. Enhancement of imported energy infrastructure and its flexible operation
2. Efficient development and utilization of domestic natural resources (gas and coal)
3. Construction of a robust, high-quality power network
4. Maximization of green energy and promotion of its introduction
5. Improvement of human resources and mechanisms related to the stable supply of energy

In relation to cross border electricity trade, the viewpoints highlight the potential of importing energy to meet the nation's growing needs. It goes on to discuss the need to improve infrastructural support for the power sector: a legal system that promotes such energy trade and international cooperation amongst neighboring countries.

Within the context of maximizing green energy, the PSMP (2016) acknowledges that, at present, importing power from neighboring countries (for example, using hydropower generation) has more potential than the limited degree of renewable energy introduction in Bangladesh.

These views are also supported by the Seventh FYP of the GoB which shares some of the key elements of the government's power sector strategy. The matters discussed include the need to rapidly increase electricity generation and diversify energy sources. It also identifies plans to explore electricity trading options with Bangladesh's neighboring countries such as India, Nepal, Bhutan and Myanmar.

Bangladesh also has mitigation goals within its comprehensive climate change policies; the Bangladesh Climate Change Strategy Action Plan (BCCSAP)[22] and the countries' NDCs. The BCCSAP emphasizes the need to explore alternative energy options that reduce the amount of GHG emissions through burning fossil fuels. Bangladesh's current development goals and energy targets will require the establishment of power plants that will emit large quantities of GHGs. The formation of large infrastructure itself will pollute the environment and contribute to existing air pollution. As such, importing secondary forms of energy will reduce environmental stress on the country and limit the country's GHG emissions.

2.3.2 Present State of Electricity Import in Bangladesh

The Seventh FYP developed by the GoB discusses that the choice of primary energy sources has a role in determining the overall cost of electricity produced (figure 7), the increase in cost of energy will add to the cost of all sectors where this electricity is consumed. If the cost of electricity is too high, it will inhibit growth of industries in Bangladesh.

Figure 7 shows that the highest cost of energy is from burning fuels such as diesel while domestic gas is still the cheapest option. The figure highlights that imported power is the second cheapest option after natural gas. Since natural gas in Bangladesh is limited and cannot be exploited further, importing electricity is a cost-effective and lucrative option for Bangladesh to consider.

As mentioned in the PSMP (2016), Bangladesh is in a position where it is possible to have bilateral trade opportunities with its neighbor India. However, if Bangladesh is to have bilateral trade relationships with Bhutan and Nepal—which is in the planning stages—and since the use of Indian network is inevitable, a multilateral framework must be designed including India as a prerequisite. To better conduct discussions of trade and opportunities, a platform has to be created with a group of countries including Bangladesh, Bhutan, India and Nepal (BBIN).

[22] https://www.iucn.org/downloads/bangladesh_climate_change_strategy_and_action_plan_2009.pdf

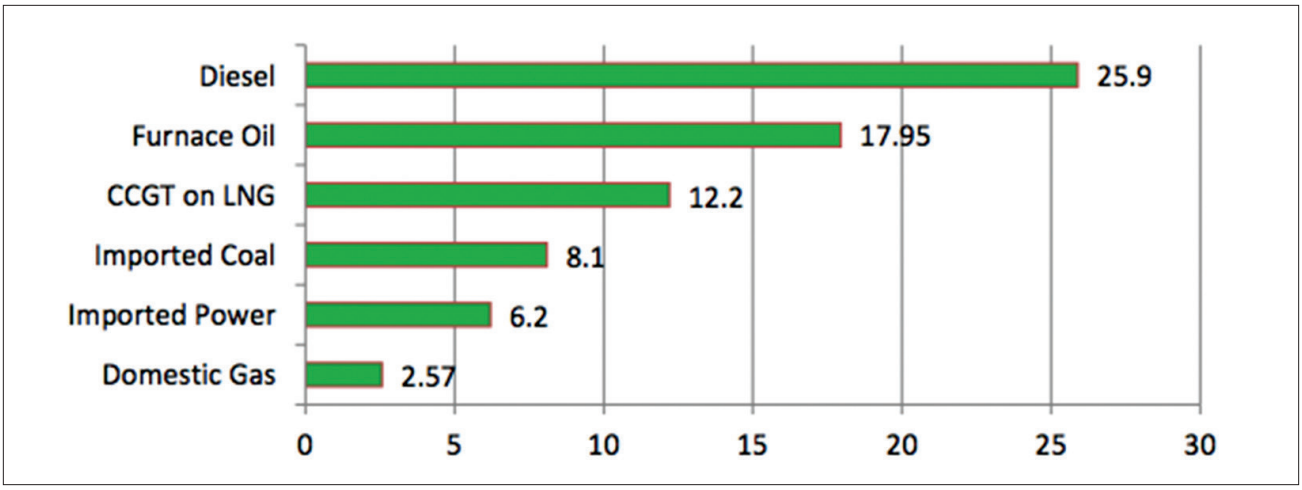

Figure 7: Unit cost of generation in TK per kWh (complied by GED)

Installed Capacity of BPDB Power Plants as on October 2017

Fuel Type	Capacity(Unit)	Total(%)
Coal	250.00 MW	1.84 %
F.Oil	0.00 MW	0 %
Gas	8529.00 MW	62.62 %
HFO	2794.00 MW	20.51 %
HSD	1158.00 MW	8.5 %
Hydro	230.00 MW	1.69 %
Imported	660.00 MW	4.85 %
Total	13621.00 MW	100 %

Figure 8: Bangladesh's fuel mix and capacity (2017)

As of October 2017, Bangladesh imports 660 MW of electricity from India, which makes up 4.85 per cent of the total installed capacity of Bangladesh Power Development Board (BPDB) power plants (figure 8). The first cross-boundary electricity import initiative began in 2013 when 500 MW electricity was imported from Baharampur, India to an existing High Voltage Direct Current (HVDC) substation in Bheramara, Bangladesh. A 400 KV double circuit line connects the two substations in the two countries. Although the initial power transfer through this connecting unit is 500 MW there is scope for transferring more power through this portal in the future.[23]

The second initiative is through the 47 km double circuit transmission line linking the power grid at Suryamaninagar in Tripura to the Comilla power grid in eastern Bangladesh. Initially 100 MW electricity was imported by Bangladesh in March 2016, but the country intended to trade a further 100 MW through this line. However, at present, Bangladesh does not have the infrastructure capacity that is needed to take an additional 100 MW power from Tripura; so an additional 60 MW was added to the existing 100 MW after developing the necessary transferring facilities.[24]

At present, after the commissioning of the Palatana and Monarchak Power plants, the state of Tripura (India) is a power surplus state and supplies additional electricity to Bangladesh, which is an opportunity for the state to earn revenue. The concept of CBET between the two countries is therefore a mutually beneficial opportunity for the growth and development of India and Bangladesh.

[23] http://www.power-technology.com/news/newsindia-bangladesh-inaugurate-cross-border-electrical-grid-interconnection-project

[24] http://www.business-standard.com/article/news-ians/tripura-to-supply-additional-100-mw-power-to-bangladesh-116042300388_1.html

2.3.3 Risks of CBET

Some of the risks of CBET as highlighted in the PSMP (2016) include the risk of massive blackouts if excess power is transferred through one connecting portal. Although it is desirable and cost effective to transfer more power through one connecting portal, the maximum amount on one grid connection should be within 10 per cent of the nation's energy demands. On November 2014, a back-to-back (BTB) system breakdown on the inter-connection line from India (Baharampur-Bheramara) triggered a massive power blackout in Bangladesh. It is, therefore, important to determine the maximum level of import capacity of one inter connection point.

The most important factor to consider when engaging in trade relationships with a neighboring country is trust and maintaining good relationships. There is always a risk of shutting the supply of power being imported if there is hostility between the two nations. Considering that electrical power is vital to survival and also relatively easy to shut down, this level of dependency puts the country at risk. Excessive reliance on one country alone should be avoided and the capacity of imported power from one country should be within the limits of generating reserve margin. More robust electricity trade policies should be drawn up to make sure both countries are protected in this arrangement (Power Division, 2016).

3 Power Sector Stakeholder Analysis of Bangladesh

Institutionally, the power and energy sector in Bangladesh is governed by the Ministry of Power, Energy and Mineral Resources (MPEMR). The MPEMR has two divisions, the Power Division and the Energy and Mineral Resources Division (EMRD), and the two divisions are led by two secretaries.

In terms of electricity generation, transmission and distribution, it is the Power Division that is in charge. As such, for the purposes of this report, the Power Division will be explained in more detail. The Power Division is responsible for electricity generation from both conventional as well as non-conventional sources. This includes electricity ranging from natural gas and coal to hydropower sources. The Figure 9 below demonstrates the structure of the Power Division in Bangladesh.[25]

List of Acronyms	
MPEMR	Ministry of Power, Energy and Mineral Resources
EPRC	Bangladesh Energy and Power Research Council
SREDA	Sustainable and Renewable Energy Development Authority
EA & CEI	Electrical Advisor and Chief Electrical Inspector
BPDB	Bangladesh Power Development Board
APSCL	Ashuganj Power Station Company Limited
NWZPGC	North West Zone Power Generation Company Limited
EGCB	Electricity Generation Company of Bangladesh
RPCL	Rural Power Company Limited
CPGCBL	Coal Power Generation Company Bangladesh Limited
IPP	Independent Power Producer
SIPP	Small Independent Power Producers
WZPDC	West Zone Power Distribution Company
DPDC	Dhaka Power Distribution Company
DESCO	Dhaka Electric Supply Company Limited
BREB	Bangladesh Rural Electrification Board
PBS	Palli Bidyut Samity
NESCO	Northern Electric Supply Company

Under the Power Division, there are separate bodies: EPRC, SREDA, Power Cell and EA& CEI. The SREDA was created in 2012 after the formation of the Renewable Energy Policy (2008) in order to promote renewable energy in Bangladesh and ensure energy efficiency. The SREDA acts as the main agency for policy coordination when it comes to the

[25] https://mpemr.gov.bd

renewable energy sector. It not only provides capacity building and advisory services to enhance RE, but also acts as a monitoring agency for entities that promote and finance energy projects, and supports public–private partnerships in RE projects. The MPEMR supports the SREDA by providing administrative oversight.[26]

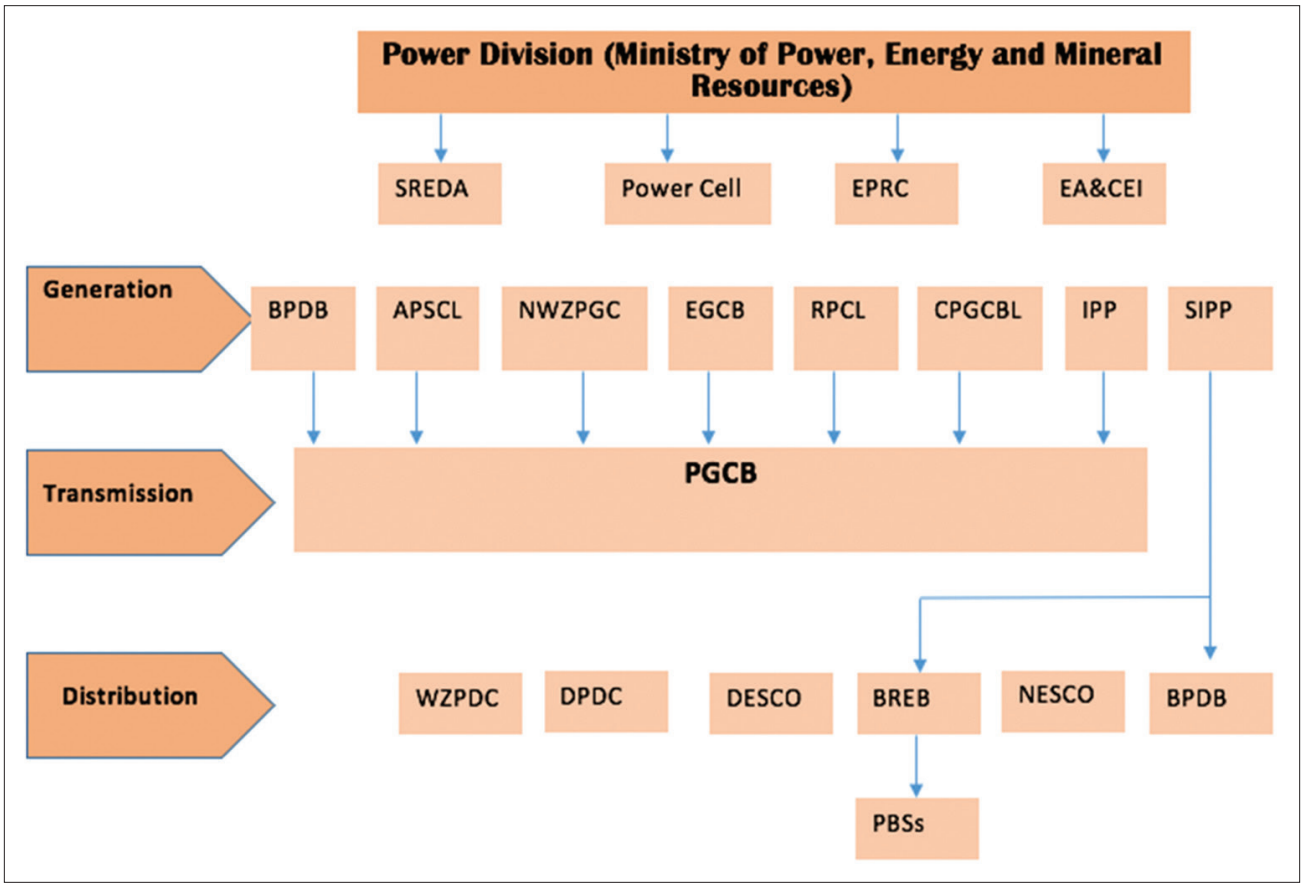

Figure 9: Organogram demonstrating structure of the Power Division in Bangladesh (MPEMR, 2017)

The Power Cell was created by the GoB in order for the implementation of the power sector reform activities of the government. The power cell acts as a think tank and provides support for the formation of plans and policies under the MPEMR. Some of the key roles of the Power Cell include coordination of specific performance improvements, consumer satisfaction and viability analysis. The Power Cell works toward developing strategies for distribution area demarcation & rationalization of utilities. The entity is also in charge of ensuring communication among system utilities.[27]

Under the MPEMR, there are entities for the purpose of electricity generation (figure 9). The electricity generating entities are a combination of both state-owned companies such as the BPDB, Ashuganj Power Station Company Limited, North West Zone Power Generation Company Limited, Electricity Generation Company of Bangladesh, Rural Power Company Limited and Coal Power Generation Company Bangladesh Limited, as well as numerous Independent Power Producers (IPPs) and Small Independent Power Producers (SIPPs). However, all the generated electricity is purchased by the BPDB.

There is one entity with the sole responsibility of transmission: the Power Grid Company of Bangladesh Ltd. (PGCB). The PGCB took over all transmission assets in 2002. The PGCB was formed under the restructuring process of the power sector in Bangladesh. The main purpose of its formation was to make sure the national power grid can expand and operate more efficiently, and to ensure the grid is expanded in a balanced manner. The electricity is then distributed

[26] https://mpemr.gov.bd/power/details/26
[27] https://mpemr.gov.bd/power/details/36

via six distribution agencies under the MPEMR (figure 9) to the end user. All distribution agencies are state-owned at the moment.

The role of the BPDB is important for understanding the power sector of Bangladesh. The BPDB[28] is a statutory body created in 1972, under the MPEMR, GoB. At present, the BPDB is responsible for buying electricity from all other generating entities, while also generating electricity itself. The body is the prime entity responsible for the bulk of power generation and distribution. Over the past decade, there has been a lot of reform and restructuring and a number of generation and distribution companies have been created. Considering that the entity acts as a *single buyer* of electric power and fully owns the PGCB—the national transmission system operator[29]—the BPDB is one of the major stakeholders in the power sector of Bangladesh.

For CBET, the focal ministry involved is the MPEMR. At the moment, the Power Cell is working to coordinate and facilitate electricity import issues. Under this ministry, the Bangladesh Energy Regulatory Commission (BERC) has a mandate to enforce the regulations upon electricity, gas and petroleum products across the nation. It aims to protect consumer interests and satisfaction through fair practices and establish reasonable costs, as well as mitigating conflicts amongst stakeholders. Most power import agreements are under the Speedy Supply of Power and Energy (Special Provision) Act-2010, which does not require a standard tender process.[30]

As matters of CBET require international cooperation and a substantial coordination between various ministries, clear goals and vision from the Prime Minister's Office (PMO) and Parliament are strong drivers for effective implementation. The key ministries that need to be coordinated alongside the MPEMR include the Ministry of Finance which allocates budgets for development activities, sets tax incentives and regulates cross border transactions through the Central Bank of Bangladesh. The Foreign Ministry is usually present during bilateral or multi-lateral agreements relating to cross-border power import. There is involvement of the Home Ministry when building cross-border transmission lines and the participation of the Law Ministry for vetting the agreements.

For overall planning and integration into national strategies and long-term policies, the focal point of coordination is the Ministry of Planning and, in particular, the General Economics Division (GED), which is responsible for developing the nation's FYPs as well as long term perspective plans. For enhancing CBET in Bangladesh, frequent engagements, consultations and interactions with these key stakeholders will be crucial for effective implementation.

[28] http://www.bpdb.gov.bd/bpdb/

[29] THE 'EVERYDAY' POLITICAL ECONOMY OF SOCIAL ENTERPRISELESSONS FROM GRAMEEN SHAKTI IN BANGLADESH, Michelle Therese Hackett MA (International Studies) BSc (Hons), Thesis submitted for the degree of Doctor of Philosophy in the Discipline of Politics, The University of Adelaide SOUTH AUSTRALIA, July 2012

[30] https://www.platts.com/latest-news/natural-gas/dhaka/bangladesh-to-award-lng-terminal-project-to-reliance-27725340

4 Impacts of CBET in Bangladesh

Rural Bangladesh has many corners where lack of electricity is a predominant concern. However, since the GoB has decided to provide electricity to all its citizens by the year 2021, many initiatives have been taken for increasing the availability of electricity. In 2013, Bangladesh started importing electricity from its neighbor, India. The electricity imported is bought by the BPDB, since Bangladesh has a single buyer model, and goes into the national grid. From the national grid, the electricity is distributed to different parts of the country.

The project aimed to understand how cross-border electricity trade between India and Bangladesh has an impact on the lives of the rural population in the bordering villages of Bangladesh. The aim of this case study was to understand how gaining access to electricity, after CBET was initiated, has made socio-economic impacts on the lives of people residing in Bhangapara, Ramkrishnapur. In order to understand the impacts of grid electricity better, another village, Chilmari, in the same Upazila was selected as a control village.

The main criteria taken into account when selecting the sites for this study include:

1. Location of the village to be studied and the control village for comparison to have a similar context and background
2. The sites to be close to the point of entry/substation through which electricity is being imported
3. Ensuring that the majority of the case study village population got electricity connection after the import of electricity from India began

4.1 Study Site Justification

The following case study is based on two villages: one with access to electricity (Pakuria Bhangapara) and the other without access to electricity (Chilmari). In order to ensure that the context of the two sites in most other cases, apart from electricity connectivity, remains the same, the villages selected are both from Daulatpur Upazila. The sites are both villages that border India (Figure 10).

Daulatpur Upazila is located in Kushtia District under Khulna Division. There are 14 unions, 143 Mouzas and 246 villages within Daulatpur. The overall literacy rate of Daulatpur Upazila is 35.6 per cent. The main source of income in Daulatpur Upazila is from agriculture activities. The main crops grown in this area include: paddy, wheat, jute, tobacco, cotton, potato, tomato, maize and betel leaf.[31] Although all the unions are under the Rural Electrification Board (REB), there are many villages in the area that do not have access to electricity.

The 400 KV power line is 100 km in length and stretches from Baharampur (India) to Bheramara (Bangladesh). It covers Kushtia District and within it two Upazilas and seven Unions (Figure 11). The Union-based administrative units of the project area are presented in table 1.

[31] http://en.banglapedia.org/index.php?title=Daulatpur_Upazila_(Kushtia_District)

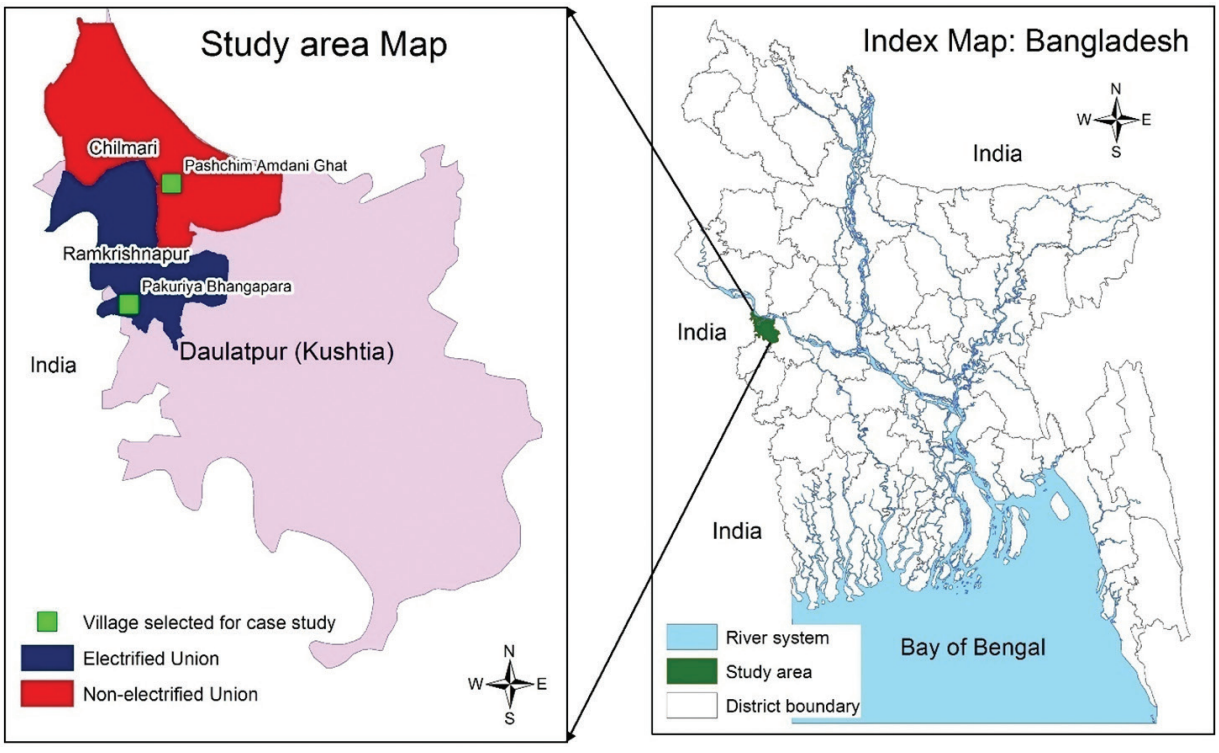

Figure 10: Study Area Map

The imported power reached 500MW on December 2013. Bangladesh has a single model buyer when it comes to electricity production and distribution. As such, the electrical power imported from India, through Bheramara substation (Kushtia), is transported to the national grid through the BPDB. From the national grid,the PGCB is in charge of distributing it to the local areas. In case of electrification in the rural areas, the REB is the body in charge.

Table 1: District Description

District	Upazila	Union	Mauza
Kushtia	Daulatpur	Ramkrishnapur	Mohiskundi
		Pragpur	Gopalpur
		Mathurapara	Char Selimpur
			Char Majdia
			Mahadevpur
			Bagoan
			Khanda
		Maricha	Chaipara
			Char Junaidaba
		Hogolbaria	ChakNiamatpur
			JhikiParankhali
	Bheramara	Junaidaba	Jogeshwar
			Gobindapur
			Dolua
			Char Mokarimpur
		Mokarimpur	Mokarimpur
			Fakirabad

(Source: Environmental Impact Study (EIA) Study, Center for Environment and Geographic Information Services (CEGIS)

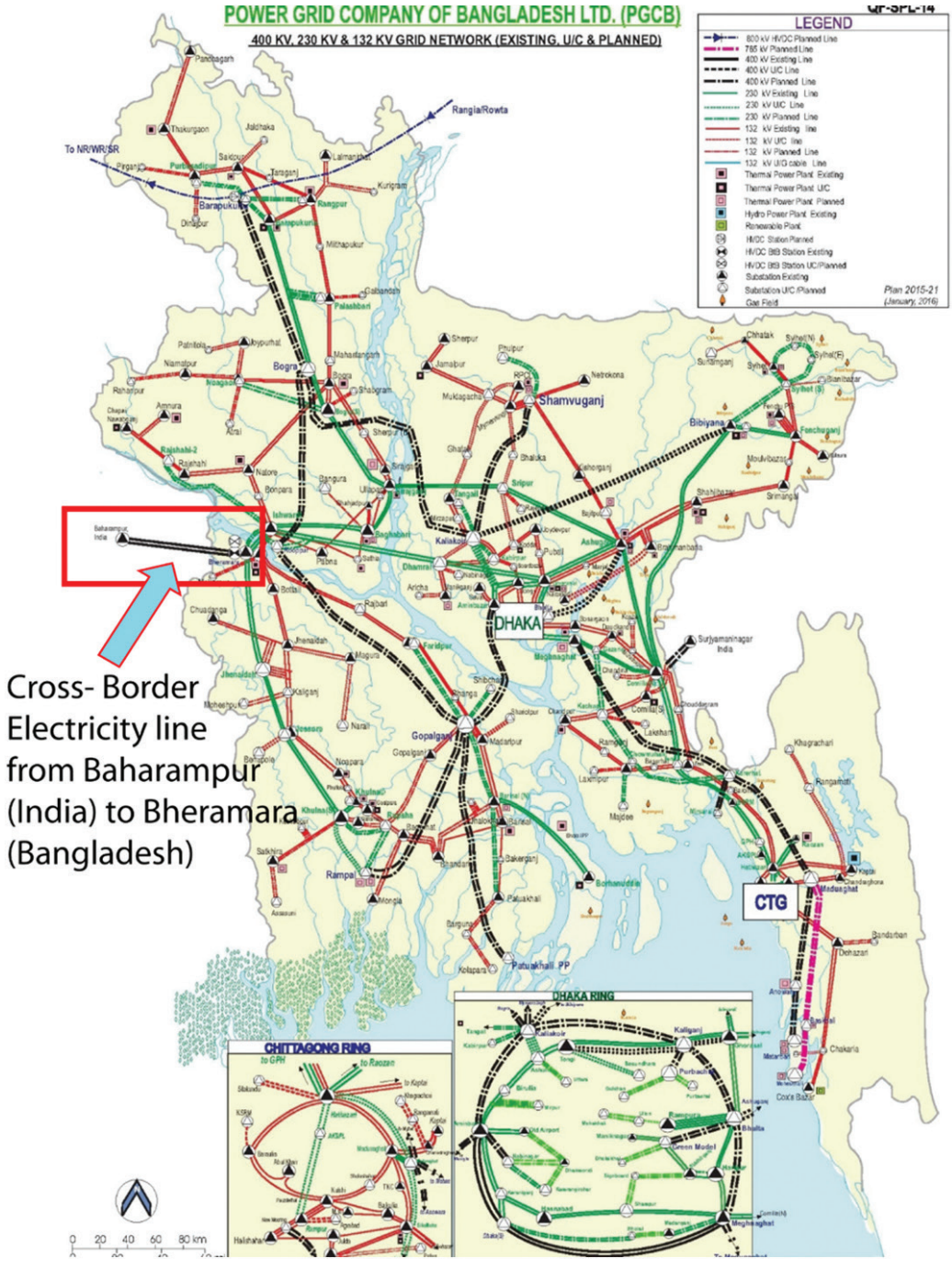

Figure 11: Existing grid network of Bangladesh (Source: PGCB, 2016)

In order to track some of the socio-economic impacts of this imported electricity, the selected case study village is Pakuria Bhangapara,under Ramkrishnapur Union. The village is in the same Upazila as Daulatpur (where the substation importing power from India is situated). A majority of the Union received electricity after the 500 MW of electricity was imported from India and its location being close to Bheramara substation means there is a possibility that the village received government attention after transboundary electricity import was initiated. The Union is also one of the areas covered by the transmission line.

As a control village, we have selected a village without any electricity in the same Upazila (Daulatpur). The village is called Pashchim Amdani Ghat, Chilmari, and is located right above our proposed field site (Figure 10), which makes it a good area to study for comparative analysis purposes.

The village Pakuria Bhangapara borders India (Figure 12) and the grid line enters through this village into Bangladesh.

Figure 12: Power line from India entering Bangladesh through Ramkrishnapur (Source: IRADe)

The main road in Pakuria Bhangapara divides two settlements. The older settlement has been residing in this area for years and so some of the members of that area got access to electricity around 2010-2011. However, this is a small fraction of the settlement and the electricity supply to the area was limited to this. The second settlement is a relatively new body of people who have settled in this area within the past decade after migrating from other regions that were affected by river erosion. The majority of the respondents for this case study were from the second settlement that got access to electricity from 2014. Figure 13 demonstrates data gathered from the REB and shows that electricity connection in the area increased since 2014, after CBET with India began.

This makes it an ideal village for studying the socio economic impacts of CBET on the lives of people who did not have access to electricity before the power import began.

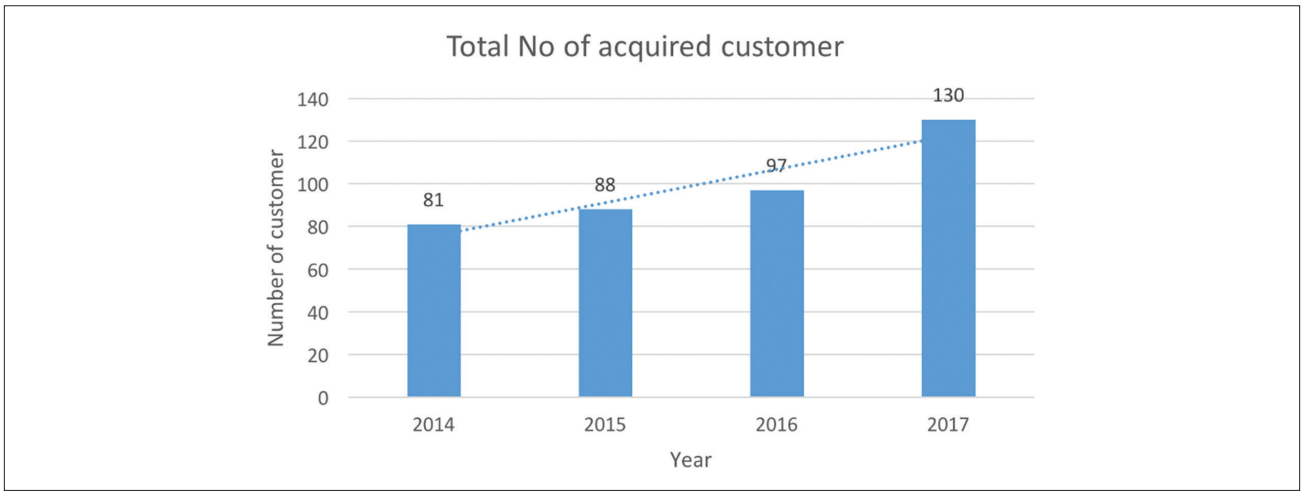

Figure 13: Electricity connectivity in Pakuria Bhangapara in the years since CBET was initiated

4.2 Study Findings and Discussion

Findings from the field survey allowed an assessment of the conditions of the two villages in the context of electrification. Evaluating the socio-economic conditions of the two villages has helped understand some of the impacts of expanding grid electricity in rural Bangladesh. The following sections highlight some of the key effects of electrification in contrast to having no electricity, or having SHSs installed.

4.2.1 Access to Electricity

Electrification in Ramkrishnapur occurred in parts; the whole village was not electrified at the same time. While the government started taking measures for electrifying the village in 2010-2012, only a small fragment of the population got access to electricity. After which, electrification of the rest of the village was somewhat forgotten. From the study sample, only 28 per cent of the respondents shared that they got access to electricity in 2010-2012.

The village received more attention after the CBET process began and the electric line from Berhampur (India) passed through the village in 2013. The majority of the population got electricity after the trade began. It was seen from the study that an additional 72 per cent got electricity from the grid line from 2015. According to the study sample, 96 per cent of the population said the whole area got electricity in 2017. The small fraction of 4 per cent without electricity still rely on kerosene, which was the source of electricity for most of the village before it had grid connection.

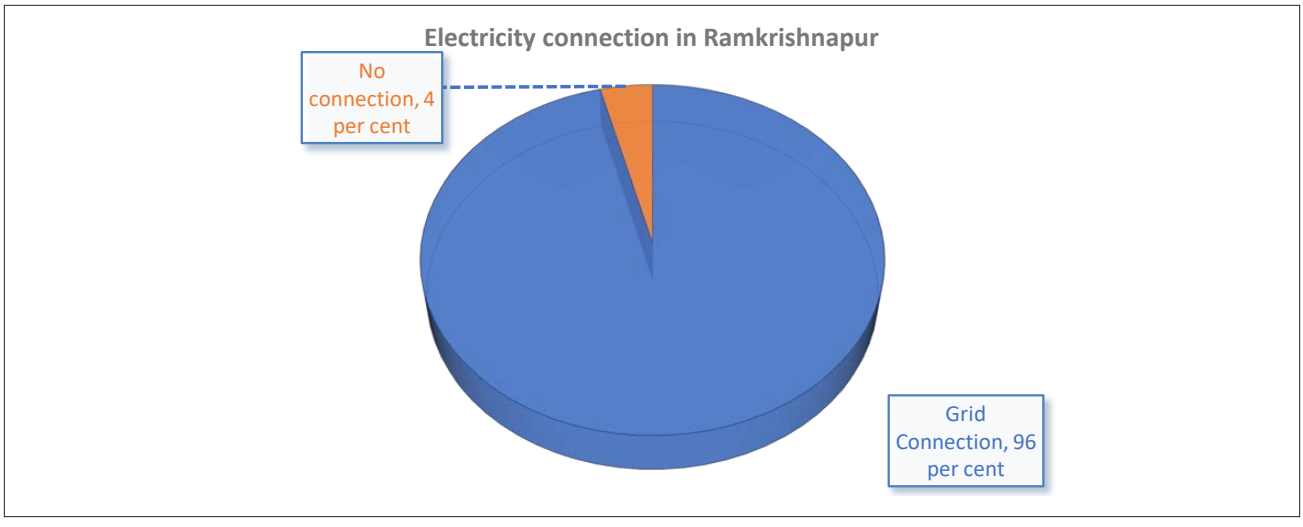

Figure 14: Percentage of respondents connected to grid electricity in Bangladesh

The respondents from Chilmari shared that none of the villagers has access to grid electricity. However, a segment of this population has SHSs installed in their houses. In Bangladesh, approximately 4.5 million SHSs have been distributed in some of the most remote off-grid corners. Since this is an alternative form of electricity used by a segment of the rural population, the study covered some of the user experiences of SHSs and their views on grid electricity.

4.2.2 Quality of Electricity

A significant problem in Bangladesh—as well as in many other developing countries—is ensuring the quality of electricity. Providing electricity to a certain area can often ignore the post-electrification follow-up process. The scope of this study assessed the quality of electricity for both villages and the uses of their respective forms of energy.

In Bhangapara, Ramkrishnapur the respondents get electricity through grid connection, approximately 78 per cent of the survey population shared that they get electricity for approximately 5 to 12 hours each day. However, some households get more hours of electricity in a day; around 14 per cent shared that they get electricity for at least 13 to 20 hours per day. This can be troublesome since there is a fraction of time when power cuts are unavoidable even with access to grid electricity.

Chilmari, however gets electricity through SHSs or relies on kerosene and candles for their energy needs. When surveyed, the population from Chilmari shared that the average amount of power they receive from their SHS per day is usually between two to three hours. This is true for at least 52 per cent of the respondents. Around 36 per cent of the respondents shared that they have access for around four to six hours and only 12 per cent can manage more than that.

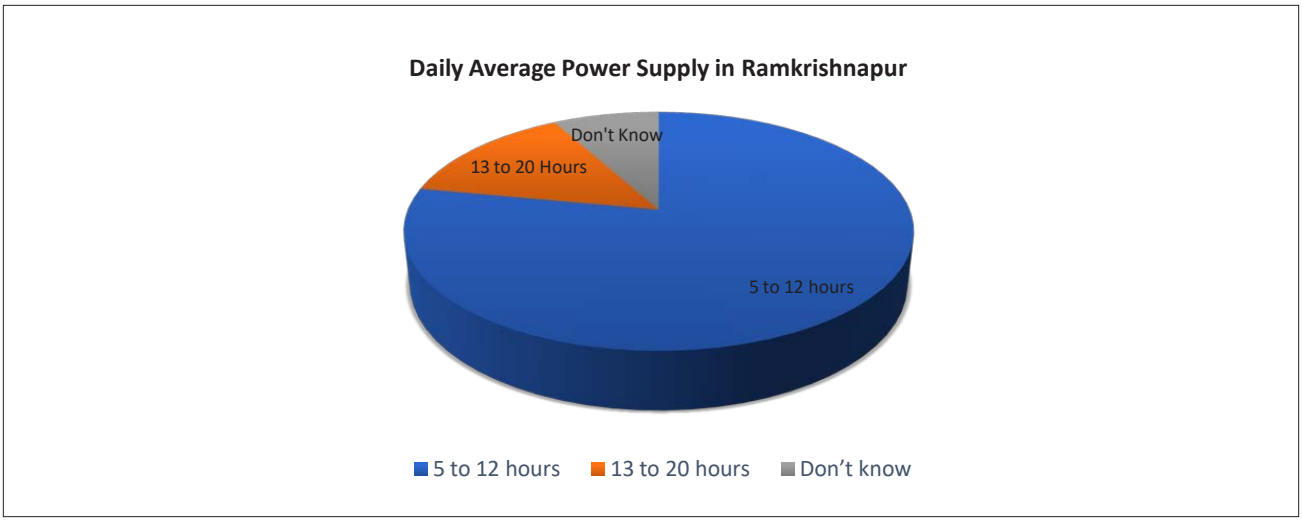

Figure 15: The hours of electricity received by the respondent mix in Ramkrishnapur

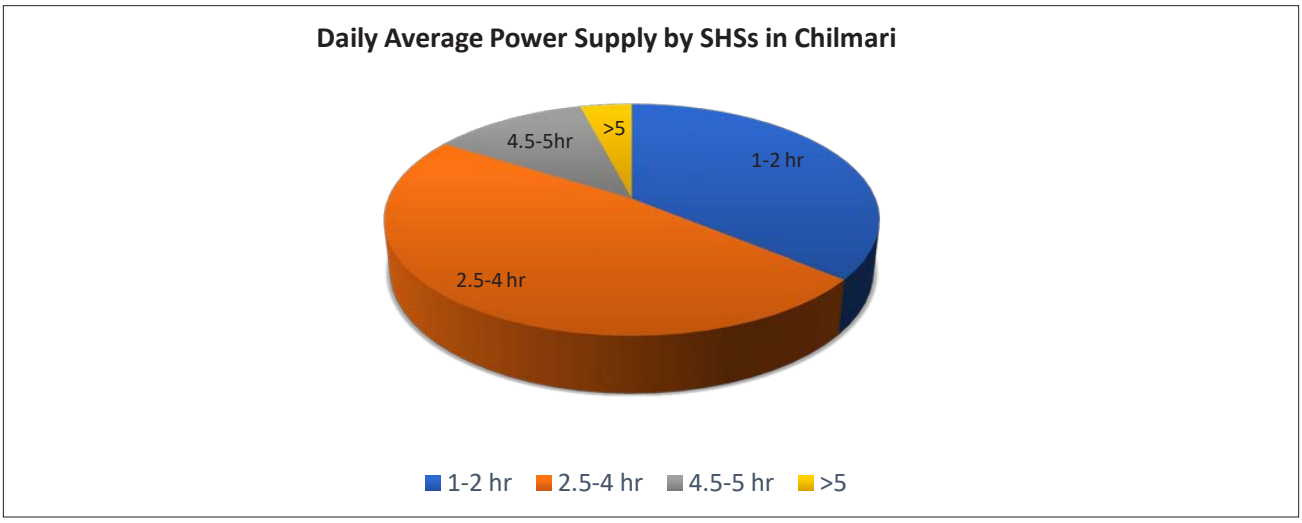

Figure 16: The amount of power generated by SHS in Chilmari for the respondents' households

Some of the reasons identified for this include the dependency on weather. The villagers complained that if it is cloudy, enough electricity is not generated by their SHS. If there is rainfall, the batteries will not charge at all, resulting in no electricity for that day. If the sunshine is not enough, there is not enough charge on the batteries to generate sufficient power for the household. Considering Bangladesh has a whole season for rainfall, the monsoon, the respondents from Chilmari complained that during the monsoon, the household has no electricity for consecutive days. Since they rely solely on this energy source, this really slows down work and productivity.

4.2.3 Uses and Socio-Economic Impacts of Electricity

Through the study, when enquired about the usage of electricity, the respondents shared that most of the people use electricity in their households for the purpose of lighting, mobile phone charging, watching television and studying at night. The respondents also discussed that with electricity at night, they can also spend longer hours studying, which is particularly useful for the community's youth. Being able to perform better in school encourages young persons to pursue higher education.

In terms of additional income opportunities since electrification, around 6 per cent of the respondent population uses electricity for income generating activities. Income generating activities include keeping shops open for longer hours after sunset, and establishing new businesses such as computer and printing shops in the local area. After electrification, there are new establishments such as auto vehicle charging shops in the village. Electrification of the

village also affects other activities; for example, 26 per cent of the village people can now use electric motors for pumping ground water. Collected groundwater is used for cooking, bathing, washing and drinking purposes.

In terms of electricity usage, Chilmari respondents shared that they mainly use electricity for lighting facilities. Around 32 per cent of the population uses solar energy for lighting and mobile phone charging, some of the people shared that they use electricity for studying at night. Most of the respondents shared that the voltage is quite low and when they use electricity for using fans or televisions, the power runs out very quickly. Which is why, on summer days, they have to ration the use of fans to a bare minimum—otherwise, they will get absolutely no electricity during the night. Being unable to use fans during hot summers proves to be difficult for those who are in the house.

Chilmari respondents did not share any additional income generating activities associated with their energy source. A small fraction—around 10 per cent of the respondents—have solar motor pumps which they mostly use for washing clothes and bathing cows.

The following subsections will delve into the details regarding livelihood changes and highlight some of the socio-economic impacts derived from access to electricity.

a) Education and Capacity Building

When education was discussed with the respondents of the two villages, it was found that although a similar percentage of children go to school in both villages, there is a higher number of population in Ramkrishnapur who continue their education beyond primary level. The FGD discussions revealed that there are university graduates from the village as well.

Out of the survey participants in Ramkrishnapur, a majority of the people said that their overall education capacity has increased in recent years. Some of the respondents also shared that since getting access to electricity, they have developed new skill sets. They have better technical skills and can now engage in new business opportunities. Most of the people said that they have household members who can now study at night and the main source of energy for this is electricity. When enquired about the extra hours available for studying, 58 per cent shared that their family members can now study at night for an additional one to two hours, while 42 per cent of the household members can continue studying for an additional three to four hours. After electrification, the community schools now have light and fan facilities, which encourage students to attend school.

It was found through discussion with the locals that Chilmari does not have higher education facilities beyond primary education. There is one high school for secondary education, but most people usually go to the Sadar (nearby town) to pursue their education.

Having access to light and fan (during the summer) allows children to perform better in school, as their understanding of school curriculum increases and their interest in higher education is also likely to increase, allowing them to have better career opportunities in the future.

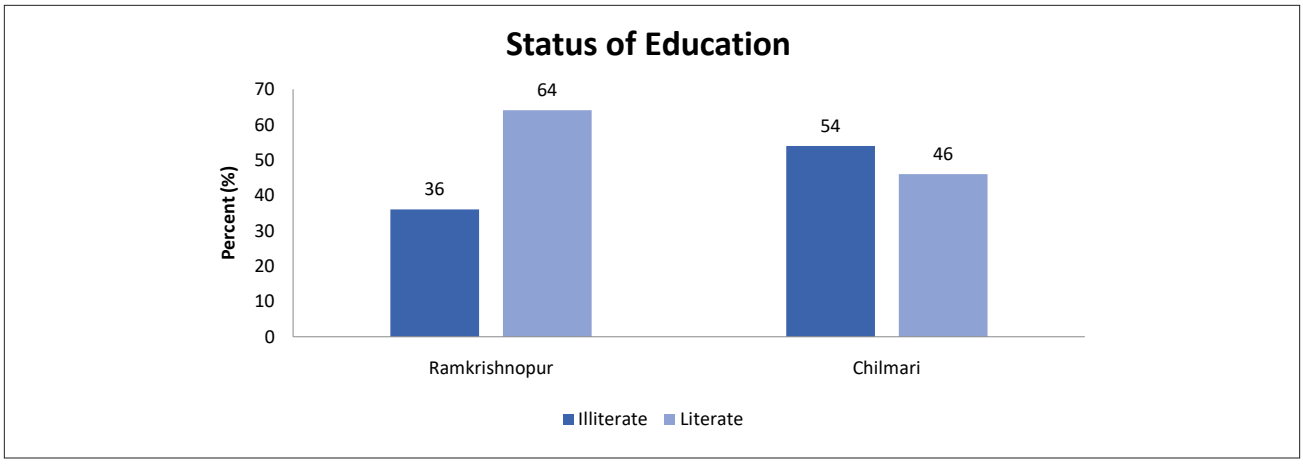

Figure 17: Percentage of respondents who are literate and illiterate in both villages

b) Work Opportunities and Income

Understanding work opportunities is a vital element when assessing the socioeconomic conditions of an area. In the village of Bhangapara (Ramkrishnapur), livelihood opportunities were well divided among different sectors. Around 36 percent of the surveyed population were engaged in farming; 34 percent had other jobs in the service sector that included working in NGOs, government offices or shops; around 8 percent were day laborers and 16 percent of the people shared that they receive income from businesses.

Access to electricity in Ramkrishnapur helped improve their overall agriculture productivity. For example,electric motor pumps are now used for irrigating land and having light at night lets farmers work for longer hours. The storage stations for agriculture products also have lighting facilities, which allows them to keep the stored products in a more hygienic environment.

The survey results from Chilmari revealed that most of the employment opportunities in the village lie in the primary sector. Around half of the respondents (50 per cent) were farmers; 8 percent were engaged in day labor; 8 percent were service holders and 10 percent had small businesses. The area does not have many industries for work in the service sector and other sectors. According to the FGDs the residents of Chilmari who are engaged in day labor have difficulty finding work on a daily basis, making their livelihood rather unstable

Having access to electricity in a community broadens the scope for work opportunities beyond the primary sector. There are more options for working in the service sector and for developing skills that could help enhance their overall employability outside the village as well.

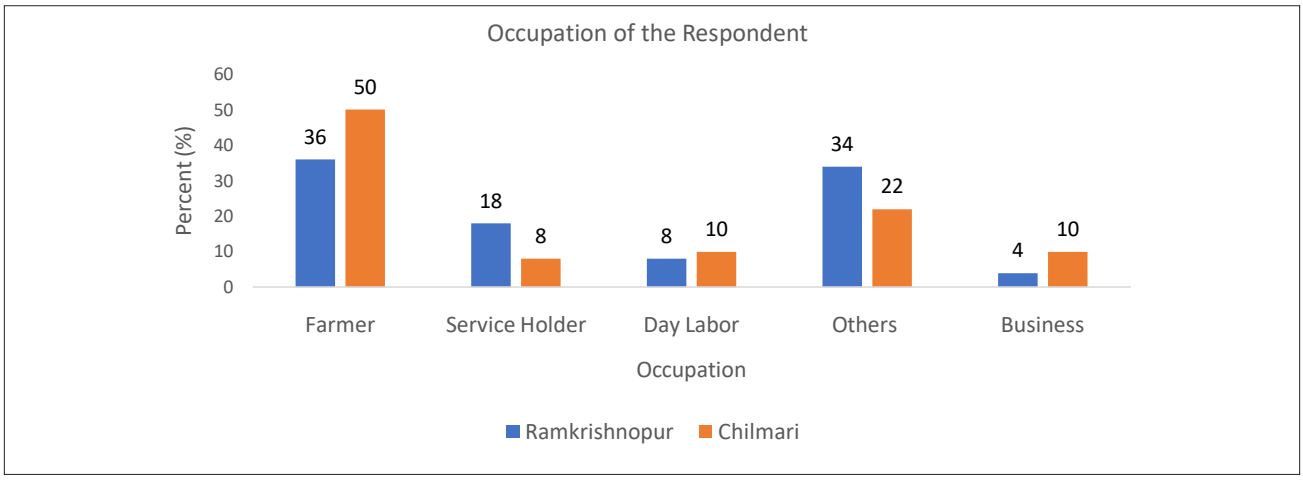

Figure 18: The range of livelihood options in both villages

In Ramkrishnapur, when enquired about how having access to electricity contributed to their overall income, at least half of the population shared that their average income rose since electrification. The rise in income is mainly through a wider range of livelihood options, scope for introducing new businesses, increasing the amount of working hours and having women contribute toward income generating activities. Overall, the survey and FGD discussions revealed that the respondents from Ramkrishnapur had more income than the respondents from Chilmari.

Even within Ramkrishnapur, there is a disparity in income levels. This is because Bhangapara is a new settlement within Ramkrishnapur where people from other areas have migrated after their homes elsewhere were inundated by floods and river erosion. Since there is more connectivity in this area, people have more incentive to migrate to Ramkrishnapur. Those who have been settled here for longer earn, save and spend more than those who are new and are still struggling to get fully settled.

One of the indicators of poverty is the amount one can spend on basic needs and facilities other than their food expenditure. FGDs and surveys revealed that the residents of Chilmari have less money to spend on facilities such as health and education. The people of Ramkrishnapur are able to save more money than those residing in Chilmari.

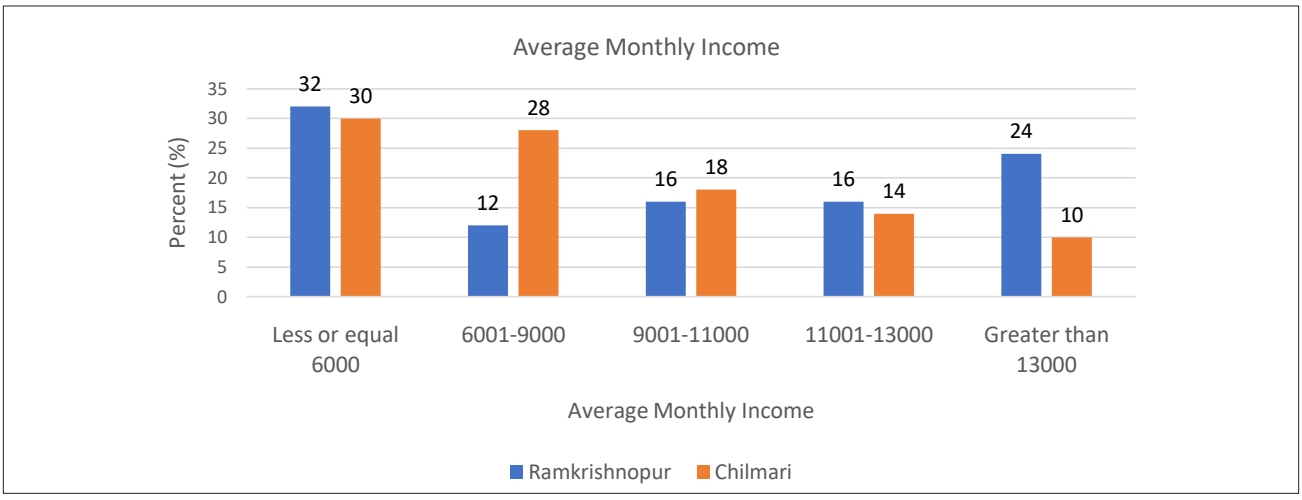

Figure 19: A comparison of the average monthly income of respondents from both villages

c) Impact on Gender

Access to electricity not only improves functionality within a household, but also empowers women within the household.

In Ramkrishnapur, from the population set, almost half of the women have gone to school. As part of the norm, most women have traditionally been helping their families within the household. However, 14 per cent of the women have now started income generating activities. A number of participants said that participation of women in economic activities has increased since the village became electrified. Women in Chilmari are yet to be involved in income generating activities.

As discussed through FDGs, working hours within the households have also increased after having light beyond daylight hours. The respondents do not acknowledge working within the household as their actual work though, since they consider this as part of their duties.

Out of the respondents, around 16 per cent of the women have savings and 8 are land owners. During the FGD sessions, majority of the households in Ramkrishnapur shared that access to electricity allowed women in the community to have a better life. Having light at night lets women engage in activities such as tailoring, sewing and making handicrafts. Having light also gives girls more time to finish their daily duties around the household, which allows them to attend school during the day and still complete their chores during the evening. Some of the women shared that they can

even cook at night. This is a significant change because it is customary for females in the village to conduct household chores and previously that is all they would have time to do. The female respondents also indicated that they have to spend less time collecting alternative fuel (firewood) after getting electricity.

With more houses lit beyond daylight hours, the local area is not as dark as it used to be and women now feel safer to travel after evening hours.

d) Connectivity and Accessibility

In Ramkrishnapur, there has been noticeable improvement in terms of mobile phone connectivity in recent years since electrification. Having access to mobile phones allows people to keep in touch with friends and family who have moved out of the village. It also enables them to be better connected with networks out of the village vicinity. The participants shared that they also have access to computer facilities in the community. Having access to electricity has enabled people to avail opportunities beyond the scope of their village.

The village in Ramkrishnapur has better links and improved road facilities since the initiation of the Baharampur-Bheramara CBET. This is because the connecting electric line passed directly through the village and its setting up and maintenance required engineers and government officials to make frequent visits to the area. As the village received more attention and it was necessary to ensure convenience when travelling to the area, the surrounding roads have been well-maintained. Since they have better transport links and improved connectivity, the participants shared that they can now go to the nearby Upazila and, in some cases, Kushtia district to avail better hospital services when needed.

Through the FGD with participants from Chilmari, it was found that most of the people in the village go to local doctors or relatives with some knowledge of medicine when they have health issues. Travelling to nearby towns and cities is much more difficult, since they are not well-connected with their neighboring towns and cities. Most people cannot afford to avail proper medical facilities out of the village.

4.3 Scope for Improvement

Electrification of Ramkrishnapur has brought numerous advantages for the people residing in the village. However, there is scope for improvement, and discussion with the residents of the village has shed light on some of the difficulties they face with grid electricity, and how their overall experience could be improved.

The respondents of Ramkrishnapur shared that they face problems such as load shedding during peak hours of the day and, during disaster events, the electric line is often damaged, resulting in power cuts. Enhancing the amount of electricity and ensuring proper maintenance of electric lines—especially after disaster events—should be ensured for improving the quality of electricity.

Other recommendations include expanding the use of electricity to increase community activities and providing streetlights throughout the village. The respondents said they would like more knowledge and training facilities for better utilization of electricity so they can maximize the uses of electricity and create bigger impacts.

Discussions with the respondents from Chilmari revealed that those without access to any electricity are still dependent on primitive forms of energy such as burning firewood and using kerosene. This is not only inconvenient, but is also polluting the environment. The households in Chilmari with access to SHS have shared that although SHSs have brought improvements to their lives, their opportunities are still limited due to the environmental constraints associated with solar energy and the restricted voltage capacity of the SHS they can afford. It is costly to purchase larger SHSs without subsidy, and once they have bought smaller systems, it is not possible to upgrade using the same loan scheme. The participants shared that they believe that in order for their village to develop further, they

need access to grid connection. Some of the comments suggested that growth in Chilmari is stunted because of their limited electricity access. The community overall needs electricity facilities, which is beyond the capacity of individual SHSs.

Through this study it could be understood that access to electricity is an integral element for uplifting the socio-economic conditions of rural Bangladesh. Discussions with participants revealed that grid electricity has given them access to various technological facilities that were previously unavailable to them. Having the option to turn on a light bulb at night is much more than just convenience, it allows people to work for longer hours, study at night and engage in social activities, all of which add to the quality of their everyday lives.

5 Conclusion

Bangladesh, over the past decade, has made immense progress when it comes to economic growth and development. The country aims to graduate from its LDC status and become a middle income country in the near future. This would result in increased industrialization and a significant increase in the demand for electricity. Considering that the supply of natural gas—the country's prime source of energy at present—is predicted to decrease by the year 2021, the country will be in motion for a shift in its energy mix. During this transition period, there is a need for exploring viable energy sources to meet the demands of a growing population.

At present, coal plants and other forms of primary energy are being contemplated, but the issue of planning and constructing large infrastructure is a time consuming process. Not to mention the debates that follow the plan processing stages. Importing electricity from neighboring countries through CBET is a rather appealing option in this regard: it is a fast and efficient way to supply electricity to the country without the struggles of resource extraction, infrastructure planning and secondary energy production.

As the country struggles to meet its electricity needs, it is usually the cities and established towns that are in the process of industrialization that get access to this limited pool of electricity. Villages that are yet to grow are usually ignored in the process. Being able to access a significant amount of electricity from CBET allows the country to have enough electricity in store to prioritize such cornered villages and allow them the opportunity to develop. Although electricity supplied to these villages cannot directly be traced to CBET, since Bangladesh has a single buyer system and all of the electricity produced and imported are added to the central grid, it is still true that there has been a significant increase in the number of rural villages being electrified since the process of electricity import from India began in 2013.

This project studied a bordering village, through which the electricity line from India entered Bangladesh to understand the role electricity plays in the everyday lives of the residents. A majority of the population in this village got access to electricity after CBET was initiated in 2013. Contrasting discussions with respondents from this recently electrified village, and a neighboring village which is still deprived of electricity, revealed the joy people received from having access to facilities that are only available through electrification. Assessing the socio-economic impacts of electricity in these villages show how electricity can significantly improve the quality of life, for both men and women—especially women, since they are now able to expand their usual chores throughout the day and can engage in more activities.

The GoB has been considerate of these off-grid remote villages and has provided SHSs for these homes. However, discussions with such SHS consumers in the non-electrified village disclosed that although having access to solar energy has certainly uplifted their lives, SHSs are usually insufficient, or just enough, for the households; there is no community growth through this. This is because of the lack of community solar programs available in Bangladesh at present. One of the needs and requirements for rural villages to flourish is community development through streetlights, hospitals, schools and improved opportunities for businesses. All of which are possible through enhanced grid electrification.

Trading Electricity from neighboring countries has many perks since no country is fully self-sufficient. Being able to tap into another country's resources can help boost a country's economic growth and development. Establishing electricity trade also opens doors for other trade opportunities and helps improve bi-lateral and, in some cases, multi-lateral relations between neighboring countries—crucial for building solidarity and enhancing global cooperation.

However, excessive dependence on another country for electricity supply may leave a country vulnerable and inhibit its own self growth in terms of electricity production. Caution must be exercised in this process since political relations are volatile and needs constant tending. So, Bangladesh should use this opportunity to learn better practices from neighboring countries to enhance its own energy production in the future.

Overall, being able to access electricity on a personal level brings out a phenomenal improvement in one's livelihood. As a nation, the impact of energy access goes far beyond meeting national targets for the power sector. Energy is intrinsically connected to the development of all sectors and the country's ultimate growth and prosperity. Bangladesh has performed remarkably well in achieving the Millennium Development Goals (MDGs) and is currently in the process of developing plans and strategies to achieve the Sustainable Development Goals (SDGs). Access to electricity will play a vital role in determining Bangladesh's success in this regard. Although availability of energy is primarily under Goal 7 of the SDG (Ensure Energy for all), it will still have a significant impact on the achievement of most other goals within the SDGs. These include Goal 1 (Poverty), Goal 2(Zero Hunger), Goal 3 (Good Health and Well-being), Goal 4 (Quality Education), Goal 5 (Gender Equality), Goal 7 (Affordable and Clean Energy), Goal 8 (Decent Work and Economic Growth), Goal 9 (Industry, Innovation and Infrastructure) and, of course, Goal 13 (Climate Action).

In order to best achieve the 2030 Agenda and to help Bangladesh continue its economic growth and development, it is essential that the country is able to provide electricity to all its citizens in the fastest and most economic manner possible. The remotest corners of the country need to be brought under electrification and truly no one should be left behind.

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Annex A: Questionnaire

Survey No.: _____

This survey is undertaken by ICCCAD as part of a research project on the socioeconomic impacts of cross boundary electricity trade between India and Bangladesh. You have been randomly selected as a respondent for this survey as you reside in our case study village. The reasons for selecting the site can be explained by the interviewer. With your consent, this interview could last for about 20 to 30 minutes. The information provided by you shall be used for research purposes only. The information will be anonymous & you will not be identifiable. Your cooperation will be highly appreciated.

Geographic locations:

Latitude	**Longitude**

Village name: _____ **Union:** _____

Upazila: _____ **District:** _____

Section A: Information on respondent and other household members

A1. Total number of household members: _____

Member no	**Name**	**Gender** **1. Male** **2. Female**	**Age**	**Relationship to Head** **1.** Household Head **2.** Wife/Husband **3.** Son **4.** Daughter **5.** Son/daughter In-Law **6.** Grandchild **7.** Parent **8.** Brother/Sister **9.** Grandparent **10.** Others (Specify)	**Marital Status** **1.** Single **2.** Married **3.** Divorced	**Is the family member literate or illiterate?** **1.** Illiterate **2.** Literate	**What is the current/last school that the family member is attending/has graduated?** **1.** Primary **2.** SSC **3.** HSC **4.** University/College graduate **5.** Don't know
1							
2							
3							
4							
5							

A1. Continued…

Member no	**Has the household member worked in an occupation, which brings income in the last 3 months?** **1.**Yes **2.** No **3.** I do not know	**If household member is not engaged in income generating occupation, please mention the reason** **(1.** Student **2.** Retired **3.** Cannot find a job **4.** So ill that he/she cannot work **5.** Not allowed to work **6.** Others**)**	**What is/are the household members' income generating occupations?** **(1.** Farmer **2.** Service holder **3.** Day labor **4.** Rickshaw puller **5.** Entrepreneur **6.** Others**)**
1			
2			
3			
4			
5			

Section B: Income, expenditure and savings

B1. What are the main income sources of your family?

(Read all the options to the interviewee. **1 Primary, 2 Secondary, 3 Occasional**)

Wage / salary	
Farming	
Remittance	
Business	
Rental income	
Pension	
Assistance from NGO	
Assistance from GOVT.	
Others	

B2. What is the average monthly income of the household? _____Taka

B3. What is the average yearly income of the household? _____Taka

B4. How do you consider yourself?

1. Very poor **2.** Poor **3.** Lower middle income level **4.** Middle income level
5. Higher middle income level **6.** Rich **7.** Very rich

B5. How much money did you spend for each of these in the last one-year?

SL.	List of Expenses	Amount (Taka)
1	Food	
2	Education	
3	Health	
4	Electricity (Those who have grid connection)	
5	Other sources of energy	
6	Others	

B6. How much do you save monthly? _____ (If the respondent does not save, **write 0** and go to section C)

B7. How do you invest your savings? (Please tick relevant answers)

1. Bank **2.** Buy land **3.** Buy gold **4.** In Business **5.** In co-operative society **6.** Other _____

Section C: Housing and infrastructure

C1. What is the ownership status of your house?

1. Owner of the house **2.** Renter **3.** Parent's house **4.** Spouse's house **5.** Others_____

C2. How did you own this house?

1. I bought it **2.** I inherited it **3.** Living on Khas land **4.** Others _____

C3. Structure of the building status of your house?

1. Pakka **2.** Semi-pakka **3.** Kacha **4.** Others_____

C4. What is the quantity of your homestead land? _____

C5. Do you have access to safe drinking water? **1.** Yes **2.** No

C6. What are the domestic water sources of your house?

1. Tubewell **2.** Pond **3.** Rainwater **4.** Tap water **5.** Others_____

C7. What type of sanitation facilities do you have?

1. Sanitary pakka toilet **2.** Kacha toilet **3.** Neighbour's toilet **4.** Open field **5.** Others_____

Section D: Land-use and Agriculture

D1. Does any of your household members work in agricultural sector? **1.** Yes **2.** No

D2. Does your household own agricultural land? **1.** Yes If yes, specify quantity_____ **2.** No

D3. Has access to electricity helped to increase agricultural productivity? **1.** Yes **2.** No

D4. If yes, specify how: **1.** Irrigation **2.** Lighting facilities **3.** Powering agriculture instruments **4.** Heating **5.** Access to information **4.** Others_____

D5. If no, specify reasons: **1.** Poor quality of electricity **2.** Expensive **3.** Others_____

D6. Has electrification helped to access better storage facilities? **1.** Yes **2.** No

D7. Has electrification helped to access a greater market? **1.** Yes **2.** No

Section E: Education and Health

E1. Do all the children of your household go to school? **1.** Yes **2.** No (if No, go to E2)

E2. Why the children are not going to school? _____

E3. Do any of household members have a permanent/chronic disease/health problem? **1.** Yes **2.** No

E4. Did any of the household members face a health problem which required treatment within the last 3 months?

1. Yes **2.** No

E5. When you experience a health problem, which health facility do you go? _____

Section F: Gender equity

F1. Do Girl children of your household go to school? **1.** Yes **2.** No (If No, specify why_____

F2. Do women in your household do income-generating activities?

1. Yes **2.** No (If No, specify why_____

F3 If women are engaged in economic activities, how much do female members contribute to total family income/year

F4 Has participation of women in economic activities increased after electrification? **1.** Yes **2.** No

F5. Do women in your household have savings? **1.** Yes **2.** No

F6. Do any of the women in your household own land? **1.** Yes **2.** No

F7. Has electricity helped girls and women in particular in your household to have a better life? **1.** Yes **2.** No

F8. (Those who do not have electricity) Do you think access to electricity would have helped girls and women in particular in your household to have a better life? **1.** Yes **2.** No

F9. If Yes to **F7**, How: **1.** Increased income **2.** Better access to education **3.** Better safety and security **4.** Others_____

F10. Has electricity helped girls and women in particular in your community to have a better life? **1.** Yes **2.** No

F11. (Those who do not have electricity) Do you think access to electricity would have helped girls and women in particular in your community to have a better life? **1.** Yes **2.** No

F12. If Yes to **F9**, How: **1.** Increased income **2.** Better access to education **3.** Better safety and security **4.** Others_____

F13. Do the community areas including public spaces around your house have adequate street lights?

1. Yes 2. No

F14. Do you feel safe making use of these public spaces? If not, please state why.

1. Yes 2. No

Reason:

Section G: Access to electricity and utilization

G1. Do you have electricity in your house? **1.** Yes **2.** No (If yes, go to G3)

G2. When did you get electricity connection? _____

G3. Does your community have access to electricity? **1.** Yes **2.** No (If yes, go to E4)

G4. When did your community get electricity connection? _____

G5. What kind of electricity connection do you have? **1.** Grid connection **2.** Solar **3.** Others_____

G6. What kind of problems do you experience? (Tick as relevant, you may tick more than one)

1. Electricity cuts. How frequent? _____ (Number of hours per day)
2. Low voltage
3. Changing voltage
4. Other. Please specify _____

G7. What is the average daily power supply you get?

G8. What are the usages of electricity in your household?

1. Lighting **2.** Mobile phone charging **3.** Watching TV **4.** Cooking **5.** Studying at night
6. Others_____.

G8. Does any of your household members use electricity for any income generating activities? 1. Yes 2. No

If yes, please specify_____

G9. Do you use electricity for running motor pumps used for collecting groundwater? **1.** Yes **2.** No

G10. If yes to G9, how do you utilize the groundwater pumped using electricity?

1. Irrigation of Agricultural land **2.** Drinking water collection **3.** Other household works (Cooking, bathing, washing etc.) **4.** Others _____

G11. How much does your household spend per month on the following energy sources?

Energy sources	**Monthly Cost (Taka)**
Electricity	
Kerosene	
Gas	
Coal	
Firewood/ Fuel wood	
Solar system	
Candle	
Batteries	
Generator (Petrol / Diesel)	
Other	
Total cost	

G12. Does your household collect firewood/ fuel wood? **1.** Yes **2.** No

G13. If yes to **G12**, Who in the household is responsible for collecting firewood? **1.** Male **2.** Female

G14. If yes to **G12**, How long do you spend for collecting firewood? _____

G 15. How has the fuelwood collection/requirement changed after electrification?

(Time spent in collection, quantity required now etc.)?

G 16. What is the average spending on energy sources after electrification?

Impacts of Electricity

H1. Do you think that the Electrification programme has benefitted your household? **1.** Yes **2.** No

H2. If yes, please specify some of the benefits you have experienced?

1. Saves money spent on alternative fuel sources **2.** Saves time **3.** Better connectivity

4. Opened small business **5.** Better environment for education **6.** Land value increase

7. Longer working hour **8.** Other_____

H3. If 'No', please give reasons (according to you) for this? **1.** Poor quality of electricity **2.** Expensive **3.** Spending more time watching TV **4.** Others_____

H4. Do you think that the Electrification programme has benefitted your community overall? **1.** Yes **2.** No

H5. If yes, please give examples of some of the benefits you have observed?

1. Increased income opportunity for the community **2.** Improved security and safety within the neighborhood

3. Increase quality of life of women **4.** Opening of new businesses such as shops

5. Jobs created in the local community **6.** Better environment for education **7.** Other_____

H6. If No, please give reasons **1.** Poor quality of electricity **2.** Increase expenses **3.** Expensive **4.** Spending more time watching TV **5.** Others_____

H7. Do you think that the Electrification programme has created jobs for people in this household? **1.** Yes **2.** No

H8. If yes, what kind of jobs? _____

H9. Do you think that the Electrification programme has led to the capacity development among community members?

1. Yes **2.** No

H10. If yes, please give examples of the types of capacity development

1. Education **2.** Computer skills **3.** Electrical skills **4.** Technical skills

5. Increase business opportunity **6.** Other_____

H11. Do you have household members who study at night? **1.** Yes **2.** No

H12. If yes please indicate the main source of energy used for lighting during night study

1. Electricity **2.** Kerosene (hurricane/lamp) **3.** Generator (petrol / diesel) **4.** Candle

5. Solar system **6.** Others_____

H13. How many hours do they utilize studying per night?

1. 1 to 2 hours **2.** 3 to 4 hours **3.** 5 to 6 hours **4.** 7+ hours

H14. Does electricity contribute to your household income? **1.** Yes **2.** No

H15. If yes, What are some of the ways in which this happens?

1. Longer working hours **2.** Small and medium businesses

3. Increased opportunity for income generation for women **4.** Increased agricultural productivity

5. Others_____

H16. Are you satisfied with the level of involvement of community members in the electrification programme?

1. Yes **2.** No

H17. If No, could you please provide reasons for your dissatisfaction? _____

H18. Do you have any other comments or suggestions for improving the Electrification programme in your community?

_____

H 19 Did the establishment of the Bheramara substation (that transports electricity from India) bring any changes to the local area? (Job opportunities, better roads, more attention to infrastructure)

H20. If so, what are some of the changes you have noticed?

H21. Did the number of schools, hospitals and internet/telephone facilities increase after electrification? If so by how many?

Comments on overall questionnaire survey	
Respondent's comments	
Fieldworker's comments	
Fieldworker's signature	

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.

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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