Power and Energy (PE)

SECTOR STRATEGY PAPER (SSP)



Programming Division
Bangladesh Planning Commission
Ministry of Planning
Government of the People's Republic of Bangladesh

August 2022

Based on

"8th Five Year Plan July 2020 – June 2025: Promoting Prosperity and Fostering Inclusiveness"

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Published by

Programming Division
Bangladesh Planning Commission
Government of the People's Republic of Bangladesh
Sher-e-Bangla Nagar, Dhaka-1217, Bangladesh.

A Note on this Edition:

This will be available on the Bangladesh Planning Commission Website: http://www. plancomm.gov.bd/ for general access.

Cover Picture Reference

1. Picture 01 (Left): Fenchugnj Gas Field
   Reference: Energy, and Mineral Resources Division. 2017. Annual Report: Financial Year 2020-2021. Energy, and Mineral Resources Division. Page-60. Retrieved on July 3, 2022. (http://www.emrd.gov.bd/sites/default/files/files/emrd.portal.gov.bd/annual_reports/7a6e0a00_8576_4c89_81ee_81c5a9e72c68/Annual%20Report%202020-21-compressed_compressed_11zon.pdf)
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   Reference: Bangladesh Atomic Energy Commission. 2017. English Brochure: A Dream Come True – Rooppur Nuclear Power Plant. Bangladesh Atomic Energy Commission. Page-31. Retrieved on July 3, 2022. (http://rooppurnpp.portal.gov.bd/sites/default/files/files/rooppurnpp.portal.gov.bd/page/323ceed5_dcaf_40b7_9518_bf407d9b928f/A%20Dream%20Comes%20True%20September%20%202017.pdf)
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M. A. Mannan MP
Minister, Ministry of Plannng
and
Vice-Chairman, Bangladesh Planning Commission
Government of the People's Republic of Bangladesh

Message

The 8th Five Year Plan (8FYP) has been developed to achieve the goals and targets envisioned in "Vision 2041". Our achievements are quite visible in most of the socio-economic indicators, including the Gross Domestic Product (GDP) growth rate. Critically, public investment in all sectors needs to be better managed to maximising value for money and provide an enabling environment for private sector investment. Therefore, the 8FYP includes a number of reforms to strengthen and make the Public Investment Management (PIM) system in Bangladesh more ef fective and efficient.

In this context, I am pleased to learn that the Programming Division of the Bangladesh Planning Commission is advocating a set of PIM tools that will improve the current PIM system in Bangladesh. I expect that the proper usage of these tools will strengthen strategic linkages among national plans, public investment, and budgeting, thereby achieving the national goals and targets in a more efficient, effective, and timely manner. Furthermore, I am glad to know that these PIM tools have been thoroughly tested and validated in two pilot sectors: (i) Power & Energy, and (ii) Local Government & Rural Development. In due course, these will be rolled out to other Sectors and Ministries, Divisions, and Agencies (MDAs).

I would like to take this opportunity to congratulate the team of Government officials and experts on the "Strengthening Public Investment Management System (SPIMS)" project, supported by the Japan International Cooperation Agency (JICA), who have successfully developed and tested these PIM tools as part of PIM reforms. Finally, I would like to express my heartfelt appreciation to the Government of Japan in their financial and technical support as well as the friendship extended towards Bangladesh since our independence.

(M. A. Mannan MP)

Dr. Shamsul Alam
Minister of State, Ministry of Planning
Government of the People's Republic of Bangladesh

Message

It is my pleasure to put forward a set of Public Investment Management (PIM) tools to my colleagues at the Planning Commission, Ministry of Planning, Ministry of Finance, and the Ministries, Divisions, and Agencies (MDAs) under the Power and Energy Sector.

The PIM tools comprise the (i) Ministry Assessment Format (MAF), (ii) Sector Appraisal Format (SAF), (iii) Sector Strategy Paper (SSP), and (iii) Multi-Year Public Investment Programme (MYPIP). I congratulate all public officials and experts who contributed to developing these tools through close collaboration and hard work under the "Strengthening Public Investment Management System (SPIMS)" Project. My special thanks go to the Programming Division of the Planning Commission for their excellent leadership and the initiative to engage a broad range of stakeholders in the process of developing these tools.

As State Minister in charge of the Ministry of Planning, I have a few remarks to make regarding the PIM tools.

First, the PIM tools will contribute significantly to the implementation of two major governance reform initiatives – the Public Financial Management (PFM) Reform Strategy led by the Ministry of Finance, and the PIM Reforms led by Planning Commission, Ministry of Planning. Both reforms will require close collaboration between the two central Ministries that are tasked to manage the national budget of the Government. I am very pleased that the PIM tools have been developed through close collaboration between them.

Second, I am also delighted that the MDAs in the two pilot sectors have played, and continue to play, an instrumental role throughout the Project. I would like to thank all the officers who participated in various seminars, workshops and consultation meetings and provided extremely useful feedback and comments to make the PIM tools relevant and effective in their day-to-day work at their respective assignments. I also hope that this Sector Strategy Paper on Power and Energy sector will help to achieve the targets of the 8th Five Year Plan for this sector.

Last, but not least, I would like to thank the Japan International Cooperation Agency (JICA) for their technical and financial support for the project, and the Government of Japan for continued partnership and friendship with the Government of Bangladesh and Bangladeshi people. I believe that our partnership will make even stronger progress for many more years to come.

(Dr. Shamsul Alam)

Md. Mamun-Al-Rashid
Member, Programming Division
and
Secretary, Planning Division
Ministry of Planning
Government of the People's Republic of Bangladesh

Foreword

The "Strengthening Public Investment Management System (SPIMS)" project is seeking to improve Public Investment Management (PIM) capacity with strengthened linkages between public investment projects, national development policies, and fiscal frameworks. The Project is co-financed by the Japan International Cooperation Agency (JICA), The Project has been implemented by the Programming Division of the Planning Commission. Crucially, four key PIM tools have been developed under this project, namely the (i) MInistry Assessment Format (MAF), (ii) Sector Appraisal Format (SAF), (iii) Sector Strategy Paper (SSP), and (iv) Multi-Year Public Investment Programme (MYPIP).

The SSP tool will provide a comprehensive outlook of sectoral goals, performance, opportunities, and challenges, and above all, identify policies and strategies that support the 14 sectors of the Five-Year Plan (FYP). The SSP is a planning tool intended to support the translation of Sustainable Development Goals (SDGs), national goals, and priorities outlined in the 8FYP into sector objectives and strategies. Crucially, SSPs are a strategic link between the national level planning (FYP) and budgeting (MTBF) at the level of Ministries/Divisions/Agencies (MDAs), supporting the 'funnelling' of development objectives from national to sectoral and subsequently to MDA levels. SSPs will provide greater detail and structure to sector-level objectives and strategies, thus aiding project design, appraisal, and approval. The SSP will be complemented by the MYPIP which provides an estimate for the upcoming budget year and a two-year projection of the development budget.

As such, the Programming Division has taken the lead to prepare SSPs and MYPIPs for the two pilot sectors under the SPIMS Project.

For achieving the desired benefits of the PIM tools, it is necessary to continue embedding them in the two pilot sectors. It is also hoped that other sectors will take the lead on preparing their own SSPs and MYPIPs.

I strongly believe that the use of the SSPs will facilitate and improve the existing process of project selection in line with the strategic directions of the 8FYP. This will bring about a qualitative change in the whole process of project preparation, appraisal, approval, and implementation and, in turn, contribute to the achievements of the goasl of 8FYP

(Md. Mamun-Al-Rashid)

Khandker Ahsan Hossain
Chief, Programming Division
Ministry of Planning
Government of the People's Republic of Bangladesh

Acknowledgments

The Public Investment Management (PIM) tool titled the 'Sector Strategy Paper (SSP)' has been developed by the "Strengthening Public Investment Management System (SPIMS)" Project of the Programming Division, Planning Commission. SPIMS project is implemented by the Programming Division of the Planning Commission and the Japan International Cooperation Agency (JICA) Expert Team (JET) provided technical support. The purpose of the SPIMS project is to deliver structural improvements in PIM capacity, with strengthened linkages between public investment projects, national development policies, and fiscal frameworks.

The Programming Division gratefully recognizes the financial support of the Government of Japan and the technical assistance of JICA in the implementation of the SPIMS project. The concerned officials of the JICA Bangladesh Office were actively involved in the implementation of the project activities for which they deserve special appreciation and thanks.

The members of the Sector Working Groups (SWGs) validation meeting in the two pilot sectors of (i) Power and Energy and (ii) Local Government and Rural Development provided very useful contributions, guidance, and inputs in the process of developing the PIM tools. We recognize their contributions with thanks and gratitude. We would also like to thank all the officials of the piloting Ministries/Divisions, Sector Division, and GED of Planning Commission, IMED, ERD, and Finance Division as well as those of the relevant agencies who cooperated with the SPIMS team in meeting and helping them with information and data.

The Member, Programming Division, and Secretary, Planning Division lent invaluable support through his vast experience and able guidance as the Chair of the Project Steering Committee (PSC) in carrying forward the project activities. His unequivocal support was the greatest source of our inspiration. We are grateful to him.

The Hon'ble State Minister for the Ministry of Planning deserves thanks for his advice and guidance in the implementation of the SPIMS project.

We are also indebted to the hon'ble minister for Planning for approving the PIM tools with the valuable instruction for utilising/practicing these tools by the Pilot Ministries, Divisions, and Agencies (MDAs), and related Sector Division of the Planning Commission.

Finally, we owe our thanks to all the members of the PIM Wing, the JICA Expert team, and the local consultants for their dedication and hard work on the project. Without their unswerving endeavours and knowledge of the best practice of PIM in other countries, it would not have been possible to develop the new PIM tools.

The Programming Division looks forward to the cooperation of all concerned and their similar involvement in the next steps for using the PIM tools as well as rollout of these tools to other sectors, MDAS, towards achieving the ultimate purpose and goal of PIM reforms in Bangladesh.

akhossain

(Khandker Ahsan Hossain)

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ABBREVIATIONS AND ACRONYMS

7FYP	The 7th Five Year Plan
8FYP	The 8th Five Year Plan
ADB	Asian Development Bank
ADP	Annual Development Programmes
AFC	Automatic Frequency Control
AMS	ADP/RADP Management System
APSC	Ashungonj Power Station Company
BAERA	Bangladesh Atomic Energy Regulatory Authority
BAPEX	Bangladesh Petroleum Exploration and Production Company Limited
BAU	Business As Usual
BCF	Billon Cubic Feet
BCMCL	Barapukuria Coal Mining Company Limited
BERC	Bangladesh Energy Regulatory Commission
BGDCL	Bakhrabad Gas Distribution Company Limited
BGFCL	Bangladesh Gas Field Company Limited
BMRD	Bureau of Mineral Resources Development
BPC	Bangladesh Petroleum Corporation
BPDB	Bangladesh Power Development Board
BPI	Bangladesh Petroleum Institute
BREB	Bangladesh Rural Electrification Board
BRP	B-R Powergen
BRTA	Bangladesh Road Transport Authority
CBA	Cost-Benefit Analysis
CFL	Compact Fluorescent Lamps
CNG	Compressed Natural Gas
CPGCB	Coal Power Generation Company Bangladesh
CSO	Civil Society Organisation
DESCO	Dhaka Electricity Supply Company Ltd.
DP	Development Partner
DPDC	Dhaka Power Distribution Company Ltd
DPP	Development Project Proposal
DRF	Development Results Framework
DSM	Demand Side Management

EDCF	Economic Development Cooperation Fund of South Korea
EEC	Energy Efficiency and Conservation
EEC-MP	Energy Efficiency Improvement and Conservation Master Plan
EGCB	Electric Generation Company of Bangladesh
ELB	Eastern Lubricants Blenders
EMRD	Energy and Mineral Resources Division
ERD	Economic Relations Division
ERL	Eastern Refinery Limited
FY	Fiscal Year
GDP	Gross Domestic Product
GED	General Economics Division
GIIP	Total Gas Initially in Place
GSB	Geological Survey of Bangladesh
GSMP	Gas Sector Master Plan
HCU	Hydro Carbon Unit
HFO	Heavy Fuel Oil
IAEA	International Atomic Energy Agency
ICS	Improved Cooking Stoves
IEPSMP	Integrated Energy and Power Sector Master Plan
IO	Intermediate Outcome
IOCs	International Oil Companies
IPP	Independent Power Producer
JGTDSL	Jalalabad Gas Transmission and Distribution System Limited
JICA	Japan International Co-operation Agency
JOCL	Jamuna Oil Company Limited
KfW	Kreditanstalt für Wiederaufbau ("Credit Institute for Reconstruction")
KGDCL	Karnaphuli Gas Distribution Company Limited
Km	Kilometre
KPI	Key Performance Indicators
ktoe	Kilo Tonne of Oil Equivalent
kWh	Kilowatt Hour
LFC	Load Frequency Control
LNG	Liquefied Natural Gas
LPGL	Liquefied Petroleum Gas Limited

MDA	Ministry, Division, and Agency
MGMCL	Maddharapa Granite Mining Company Limited
MMCFD	Million Cubic Feet Per Day
MMCF	Million Cubic Feet
MoFA	Ministry of Foreign Affairs
MoPEMR	Ministry of Power, Energy, and Mineral Resources
MoST	Ministry of Science and Technology
MPL	Meghna Petroleum Limited
MTBF	Medium Term Budgetary Framework
MTSBP	Medium Term Strategy and Business Plan
MW	Megawatt
MYPIP	Multi-Year Public Investment Programme
NESCO	Northern Electricity Supply Company Ltd
NGO	Non-Governmental Organisation
NLDC	National Load Dispatch Centre
NPO	Non-Political Organisation
NPP	Nuclear Power Plant
NWPGC	North-West Power Generation Company
O&M	Operation and Maintenance
PE	Power and Energy
PFM	Public Financial Management
PGCB	Power Grid Company of Bangladesh
PGCL	Pashchimanchal Gas Company Limited
POCL	Padma Oil Company Limited
PP	Power Plant
PPP	Public Private Partnership
PSCs	Production Sharing Contracts
PSMP	Power System Master Plan
PV	Photo Voltaic
R&D	Research and Development
RADP	Revised Annual Development Programme
RPCL	Rural Power Company Limited
SAOCL	Standard Asiatic Oil Company Limited
SCADA	Supervisory Control and Data Acquisition

SDGs	Sustainable Development Goals
SGCL	Sundarban Gas Company Limited
SGFL	Sylhet Gas Fields Limited
SHS	Solar Home System
SIPP	Small Independent Power Producer
SO	Sector Outcome
SPIMS	Strengthening Public Investment Management System (JICA Project)
SPM	Single Point Mooring
SREDA	Sustainable and Renewable Energy Development Authority
SRF	Sector Results Framework
SRM	Sector Results Matrix
SRMM	Sector Results Monitoring Matrix
SSP	Sector Strategy Paper
SWG	Sector Working Group
T&D	Transmission and Distribution
TAPP	Technical Assistance Project Proposals
TCF	Trillion Cubic Feet
TEPCO	Tokyo Electric Power Company
TGTDCL	Titas Gas Transmission and Distribution Company Limited
Tk.	Taka
TPES	Total Primary Energy Supply
UN	United Nations
WB	World Bank
WHO	World Health Organization
WZPDCL	West Zone Power Distribution Company Ltd

EXECUTIVE SUMMARY

Sector Definition

This SSP adopts an institutional definition of the power and energy (PE) sector, namely, the sector encompassing all the areas covered by the Ministry of Power, Energy, and Mineral Resources (MoPEMR) consisting of two main Divisions – Power Division and the Energy and Mineral Resources Division (EMRD).

This PE SSP recognises the critical role of the private sector in power and energy development to achieve better value for money, time delivery, performance assurance and access to financing, including through Public Private Partnerships (PPPs). International experience has demonstrated that Government policies have a significant impact on attracting private sector participation in the PE sector, and Bangladesh is no different in this regard. The Government has a crucial role to play in creating a climate which makes investment in energy and power infrastructure development attractive, thus supporting the strategic goal of "affordable, reliable, sustainable and modern energy for all" in Bangladesh through the development of conventional and non-conventional energy infrastructure, with both public and private sector participation.

Sector Situation

The PE sector in Bangladesh has made impressive progress in the 7FYP period from FY2016 to FY2020. The first key performance indicator (KPI) of this sector - per capita generation of electricity – missed the target by only 0.4% in FY2020, and the second KPI of this sector - access to electricity as percentage of population – surpassed the target by 1% in FY2020.

The Government, however, recognises that there remain challenges arising from the implementation of the 7FYP as outlined in the 8FYP. It also recognises the need to meet Sustainable Development Goal (SDG) targets and seize potential opportunities emerging from new trends.

Energy sub-sector

For the Energy sub-sector the following main challenges remain:

- Formulating a long-term strategy about how the growing needs of primary fuel will be met in the next 20 years as well as and achieving Vision 2041.
- Exploring domestic gas resources, both onshore and offshore, to address the growing shortage of natural gas.
- Diversifying energy supply through (i) energy imports, both Liquefied Natural Gas (LNG) and coal and supporting infrastructure, (ii) energy conservation measures and Demand Side Management (DSM), and (iii) renewable energy sources, biogas, and improved Cooking Stoves (ICS).

Power sub-sector

For the Power sub-sector the following main challenges remain:

- Curbing an increasing electricity cost and improving financial viability of the power sector, through fuel diversification, economic dispatch and improving energy efficiency.
- Enhancing reliability and network quality of power supply to meet rapidly increasing power demand and higher quality of power supply.
- Increasing capacity for power transmission and distribution to keep pace with the increase in generation capacity.
- Improving power sector efficiency by (i) reducing technical and non-technical losses, and (ii) improved operation and maintenance (O&M) of power plants.

Cross-cutting issues

And the following cross-cutting challenges remain:

- Improving energy (gas) and power tariff setting mechanism to cover the 'true' cost of energy and power supply and reduce the burden of subsidies on national budget.
- Pursuing DSM in both energy and power sub-sectors through regulatory reforms.

Sector Theory of Change

Building on the achievements, the 8FYP sets forth the sector Goal (outcome statement) for the PE sector:

> **Ensure sustainability in production, consumption and use of power, energy and mineral resources.**

The 8FYP identifies the KPIs and their targets over FY2021-FY2025 presented in the following Table. This is also aligned with the SDGs.

Key Performance Indicator (KPI)	Baseline (FY 2020)	Target (FY 2021)	Target (FY 2022)	Target (FY 2023)	Target (FY 2024)	Target (FY 2025)
Electricity generation installed capacity (MW)	23,548	24,000	26,000	28,000	29,000	30,000
Access to electricity (% of households)	97%	100%	100%	100%	100%	100%
Per capita generation of electricity (kwh)	512	552	592	632	674	720
Share of renewable energy to the total electricity generation (%, including hydro)	3.05	4.50	5.75	7.00	8.50	10.00
Proportion of population with primary reliance on clean fuels and technology	26.3% (FY2019)	21%	23%	25%	27%	30%

Source: 8FYP

The Government will achieve the sector Goal through the Theory of Change in the PE sector. Achieving three sector Outcomes below will collectively attain the sector Goal.

- ***Sector Outcome 1***: Reliable, affordable, and efficient energy supply achieved and sustained.
- ***Sector Outcome 2***: Reliable, affordable, efficient, and quality power supply achieved and sustained.
- ***Sector Outcome 3***: Well-articulated Demand Side Management (DSM) policy adopted and implemented.

All interventions in the PE sector will contribute to the realisation of one or more sector Intermediate Outcomes in the sector Theory of Change. The achievement of those sector Intermediate Outcomes will help deliver one of the three Sector Outcomes, thereby achieving the overall sector Goal.

To this end, concerned MDAs in the PE sector will identify and formulate investment projects and technical assistance projects to achieve one or more sector Intermediate Outcomes, whereas the Planning Commission will appraise relevance of project proposals against the sector Intermediate Outcomes.

Implementation Strategy

The Government will implement legal, regulatory, and institutional reforms in the 8FYP period that are required to achieve the sector objectives outlined in the sector Theory of Change.

Legal and regulatory issues

The following legal and regulatory reforms have been identified as part of the implementation strategy:

- Develop regulations on safety and security standards for nuclear power plants which ratify and align with international standards and International Atomic Energy Agency (IAEA) recommendations.
- Develop laws and regulations for the improvement of power quality, for example implementing the Electricity Distribution Code.
- Develop regulations on periodical maintenance of power plants.
- Develop rules and systems for DSM such as amending the New Building Code, Energy Management/Audit Programme, and Energy Efficiency Labelling Programme.

Institutional issues

The following institutional reforms have been identified as part of the implementation strategy:

- Adopt a comprehensive National Energy Policy, addressing energy security, improving energy production, and limiting import dependency.
- Amend the Renewable Energy Policy 2008.
- Adopt Integrated Energy and Power Sector Master Plan (IEPSMP) 2021, taking into account lessons learned during 7FYP implementation.
- Develop institutional capacity and legal framework of National Load Dispatch Centre (NLDC).
- Strengthen Bangladesh Energy Regulatory Commission (BERC).
- Strengthen Sustainable and Renewable Energy Development Authority (SREDA).

Financing. Financing of the PE sector is a major challenge to achieve the sector Goal. The 8FYP projection estimates a funding shortfall in this sector over most of the 8FYP period. According to the estimation of 'fiscal space' (*i.e.,* the sector budget ceiling minus forward baseline estimates) using the Multi-Year Public Investment Programme (MYPIP), the fiscal space of the PE sector is negative in FY2022-23 and FY2023-24, and only becomes positive in FY2024-25.

This points to the need of the Government to expand fiscal space by exploring other sources of financing. Other potential sources of financing may include: (i) increasing self-finance by autonomous bodies under the MoPEMR; (ii) increasing PPP arrangements; (iii) adjusting electricity tariff policies; (iv) enhancing efficiency of the PE sector; and (v) sector-specific foreign assistance. The adoption of new projects in this sector will require a careful fiscal space analysis to ensure that the budgetary implications of new projects for current and future years is accurately estimated and a set of remedial measures to expand fiscal space are well developed.

Sector coordination. The MoPEMR has the lead role in the coordination of the PE sector. Other key institutions include the Industry and Energy Division, General Economics Division (GED) and Programming Division of the Planning Commission as well as Implementation Monitoring and Evaluation Division (IMED), Finance Division, Economic Relations Division (ERD), Ministry of Science and Technology (MoST), Ministry of Foreign Affairs (MoFA), Ministry of Road Transport and Bridges, and Ministry of Industries. The Energy Sector Working Group under the Local Consultative Group mechanism will be a venue for dialogue and coordination between the Government and Development Partners (DPs).

Sector Monitoring and Evaluation

The Government will conduct monitoring and evaluation (M&E) using the Sector Results Framework (SRF) presented in Chapter 5. The SRF, which consists of a Sector Results Matrix (SRM) and a Sector Results Monitoring Matrix (SRMM), will allow the Government to conduct sector-level M&E at three levels – Sector Goal, Sector Outcomes, and Sector Intermediate Outcomes. This will complement the higher-level M&E through the Development Results Framework (DRF) in the 8FYP. The SRF in Chapter 5 covers the 8FYP period from July 2020 to June 2025, and the format of SRMM in Annex III could be used for M&E by relevant authorities in the PE sector.

1 INTRODUCTION

1.1 Background

This Background section presents the methodology by which the Power and Energy Sector Strategy Paper (SSP) has been produced, and an overview of the SSP as a key planning tool. This PE SSP tool has been introduced through a collaborative exercise jointly led by the Programming Division and the Industry and Energy Division of the Planning Commission, in close collaboration with Power Division, Energy and Mineral Resources Division and other key stakeholders, notably GED of the Planning Commission, IMED and ERD.

The PE SSP based on 7FYP first approved by the Government in 2018. This updated version of the SSP is aligned fully with the 8FYP and the new ADP sector classification adopted by the Government in 2021 and conducted to complement, and be consistent with the 8FYP, SDG, and other strategic and policy documents. When comparing the key elements of PE sector strategy goals of 7FYP with the 8FYP (see table below), one can observe that the sector strategies have remained almost the same. The 8FYP, however, puts more emphasis on increasing renewable energy generation while maintaining highly efficient "least polluting" coal power plants.

Table 1-1. Comparison of Strategies under 7FYP and 8FYP

7FYP	8FYP
A rapid growth in electricity generation.	A rapid growth in electricity generation.
Development of transmission and distribution system in line with generation.	Development of transmission and distribution system in line with generation.
Mobilizing private and joint venture investment in power sector.	Mobilizing private and joint-venture investment in power sector.
Diversification of primary fuel for electricity generation.	Diversification of primary fuel for electricity generation, with special emphasis on increasing renewable energy generation.
Use coal as main source of energy for power generation.	As part of its pursuit of the strategy of least cost power generation, continue to have some highly efficient least polluting coal plants.
Improving power sector efficiency and reducing transmission and distribution losses.	Improving power sector efficiency and reducing transmission and distribution losses.
Use of alternative sources of energy.	Use of alternative sources of energy.
Use of nuclear energy for power generation.	Use of nuclear energy for power generation.
Exploring electricity-trading options with neighbouring countries (India, Nepal, Bhutan, and Myanmar)	Exploring electricity-trading options with neighbouring countries (India, Nepal, Bhutan, and Myanmar).
Use of alternative sources of financing (Export Credit Agency, etc.)	Use of alternative sources of financing (Export Credit Agency, etc.)

Sources: 7FYP and 8FYP

The SSP is a planning tool intended to help translate national goals and priorities outlined in the 8FYP into sector strategies and objectives. The 8FYP sets out national goals across 14 thematic sectors and has a higher-level Development Results Framework (DRF). The SSP complements this by providing greater detail and structure to sector-level objectives and a basis on which these can be monitored and evaluated.

The SSP is designed to complement and be consistent with the 8FYP and other strategic and policy documents. Their value-added lies in the way in which they focus on existing priorities in a concise, accessible, and logical manner.

1.2 Purpose

This PE SSP is designed to offer benefits in the following six main areas.

- **Project identification**: Provide clear guidance MDAs and Statutory Bodies[1] engaged in the identification of projects to ensure that projects are aligned with sector goals and outcomes from the earliest stage.
- **Project formulation:** Provide clear guidance to MDAs and Statutory Bodies engaged in the formulation of projects to ensure that projects deliver Sector Goals and Outcomes required to achieve 8FYP objectives.
- **Project appraisal:** Provide a means through which Ministries, Divisions, Statutory Bodies, and Sector Divisions of the Planning Commission can assess and appraise project proposals against their relevance to the 8FYP.
- **FYP monitoring:** Provide GED with more detailed information on sector-level performance through SRF to complement the higher-level DRF.
- **FYP financing:** Provide Finance Division, GED, and Programming Division with the information on sector-level resource needs, including the cost of the current and planned investment projects and programmes over multi-years.
- **Aid co-ordination:** Provide a clear overview of current priorities in the PE sector from which DPs – under the tutelage of the ERD – can identify prospective projects and programmes for funding.

It will also have broader relevance as a concise source of information on the PE sector for stakeholders both within and outside the Government, *e.g.*, the private sector, think-tanks, and research institutes.

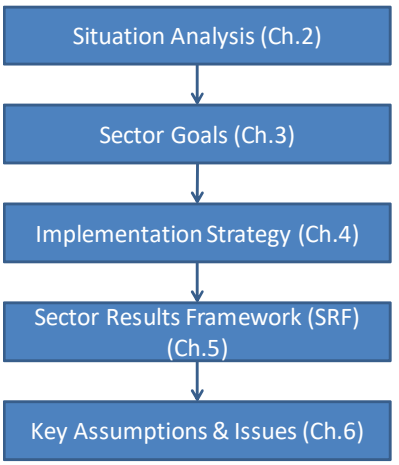
The PE SSP should also be seen in the context of the other Government-led reform initiatives, notably efforts to strengthen the results-orientation of the 8FYP, including mapping the SDGs onto key 8FYP actions led by GED; efforts to improve the quality of project design and appraisal and to adopt a MYPIP both led by the Programming Division; and ongoing public financial management (PFM) reforms led by the Finance Division.

[1] Statutory Bodies such as the Anti-Corruption Commission, Election Commission, and Public Service Commission do not fall under the category of 'Ministries, Divisions, and Agencies' (MDA) and should be considered separately.

1.3 Structure

The SSP is designed to be a concise, synthetic document and is therefore structured as in Figure 1-1.

Figure 1-1 Structure of SSP



Chapter 2 provides a synthesis of situation analyses of sector performance. This chapter highlights the progress made to date, outlines the SDGs toward which Bangladesh has been working, and identifies the main challenges and opportunities facing the sector. It also looks at the sector from long-term perspectives until 2041.

Chapter 3 elaborates the sector objectives for the 8FYP period. It begins by focusing on the PE sector Goal contained in the DRF of the 8FYP, then elaborates how this sector Goal will be achieved through the sector Theory of Change that outlines the key sector Outcomes and Intermediate Outcomes through which the overarching sector Goal will be achieved.

Chapter 4 highlights the key implementation strategies required to achieve the sector Outcomes and Intermediate Outcomes. This covers the main areas of reform which need to be undertaken in the 8FYP period, including: i) legal and regulatory; ii) institutional (including sector coordination mechanisms); and iii) financing, including expanding potential financing options for the sector.

Chapter 5 presents a PE Sector Results Framework (SRF) for the 8FYP period. The SRM includes the indicators for each element of the sector Theory of Change and their targets to be achieved over five years in the 8FYP period. It also specifies the lead institutions responsible for collecting data for each respective indicator.

Chapter 6 elaborates key assumptions and risks, as well as key risk mitigation strategies where possible.

Chapter 7 presents the Annexes. Annex I contain a Bibliography of all documents consulted. Annex II presents a format of Sector Results Monitoring Matrix (SRMM) for the monitoring and evaluation of PE SSP in the 8FYP period.

2 SITUATION ANALYSIS

2.1 Progress under the 7FYP

This section provides a situation analysis of the PE sector focussing on the sector performance during the 7FYP period (FY2016-FY2020). It covers the specific areas of energy supply, power generation, transmission and distribution, institutional issues and fiscal performance.

Energy Sub-Sector

The energy sub-sector consists of gas, coal, oil, and renewable energy sources (e.g., solar, wind, biogas). The focus of sub-sector performance during the 7FYP period is primarily on the two primary fuels that Bangladesh possesses, *i.e.*, natural gas and coal.

Gas Exploration, Development and Fuel Diversification

In relation to natural gas, considerable progress was made during the 7FYP, in which average gas production (including LNG import) was 2,966 million cubic feet per day (mmcfd) in FY2020, a significant increase from 2,444 mmcfd in FY2015. By contrast, less progress was made in coal. Only one (Barapukuria) of five identified coal fields produced coal during the 7FYP period. The domestic gas production is divided between public (Petrobangla) and private producers (international oil companies). According to the latest estimation of Petrobangla, total gas initially in place (GIIP) is 39.80 trillion cubic feet (TCF), of which 28.23 TCF is recoverable in proven and probable categories.

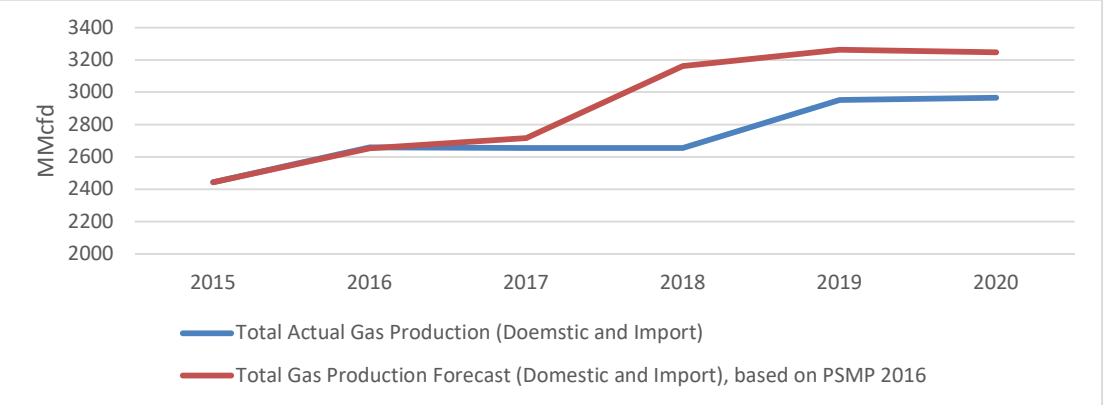
Domestic gas production has stagnated due to depleting gas reserves during the 7FYP period. To meet increasing gas demand, LNG import was planned in FY2018, and started its supply to the national gas grid in FY2019. Table 2-1 and Figure 2-1 show the gap between the planned and actual natural gas production (including LNG import) during the 7FYP period. It reveals that actual gas supply in FY2016 and FY2017 nearly reached the target levels in the Power System Master Plan (PSMP) 2016, but underperformed from FY2018 to FY2020 because of delayed LNG import.

Table 2-1 Gap between Planned and Actual Gas Production (including LNG) between 2016 to 2020

Actual Gas Production	2015	2016	2017	2018	2019	2020
MMCM	25,263	27,559	27,445	27,430	27,233	24,993
MMCF	892,154	973,237	969,211	968,681	961,724	882,619
MMCFD	2444	2659	2655	2654	2635	2412
Actual LNG Import					317	554
Total Actual (Gas Production and LNG Import):	**2,444**	**2,659**	**2,655**	**2,654**	**2,952**	**2,966**
PSMP 2016 Forecast: Domestic and Import:	**2,444**	**2,653**	**2,716**	**3,162**	**3,263**	**3,247**
Domestic		2,653	2,716	2,662	2,563	2,547
LNG Import				500	700	700

Source: Petrobangla MIS, June 2020; RPGCL Annual Report 2020; PSMP 2016 P 7-16

Figure 2-1 Gap between Planned and Actual Gas Production (including LNG) between 2016 to 2020



A critical issue to be addressed is the depletion of gas reserves in Bangladesh. The 8FYP notes that "It is evident that gas reserves are depleting and will be requiring enhanced exploration in future." Total 17.79 trillion cubic feet (TCF) gas has been produced cumulatively from 1960 to June 2020, and only 10.43 TCF was left recoverable in 2020 (see Table 2-2). Consequently, the reserves to production ratio (R/P ratio) in 2020 is only 10 years, one of the lowest ratios in the world.

Table 2-2 Gas Initially in Place (GIIP) and Gas Reserve as of 2020

	Description	TCF
1	GIIP as of June 2020	**39.80**
2	Recoverable gas (Proven + Probable)	**28.23**
3	Cumulative production up to June 2020	**17.79**
4	Remaining gas reserve in June 2020	**10.43**
5	Reserve production ratio (R/P ratio)	**10 Years**

Source: 8FYP, Table 5-10, Page-354

This points an urgent need to address a fuel diversification challenge and restore financial sustainability of the PE sector. Besides the import of primary fuels such as coal, LNG and other petroleum products, the Government encouraged the use of renewable energy sources as well as biomass-fuelled improved cooking stoves (ICS) in the 7FYP period.

The Government also strived to accelerate the implementation of scalable power generation through renewable energy, and achieve a 7FYP target, *i.e.*, generate 10% of total generation from renewable energy sources by 2021. As of 2020, 650 MW of electricity was generated from renewable sources, 543 MW renewable projects are under construction, and another 1,416 MW renewable projects are at the planning stage. However, the 7FYP target for renewable energy was not achieved in the 7FYP period.

Gas Transmission and Distribution

Besides gas production, supporting infrastructure for gas supply was considerably improved. In 2017 the Government formulated the Gas Sector Master Plan of Bangladesh (GSMP 2017), a long-term plan up to 2041. The primary objective of the GSMP 2017 is to update the GSMP 2006 to align it with the current priorities of infrastructure development and guide long-term development of the sector.

Key Developments over the 7FYP Period:

The 7FYP plan period experienced progress in diversifying primary energy source through LNG imports. There have also been several price adjustments in all segments of the energy sector.

However, the progress in expanding and diversifying primary energy supply, renewable energy, and in improving the energy sector finances has been limited.

Power Sub-Sector

The 8FYP reflected upon sub-sector performance in the 7FYP period,

> "The Power & Energy Sector that has been at the centre of the infrastructure development vigorously pursued both during the 6th and the 7th FYP periods, have been catalytic in achieving the high growth trajectory that Bangladesh has been enjoying. In the process it has also facilitated faster growing manufacturing and export sectors growth (8FYP, page 342)."

It was also noted that the power sub-sector has been,

> "Showing tremendous progress since 2011, and at present has generation capacity well above the demand. The Government which had been implementing the power sector programmes based on the PPSMP 2010 during the 6th Five Year Plan period revised it to PSMP 2016, to help adapt to changing scenarios. This growth in generation capacity along with expansion of transmission and distribution networks have helped achieve substantial progress in both the indicators for the power sector: increasing growth of per capita generation of electricity and improving the access of the population to electricity. (8FYP, page 342)"

Table 2-3 below presents two key indicators and targets in the 7FYP Development Results Framework: (i) per capita generation of electricity; and (ii) access to electricity. Contrary to a common perception that those targets were highly ambitious, electricity generation per capita missed the target only by 0.4% in FY2015-2020, and access to electricity exceeded the target by 1%.

Table 2-3 Performance towards the 7FYP Power and Energy Sector Objectives

Indicator	Baseline (FY 2015)	Target (FY 2020)	Actual (FY 2020)	Difference (Actual vs. Target, %)
Per capita generation of electricity	371 KWh	514 KWh	512 KWh	-0.4%
Access to electricity (% of population)	72%	96%	97%	+1%

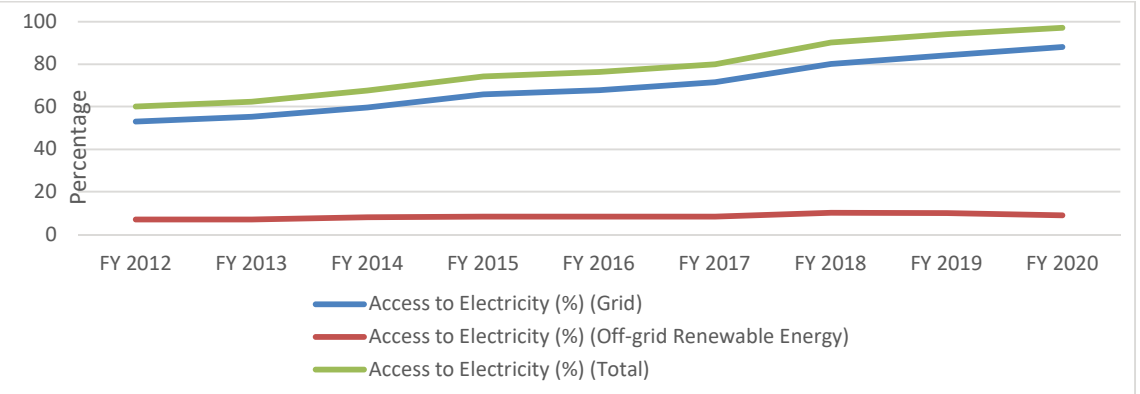
Source: 8FYP.

Generation

The 7FYP had a target of total installed generation capacity of 23,000 MW by 2020. Actual performance comfortably exceeded this target: installed power generation capacity expanded to 23,548 MW (including captive power and renewable energy) by FY2020. On a per capita basis, electricity generation rose from 371 kWh per capita in 2015 to 512 kWh per capita in 2020. Progress was also made in engaging with energy trade. In line with the 7FYP target, some 660MW of power was added to the national grid based on purchases from India.

Significant progress continues to be made in expanding off-grid generation, contributing to the impressive growth in access to electricity nearly 97% as of 2020 (Figure 2-2).

Figure 2-2 Progress of Electrification Rate (Actual) as of 2020



Source: System Planning, BPDB

The overall system loss of electricity decreased substantially to 11.2% in FY2019-20 from 15.7% in FY2009-10. However, the share of renewable energy (including hydro) to total electricity generation capacity declined from 3.6% in FY2015 to 3.05% in FY2020.

Transmission and Distribution

The Government's vision to provide electricity to all has been achieved by the expansion of generation capacity along with the expansion of transmission and distribution network and speedy new consumer connections (mostly rural residential) over the period 2015-2020. As of 2020, almost 97% of the population was provided electricity connections (direct grid electricity and off-grid renewables).

The reduction of system loss is a success story in Bangladesh. Losses in electricity transmission and distribution (T&D) network (including theft/pilferage in distribution) was more than 28% in 2000. The T&D loss was reduced to 13.6% in 2015, and further down to 11.2% in 2020.

Key Developments over the 7FYP Period:

There was considerable private investment in the power sector during the 7FYP. Power generation has increasingly moved to the private sector, which is helping reduced use of public investment funds. The share of private power sector power generation, including Joint Venture PPP and power imports, increased to 53% in FY2020 in terms of installed capacity from 50% in FY2015.

Bangladesh has been increasing participation in regional power trade successfully and has been increasing electricity import from India. Bangladesh started to import 500 MW of power from India through Baharampur (West Bengal, India) – Bheramara (Kushtia, Bangladesh) 400 kV transmission line from 2013, and has now enhanced the import 1,000 MW from Baharampur after enhancement of the same Bheramara HVDC (Back-to-Back) substation capacity in June 2018. Bangladesh also started importing 160 MW of power through 2nd regional inter-connection (Agartala, India to Cumilla, Bangladesh) in the eastern part of Bangladesh from March 2016. At present, Bangladesh is importing a total of 1160 MW power from India. Bangladesh has also been taking concrete initiatives to help open up new avenues for cross border electricity trade with other neighbouring countries - Nepal, Bhutan and Myanmar - through bilateral cooperation.

There has been a visible improvement in power sector reliability, which has also resulted in reduction in the incidence of power outages.

Fiscal Performance

Table 2-4 below presents fiscal performance of the PE sector over the 7FYP period. Two key observations can be made. Firstly, there was significant growth in both allocations and actual expenditure over the five-year period. The ADP allocation rose by 65% from FY2016 to FY2020 and ADP expenditure rose by 66%. Secondly, the growth in ADP allocations and actual expenditures was almost identical (65% vs. 66%).

Table 2-4 Fiscal Performance of the Power and Energy Sector (FY2016-FY2020; Billion Taka)

	FY2016			FY2017			FY2018		
	Allocation		ADP Expenditure	Allocation		ADP Expenditure	Allocation		ADP Expenditure
	ADP	7FYP		ADP	7FYP		ADP	7FYP	
Power Division	158.64	164.9	155.58	134.47	168.5	181.36	265.52	171.5	258.1
Energy and Mineral Resources Division	10.56	19.9	20.08	10.99	34.5	24.35	8.62	41.1	57.37
Total	169.2	184.8	175.66	145.46	203	205.71	274.14	212.6	315.47

	FY2019			FY2020		
	Allocation		ADP Expenditure	Allocation		ADP Expenditure
	ADP	7FYP		ADP	7FYP	
Power Division	241.76	201	231.45	260.14	235.9	219.35
Energy and Mineral Resources Division	22.09	48.2	n/a	19.16	56.6	17.49
Total	263.85	249.2	n/a	279.3	292.5	236.84

Source: 8FYP, RADP FY2019-20 and RADP FY2020-21

2.2 Sustainable Development Goals (SDGs)

In 2015 the United Nations adopted the SDGs as a new development target to be achieved by 2030.

Out of 17 goals of SDGs, the following four goals have significant connection with the PE sector development.

Goal 7 (Affordable and clean energy): Ensure access to affordable, reliable, sustainable, and modern energy for all.

Goal 9 (Industry, innovation, infrastructure): Build resilient infrastructure, promote sustainable industrialization, and foster innovation.

Goal 12 (Responsible, Consumption and Production): Ensure sustainable consumption and production patterns

Goal 13 (Climate action): Take urgent action to combat climate change and its impacts.

2.3 8th Five Year Plan (July 2020 – June 2025) for Power and Energy Sector

8FYP Development Results Framework

The Development Results Framework (DRF) of the 8FYP sets forth the following outcome statement for the Power and Energy sector:

> ***Ensure sustainability in production, consumption and use of energy and mineral resources.***

Under this statement, the DRF also identifies five key performance indicators for the sector as summarised in Table 2-5. The indicator "Proportion of population with primary reliance on clean fuels and technology" has been added as a new indicator to the DRF.

Table 2-5 8FYP DRF Indicators for the Power and Energy Sector

Key Performance Indicator (KPI)	Data Source	Baseline (FY2020)	Target (2021)	Target (2022)	Target (2023)	Target (2024)	Target (2025)
Electricity generation installed capacity (MW)	Power Division	23,548	24,000	26,000	28,000	29,000	30,000
Access to electricity (% of households)	Power Division, BBS	97%	100%	100%	100%	100%	100%
Per capita generation of electricity (kWh)	Power Division	512	552	592	632	674	720
Share of renewable energy to the total electricity generation (%, including hydro)	Power Division	3.05	4.50	5.75	7.00	8.50	10.00
Proportion of population with primary reliance on clean fuels and technology	BBS	26.3% (FY2019)	21%	23%	25%	27%	30%

Source: 8FYP

The 8FYP further elaborates a set of priorities for the PE sector over the 2021-2025 period, which are aligned with the goal of energy security set forth in the Perspective Plan 2021 – 2041. The 8FYP states that the most important strategic issue to achieve is efficient supply of primary energy, as had been during the 7FYP. Therefore, the policy actions that were identified in the 7FYP remain as the crucial policy actions to be pursued during the 8FYP period. These policy actions are presented below:

Energy Sub-Sector

The key energy sub-sector priorities over the 8FYP period are summarised as follows:

- The development of a Gas Allocation Policy to address critical gas supply issues.
- The development of a Domestic Gas Exploration Policy (on-shore and off-shore) to exploit the potential of untapped domestic gas resources, which cost less than LNG imports.
- Improving the efficiency of domestic coal utilisation to ensure that high quality domestic coal is channelled to higher value-added processes.
- Increasing energy imports, including developing Floating Storage and Regasification Unit for immediate and land-based LNG terminal for long-term solution, as well as facilitating coal import for electricity generation.

- Encouraging DSM and energy conservation.
- Encouraging the increase of biomass-based Improved Cooking Stoves (ICS).
- Developing an appropriate energy subsidy and pricing policy for increased fiscal sustainability and the promotion of efficient energy use.

Power Sub-Sector

The 8FYP will broadly continue the strategy adopted in the 7FYP, and bridge some gaps identified to achieve the goals and strategies laid out in PSMP 2016 and the Perspective Plan 2021-2041.

The key power generation priorities over the 8FYP period are summarised as follows:

- Increasing the installed generation capacity to 30,000 MW by 2025.
- Reducing the cost of electricity generation by restricting the reliance on high-cost liquid fuel-based power plants and more attention to the gas (increased supply with LNG import) and coal-based power generation.
- Greater emphasis on O&M to maximise the power generation yield from installed capacity and ensure system reliability.
- Greater reliance on Independent Power Producers (IPPs) to meet the financing gap.
- Increasing the share of renewable power generation, particularly from solar and wind power.
- Increased use of power trade with neighbouring countries (particularly India, Nepal and Bhutan). Also, participation in Indian power trading platform (e.g., Indian Energy Exchange) for maximizing benefits of regional power market is considered a key priority.

The key power transmission and distribution priorities over the 8FYP period are as follows:

- Further reducing transmission and distribution (T&D) losses from 11.23 per cent in FY2020 to a single digit (less than 10 per cent) by FY2025.
- Construction of around 3,358 km of new transmission lines and 100,000 km of distribution lines.
- An additional 38,379 km of distribution lines and other investments by the BREB aimed at increasing the number of consumer connections by 2.14 million.

Demand Side Management

Demand Side Management (DSM) is being actively pursued by BPDB as a means for modifying energy use to maximize energy efficiency to reap maximum benefit out of existing energy generation. The BPDB has taken the following steps for DSM:

- BPDB campaigns for more use of off-peak hours through electronic and print media, as a means for shifting irrigation load from peak hour to off peak hour; and in the last few years, it has been estimated that about 500 MW irrigation load was shifted from peak hour to off peak hour.
- BPDB has taken motivational programs to enhance awareness of the consumers during peak hours.
- BPDB has taken steps to use Compact Fluorescent Lamps (CFL) in BPDB's offices and motivate consumers to use Energy efficient lamps.

- Industries operating in two shifts are being requested not to operate during peak hours.
- Holiday staggering for industries has been implemented, which contributes about 200 MW load shifting.
- The Load Management Committee has been formed in every distribution zone/circle/division to monitor the proper load distribution during irrigation.
- BPDB is monitoring shop/market closure time at 8 pm, which is estimated to have contributed about 400 MW load shifting from peak hour.

2.4 Challenges and Opportunities

This section presents a synthesis of the main challenges and opportunities in the energy and power sub-sectors. It focuses on the main challenges arising from the implementation of the 7FYP as outlined in the 8FYP, the need to meet SDG targets outlined above, and potential opportunities arising from emerging trends.

Energy Sub-Sector

Formulating a long-term strategy on energy sub-sector. A key challenge in primary energy is the absence of a long-term, strategic view about how the growing needs of primary fuel will be met in the next 10 – 20 years as seen in Table 2-6 and Figure 2-3 below. The Government needs to finalise and adopt the pending National Energy Policy and adopt the energy strategy outlined in the PSMP 2016. The PSMP 2016 outlines the following energy demand projection and supply targets by 2041 in Table 2-6 below.

Table 2-6 Long-term Targets of Energy Sub-Sector

Indicators	Baseline (2015)	Projection/Target (2041)
Total Primary Energy Demand (ktoe)	27,549	98,071
Energy Intensity (toe/million taka)	3.42	2.56
Gas		
Domestic Gas Production[2] (mmcfd)	2,500	2,000
Import LNG (mmcfd)	0	4,000
Coal		
Domestic Coal (million tons/year)	0.7	11
Import Coal (million tons/year)	0	60
Oil		
Import Oil (million tons/year)	5	30

Source: PSMP2016

Figure 2-3 shows a striking increase of energy consumption growth, and Figure 2.4 illustrates that the energy diversification needs to meet such demand growth.[3] It is projected that energy consumption in 2041 would be nearly 3 times more than that at the current level. It should be noted that such energy consumption and demand projections are based on the assumptions that (i) the energy efficiency and conservation (EEC) is holistically implemented from primary energy supply to electric

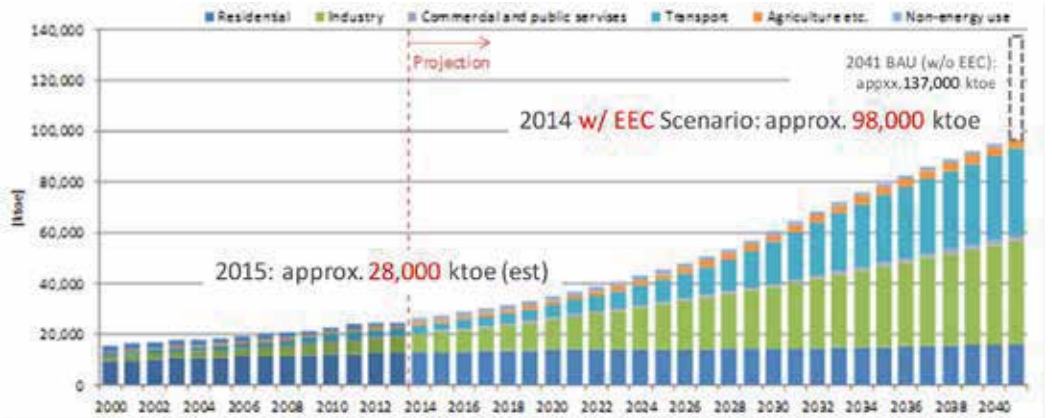
[2] Domestic gas production includes the exploration and development of yet-to-be-found resources, both on-shore and off-shore.

[3] In this document, the term "energy consumption" is distinguished from "energy demand", where the former means the energy required by various sectors including power generation, while the latter means the synonym of "energy supply" as seen in the Total Primary Energy Supply (TPES) of IEA energy balance statistics. Therefore, "energy supply (or demand)" is the sum of "energy consumption" and the total loss in the energy and power systems.

power generation and consumption, and (ii) the energy intensity is improved over the long-run.[4] If Bangladesh cannot achieve the EEC for whatever reasons, it is projected that its energy requirement would be nearly four times more than at current levels. Approaching the new era of a Bangladesh economy that would be dependent on imported fuel, more energy requirement would immediately imply the outflow of national wealth soon.

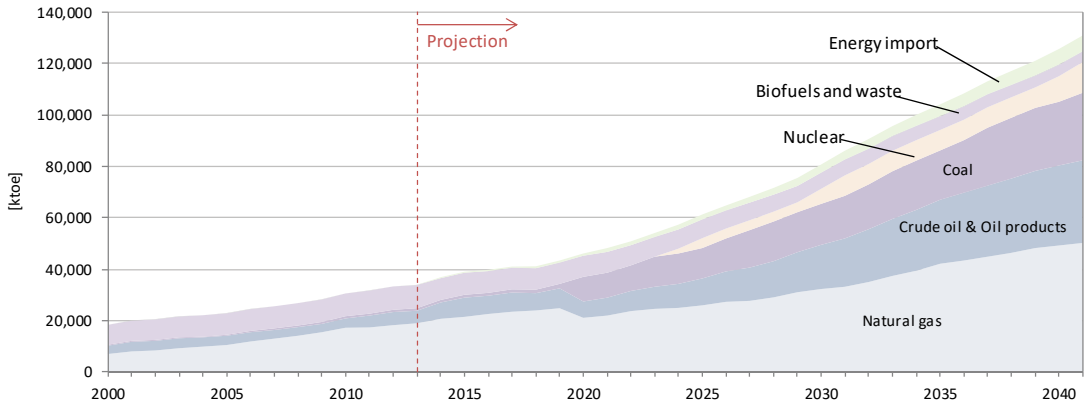
Bangladesh is therefore facing a major challenge, *i.e.*, the need to change from dependence on cheap, abundant domestic natural gas to expensive import of primary energies such as natural gas, oil, and coal in all sectors. However, this may be considered as a potentially significant opportunity to transform Bangladesh to a more energy efficient economy as well.[5]

Figure 2-3 Final Energy Consumption Projection with EEC Scenario (2015-2041)



Source: PSMP2016

Figure 2-4 Total Primary Energy Supply Projection (2015-2041)



Source: PSMP 2016

[4] Energy intensity is defined as the energy consumed per economic activity. Generally, it is defined as the amount of energy (ktoe) per GDP (or sectorial value-added). It should be noted, however, that the energy intensity is not determined by solely by the energy efficiency, but also various factors such as economic structure, industry base, affordability and accessibility to the energy.

[5] It is worthwhile to mention that the projected TPES in the 2040s, approximately 130,000 ktoe in Figure 2-4 happens to be the same level to the projected total primary energy final consumption under the "Business as Usual" (BAU) scenario (*i.e.*, without EEC programme implementation) in the same period in Figure 2-. This indicates that in Bangladesh, the energy and power supply loss incorporating the impact of the future energy intensity improvement (*e.g.*, fertilizer plants and gas-fired thermal power plants efficiency improvement, and system loss reduction in power transmission and distribution lines) would happen to be the same level of EEC saving potential.

Exploring domestic natural gas resources. Facing up to the challenge of growing shortage of natural gas, Bangladesh needs to explore potentially a considerable amount of unexplored and undiscovered gas resources, both onshore and offshore.

Petrobangla and its subsidiaries will take the lead in exploring onshore resources with the Gas Development Fund where 15% of gas tariffs are utilised for upstream exploration and development. A key opportunity for onshore and offshore exploration of undiscovered resources is Production Sharing Contracts (PSCs) with reputed International Oil Companies (IOCs). The IOCs will be selected based on a competitive-bidding process, because direct contract is not suitable for ensuring effectiveness of contract and transparency of the selection process of IOCs.

Promoting efficient use of natural gas. Another key opportunity is to use "merit-based gas allocation" with the adoption of Gas Allocation Policy, in which scarce gas resources are allocated for more energy efficient users. Adoption of this policy will save much volume of natural gas that is currently provided to inefficient state-owned, gas-fired power plants and fertilizer factories. The gas saving under this policy is estimated to amount to 92 BCF/year that could fuel 2,300 MW state-of-the-art, gas-combined-cycle power plants.

Diversifying energy supply. There is an urgent need to address energy supply diversification to restore financial sustainability of the PE sector. In 2020, a decline in international oil prices has provided a relief in energy supply. And yet, the trends of future oil prices remain uncertain. Besides increasing domestic gas, considerable emphasis will be given on at least four other energy sources: (i) energy imports, both LNG and coal, and their supporting infrastructure; (ii) energy conservation measures[6] and DSM; (iii) renewable energy sources[7], and biogas and solid biomass-based ICS; and (iv) utilization of high-quality coal from Barapukuria for higher value-added processes such as corking coal or export with the development of Domestic Coal Utilization Policy.

A major challenge in expanding energy imports is to implement large-scale public investment for port facilities and related infrastructure to import coal and LNG. Renewable energy sources are crucial first to encourage development of environmentally friendly, low-carbon energies, and second to improve energy access for rural people.

Power Sub-Sector

Despite a major progress in the 7FYP period, some key challenges remain to be addressed in the power sub-sector.

Curbing an increasing electricity cost and improving financial viability. The marginal cost of electricity increased considerably because most of the power plants added to the national grid use liquid fuel-based sources. These plants incur much higher power generation costs than other power plants using gas and coal. In addition, inefficient use of gas at some power plants calls for additional (or recoverable) generation capacity and regulatory reforms discussed earlier.

[6] In line with Bangladesh's Energy Efficiency and Conservation Master Plan up to 2030 (Power Division, MoPEMR)
[7] In line with Bangladesh's Renewable Energy Policy 2008 (Power Division, MoPEMR)

Enhancing reliability and network quality of power supply. The nationwide blackout[8] experienced in November 2014 resulted from the failure of a single high voltage transmission line connecting Bheramara, Kushtia with Baharampur, West Bengal in India. This points to the need to enhance reliability of power supply to meet rapidly increasing demand for power. Enhancing network quality is also required to maintain quality of industrial products in domestic and international markets. The network quality is also a prerequisite for safe operation of Nuclear Power Plant (NPP) since it requires highly stable network quality with the frequency within 50±0.5 Hz. The issue of network quality must be addressed through enhancing infrastructure and strengthening institutions and organisations.

Increasing capacity for power transmission and distribution. Besides increasing power generation, increasing capacity for transmission and distribution is crucial to keep pace with the increase in power generation and solve bottlenecks in the system which prevent residences and businesses from receiving electricity. Additional generation capacity will be ineffective without increased transmission and distribution capacity. An analysis suggests that many of the "rolling blackouts", which occur during summer months, may be due to transmission and distribution bottlenecks, and not necessarily due to capacity constraints of power generation.[9]

Improving power sector efficiency. Over the 7FYP period the power sector successfully achieved a substantive reduction in transmission and distribution losses. Building on the achievement, effort will be made to further improve power sector efficiency. First, there is scope for further reducing technical losses in power transmission and distribution and non-technical losses in power distribution. Second, there is large potential to improve efficiency of thermal power plants, including ensuring appropriate O&M of these power plants through appropriate regulation.

Renewable Energy. Though Bangladesh is the world's fastest growing country in terms of dissemination of small Photovoltaic (PV) systems for households, it still faces many challenges in introducing utility-scale (large scale) renewable energies. First, Bangladesh has scarce land, especially for large scale solar PV (as it has low energy density and requires large space). Second, Bangladesh's renewable energy potential has yet to be fully realised, especially in wind and biomass using municipal waste. As a result, Bangladesh's current renewable energy portfolio unevenly concentrates on small/off-grid solar PV, and projects and pipelines of other renewable energy sources are relatively small. Third, Bangladesh needs proper implementation of 'Electricity Grid Code' where technical standards and regulations are framed for grid-connected renewable generation, especially solar and wind (as their outputs are variable and can cause network disturbance). Bangladesh has commissioned several public- and private-owned, grid-connected, large-scale PV plants of total capacity 129 MW as of June 2021. In addition, several solar and wind power projects are under the construction stage. Against this backdrop, the implementation and practice of 'Grid Code' is critical for system stability.

[8] Blackout referred as a period of darkness caused by a power system failure, specifically in a wider area or even nation-wide. A specific example is the one happened in November 2014 in Bangladesh. "Rolling blackouts" means planned shutdown when demand surpasses generation.

[9] Power Division. 2015. Power Division Medium Term Strategy and Budget Plan: 2016-2020.

Power Trade. Power trade with neighbouring countries would be one of the viable solutions to address power network reliability and quality improvement, and to explore the potential of renewable energy at the same time. Indeed, additional power imports will be sought through grid lines from India (this process is underway). Potential power trading agreements will also be sought with countries such as Bhutan, Nepal and Myanmar to exploit their hydropower potential. In addition, the potential for regional cooperation in gas exploration is a further opportunity to be explored. Section 8.7 in the PSMP 2016 mentions the potential for cross-border LNG trade, specifically the development of a cross-border gas transmission pipeline from a Floating Storage and Regasification Unit in the state of West Bengal, India, to a combined cycle power plant (to-be-built) in Khulna, Bangladesh.

Cross-cutting issues

Besides the specific sub-sector challenges and opportunities identified above, there are key cross-cutting issues which apply to both sub-sectors.

Improving energy and power tariff setting mechanism. Improving the energy and power tariff setting mechanism is crucial to ensure that consumers pay the 'true' cost of energy and power supply and reduce the burden of energy and power subsidies on the national budget. Currently, the BPDB receives significant budgetary support from the Government to fill the financial gap between the generation costs, which BPDB pays to power generators, and the bulk supply tariff that BPDP charges to users. Both national gas and oil tariffs will be exposed to international market price fluctuation and exchange rate risks. Significant risks of the subsidy regime to the national officer could become reality. Adjusting tariff policy will help ensure that the rates for energy and electricity cover reasonable operating costs of energy and power utilities.

Optimising choice for power generation. While tariff setting is mainly an issue for the BERC, the choice of fuel for generation critically affects supply costs and consequently the amount of budget support by MoF for the sector. In addition, DSM will help curtail peak demand, which would reduce peak capacity use and translate into cost savings for investment in new capacity. The SREDA will be critical for the implementation of DSM.

Impact on society and environment. The importance of reliable energy and power supply for Bangladesh's development cannot be overemphasized. However, its impact on both society and the environment remain a point of contention, especially in relation to coal-based power plants and the development of nuclear energy. Besides key issues around land acquisition and the impact of resettlement on communities, there are also significant environmental concerns around the negative impact of coal-fired power plants as well as the management and disposal of spent fuel and other nuclear waste.

3 POWER AND ENERGY SECTOR OBJECTIVES – Theory of Change

3.1 Scope of the Power and Energy Sector

Before examining the sector Objectives in detail, it is important to reiterate the scope of the PE sector as defined in this SSP. This SSP adopts an institutional definition of the PE sector, namely, the sector encompasses all the areas covered by the MoPEMR and that of its two Divisions – Power Division and the Energy and Mineral Resources Division (EMRD).

This PE SSP recognises the critical role of the private sector in power development to achieve better value for money, on-time delivery, performance assurance and access to financing, including PPPs. International experience has demonstrated that the Government policies have a significant impact on attracting private sector participation in the PE sector, and Bangladesh is no different in this regard. The Government has a crucial role to play in creating a climate which makes investment in energy and power infrastructure development attractive, thus supporting the strategic goal of "affordable, reliable, sustainable and modern energy for all" in Bangladesh through the development of conventional and non-conventional energy infrastructure, with both public and private sector participation. The role of the private sector is further discussed in Sections 4.1 (Strategies to Achieve 8FYP Targets) and 4.3 (Financing Strategy).

3.2 Sector Theory of Change

The priorities in the 8FYP and various other policies and strategies were identified after careful review and content analysis of the 8FYP. Based on this review it can be concluded that the Theory of Change of the SSP remains largely the same as the one in the SSP which was based on the 7FYP, except that the 8FYP put more emphasis on increasing renewable energy generation while maintaining highly efficient "least polluting" coal power plants. In addition, the PE sector Theory of Change has been also developed in line with the targets outlined in the DRF of the 8FYP (discussed in Section 2.3 above) and the current performance of the sector in relation to the KPIs outlined in the 8FYP DRF.

The Theory of Change provides a logically structured framework for the design, formulation, appraisal, and approval of projects in the PE sector. All interventions in this sector should contribute to the realisation of one or more sector Intermediate Outcome, which if achieved, will help deliver one of three sector Outcomes required to achieve the overall sector Goal. The assumptions for achieving each of the sector Outcomes are described in more detail in Chapter 6 on 'Assumptions and Risks'. A set of relevant risk mitigation measures to reduce the likelihood of the risk occurring and/or reduce the impact of the risk should it occur are outlined in more detail.

Since PSMP 2016 has a much longer time duration (until 2041) than PE SSP (until 2025), the Theory of Change of the PE sector focuses on the objectives that would be realised within the five-year duration of the PE SSP, or where significant actions will be required in the 8FYP period.

Figure 3-1 Power and Energy Sector Theory of Change

3.3 Narrative Descriptions of the Theory of Change

The Theory of Change for the PE sector is based on the assumption that pursuing three sector Outcomes will collectively achieve the Sector Goal in the DRF of 8FYP, namely, 'Ensure sustainability in the production, consumption and use of power, energy and mineral resources.' Those three sector Outcomes are the following.

Sector Outcome 1: Reliable, affordable, and efficient energy supply achieved and sustained

Sector Outcome 2: Reliable, affordable, efficient, and quality power supply achieved and sustained

Sector Outcome 3: Well-articulated Demand Side Management (DSM) policy adopted and implemented

Sector Outcomes 1, 2 and 3 are both *necessary* and *sufficient* for the sector Goal to be realised if the broader contextual factors remain constant. Those factors include, for example, that Bangladesh continues to achieve more than 7% GDP growth year-on-year, and that domestic peace prevails.[10]

When all these outcomes materialize and contextual factors remain the same, the sector goal can be achieved and can contribute to realizing economic and social development, poverty reduction, and improvement of people's quality of life. To bring about this change, sector Outcomes 1, 2 and 3 should be implemented in parallel, namely, energy and power supply expansion should come along with rationalisation of energy and power tariffs and successful implementation of DSM.

In the following, Intermediate Outcomes under respective sector Outcomes are explained in detail.

Sector Outcome 1: Reliable, affordable, and efficient energy supply achieved and sustained

Intermediate Outcomes

1.1 Clear policy on long-term energy sources including energy security and fuel source diversification developed and approved

Bangladesh's energy consumption is projected to become three times higher in the next 20 years than now if the current level of robust economic growth is maintained and EEC is implemented as planned (see Chapter 2, Figure 2-3).

To meet the rapid growth of energy demand in Bangladesh, there is a need to articulate a clear energy policy that ensures sustainable production and usage of energy at reasonable cost in the long term. This policy should ensure (i) energy security in Bangladesh, (2) address fuel diversification through an appropriate fuel mix of power plants and the realization of the potential of renewable energy and mega-watt (synonym of energy efficiency and conservation at supply and demand sides), (3) broaden people's access to modern energy services, and thereby facilitating economic growth, poverty reduction, and improvement of quality of life.

[10] Here, it is important to note that these factors are mutually reinforcing, that is, sustainability in the production, consumption and use of power, energy and mineral resources also contributes to Bangladesh achieving more than 7% GDP growth year-on-year, and the prevailing domestic peace.

The share of renewable energy to the total electricity generation (% including hydro) declined from 3.6% in FY2015 to 3.1% in FY2020. This continued reliance on fossil fuel needs to be reduced to keep pace with the progress made globally in the use of clean fuel. Second, despite price increases, the progress in improving energy sector finance has been limited. The 8FYP has put stronger emphasis on these aspects of PE sector development.

1.2 Increased efficient production of domestic gas and coal

Bangladesh has a good prospect of gas resources in on-shore and off-shore areas (Yet-to-Find). However, more advanced technological skills and financial backup will be required to manage exploration of the remaining oil and gas resources in the increasingly difficult and risky areas.

To minimize exploration risks and maximize recovery of resources, Bangladesh needs to consider partnership with internationally known Internation Oil Companies (IOCs), through attractive Production Sharing Contacts (PSC), both for onshore and offshore exploration. Unsatisfactory performance of the recent exploration and production implies that Petrobangla requires more financial resources, state-of-the-art skills for well exploration and development, and experiences in on-shore resources. It is therefore recommended that Petrobangla would engage in strategic partnership with internationally renowned IOCs and utilize their technologies for both off-shore and on-shore resources. PSMP2016 can be a good reference source, since it offers specific approaches for the strategic partnership with IOCs, and for the improvement of Production Sharing Contacts (PSC).

Compared with domestic gas exploration and production, domestic coal production poses a challenge to Bangladesh. In Bangladesh, five coal fields have been discovered so far. Total reserve in these coal fields is about 3,300 million tons (PSMP 2016). Out of five identified coal fields, only Barapukuria is currently in production. However, since the main factor of this gap was simply a delay in the installation of new on-site equipment, the expansion of the production to the required production level (a million tons per year) has been realised with a delay. At present, about 1 million metric tons of coal is produced annually from Barapukuria, Dinajpur. As of June 2020, total 11.78 million tons of coal has been extracted. 525 MW electricity is generated and supplied to national grid, using this coal. A larger challenge than that of Barapukuria production is the development and operationalization of other potential coal fields, especially under the open-cast mining method that was recognized as infeasible in the past.

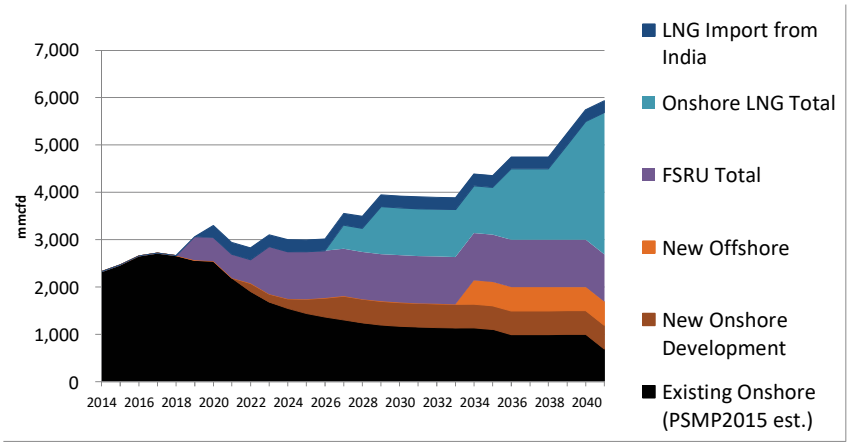
The implementation and completion of planned coal fired plants has been very slow, though there are some large-scale, coal-fired power plants at different stages of implementation. Coal mining has not proceeded due to the lack of a coal policy. The planned large-scale imports of coal have not moved fast enough because of infrastructure constraints, particularly port and related transport and handling infrastructures (Figure 3-3). To meet the coal demand for power generation from domestic sources, Petrobangla has a plan to develop two additional coal fields at Dighipara, Dinajpur and Khalaspir, Rangpur.

1.3 Infrastructure to import coal, gas, and oil products developed

As discussed earlier, Bangladesh still has natural gas exploration and development potential. However, this will be far from sufficient to meet the rapidly growing demand for energy in the future. Figure 3-2 shows the clear trend of LNG import to support the gas demand of Bangladesh. It should be noted

that the successful exploration and development of 'Yet to Find' resources are assumed here. If this assumption does not hold in the future, Bangladesh will be required to import more gas resources and develop more infrastructures for imports, and thereby more financial resources as a result.

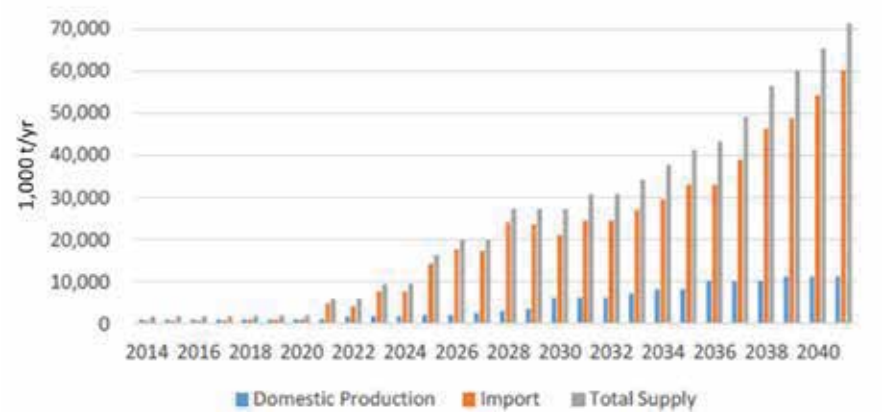
Figure 3-2 Gas Supply Scenario up to 2041



Source: PSMP2016

Similarly, import of coal and oil is projected to grow rapidly, as shown in Figure 3-3 and Figure 3-4, respectively, to respond to the growing demand for energy. Imported coal will support power generation. The expected rapidly growing import of LNG and coal points to the urgent need of a deep-sea port to be developed. Both coal carrier (collier) and LNG tanker (Q-Flex class) require the depth of 14-15m for waterways and turning basin.[11] Hence, the development of a deep-sea port is a highly urgent task. Oil demand will become four times higher in 2041 than in 2020 especially through the growing use of automobiles.[12]

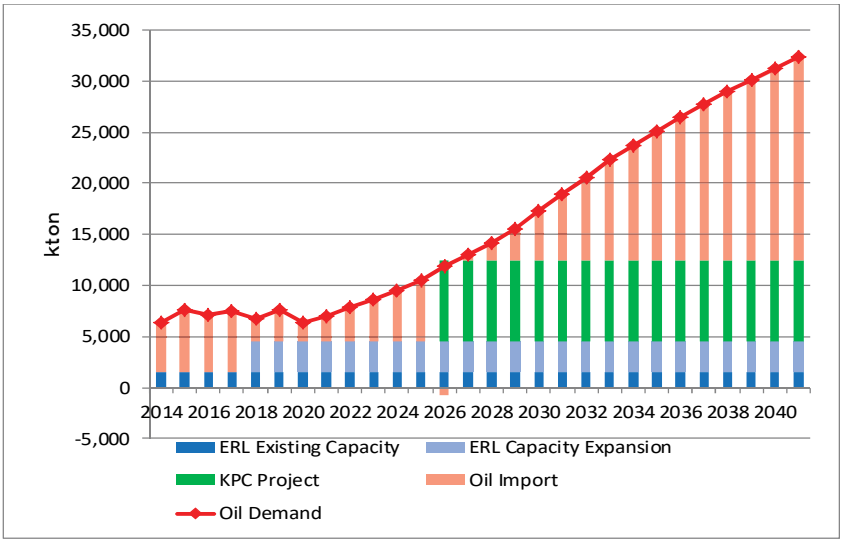
Figure 3-3 Coal Supply Projection



Source: PSMP 2016

[11] PSMP2016, Table 8-12 "Specification of LNG Harbour for Receiving Q-Flex Class LNG Tanker"
[12] PSMP2016, Figure 10-4 "Oil Demand Projection for Non-Power Sectors, 2014 to 2041"

Figure 3-4 Oil Supply Projection



Source: PSMP 2016

It should be emphasized that capital-intensive mega projects call for a well-developed business plan and appropriate cost-benefit analysis (CBA). For example, a refinery development project, such as the Kuwait Petroleum Corporation Project, will require a careful CBA because, under the recent oil market situation where oil price has been stagnantly low, it is not certain whether owning a costly refinery is a better option than developing the storage and distribution capacity of oil products.[13]

1.4 Shipping cost for oil imports reduced

Shallow draft along the coast of Chattogram has prohibited a direct access of large-size tankers, and thus caused a higher shipping cost of crude oil to refinery, as lightering operation is required to deliver crude oil. Bangladesh plans to build a single point mooring (SPM) system in the offshore Matarbari Island to address this problem.[14]

Bangladesh has now gained considerable shipping experience. Total merchandise trade amounted to $73 billion in FY2017. The usual shipping margin is about 10%, which yields a total shipping market of about $7.3 billion. If Bangladesh can tap 50% of this market, earnings from shipping will grow from $0.4 billion now to $3.6 billion.

1.5 Gas transmission and distribution pipeline expanded and efficiency improved (loss reduced and condensate production increased)

When the supply and demand of expensive, imported LNG grows, stricter control and monitoring of gas inflow and outflow will be required to reduce “lost profit opportunities”, minimize the system loss and leakage from the system, and improve efficiency at domestic gas fields.

[13] A detailed discussion on this point can be found in PSMP2016, Section 10.3 Refinery Development – World Trend and Implication to Bangladesh.
[14] The technical specification of the system is described in PSMP2016 Section 10.1.3 on Oil import supply: future projects.

Particularly, the current fixed gas tariff for the domestic (resident) sector regardless of the amount of use is known for the inefficient use. The Government has taken an initiative to replace this tariff with the gas pre-paid meter. With previously installed pilot projects (13,100 meters) and extended coverage in Dhaka and Chattogram areas (in total 260,000 meters), it is expected to reduce the gas usage by more than 7.3 million m^3 (or 0.3 BCF).[15]

1.6 Biogas for cooking and improved cooking stove (ICS) encouraged instead of traditional clay stove

Currently only 12% of the entire population in Bangladesh has access to grid gas for cooking. The grid gas users are highly concentrated in the Dhaka area. More than 4 million households are now using piped natural gas for cooking. Consumption of Liquefied Petroleum Gas (LPG) is nearly 1 million ton per year and roughly 8-10% of population in urban and rural areas are now using LPG. Electricity is too costly for cooking, except some rural rich people who use electricity in absence of piped natural gas and LPG. The remaining 80% of the population mostly living in rural areas of Bangladesh uses traditional solid biomass for cooking. Therefore, social and environmental impacts will be enormous if the solid biomass users gain access to modern and cleaner energy for cooking.

One of the drastic social impacts is the liberation from the respiratory diseases caused by the incomplete combustion of solid biomass.[16] The WHO found that indoor air pollution is the second major cause of illness in low-income countries, next to the poor access to safe water and incomplete sanitary environment.

Although LPG is a cleaner energy solution (compared to firewood) and can be used in off-gas pipeline areas, it is too expensive to afford for average rural households in Bangladesh. For instance, an average size of household with 4-5 persons requires two LPG cylinders (12kg) per month, which costs 2,000-2,400 Taka per month on average. While we recognise that many relatively wealthier rural households have switched from using firewood to using LPG, LPG remains unviable for the 'energy poor' in rural Bangladesh. The 'energy poor' is defined as a household with an energy expense of more than 10% of monthly income. In the same vein, subsidies for LPG are not a long-term, sustainable solution.

By contrast, ICS and biogas produced from a biogas digester are reasonable and low-carbon energy solutions. The above actions will directly contribute to the SDG Goal 7 "Ensure access to affordable, reliable, sustainable and modern energy for all."

1.7 Private financing promoted and increased for energy infrastructure investment

Investment in energy infrastructure is capital intensive at front-end, especially deep-sea ports. Public investment financed by the Government or DPs alone are not sufficient to finance the required amount of investment in energy infrastructure. This points to the critical need to facilitate public-private financing to achieve required infrastructure investment.

[15] For other gas transmission and distribution infrastructure, see PSMP2016 Chapter 7.

[16] According to the World Health Organization (WHO), solid biomass incomplete combustion by using inefficient traditional cook stove produces toxic substances, so called "black carbons", such as mono dioxide and particle matters, and these substances cause respiratory diseases. Many of the victims are women and children, because they cook inside the house or are more exposed to the toxic substances owing to their low height

While recognising the critical need for increased private financing for energy infrastructure investment, the Government also acknowledges that there are challenges in this regard which need to be overcome. In particular, the organisational transformation of Petrobangla is required to increase its attractiveness to private sector investors. These issues are further discussed in Chapter 4, which looks at implementation strategies.

There are three main instruments for boosting private financing for the environment. First, private supply will be encouraged with proper regulatory and pricing policies in several areas such as afforestation outside dedicated forests for timber and non-timber forest products, fisheries, eco-tourism, water supply and waste management. Second, legal and regulatory policies will be used to encourage proper adoption of the measures that include private investment in the protection of environment. Third, the public sector will enter co-financing arrangements for environmental services through PPPs, including partnerships with communities.

1.8 Energy tariff responding to the increase of supply cost

It is time for Bangladesh to face the challenge of raising energy tariff for gas, coal, and oil products to meet financing requirements for expensive imported fuel and investment in energy infrastructure. Although energy tariffs should inevitably be raised, the fiscal burden on the national coffer and negative impact on the national economy (or negative growth) should be minimized. To address this issue, PSMP2016 proposed that the slow, steady, and continuous raise of energy tariffs should be undertaken at the rate of 19.3% in nominal BDT until 2041. This scenario is expected to realize financial sustainability in the energy sector and minimize the negative impact on economic development (see PSMP2016, Chapter 21).

Sector Outcome 2: Reliable, affordable, efficient and quality power supply achieved and sustained

The following Intermediate Outcomes must be in place to achieve Sector Outcome 2.

Intermediate Outcomes

2.1 Power supply through both generation and imports increased

PSMP2016 sought an optimal balance of power generation development to attain the optimum balance of cost, environmental and social impact, and energy security.[17] Figure 3-5 presents the long-term power generation plan, which was based on intensive discussion of BPDB System Planning and factoring in other key parameters such as import fuel availability and assumed completion of import fuel facilities. In this plan, Bangladesh would have more than 57,000 MW at the end of 2040s, whereas expensive oil-based power plants would be decreased gradually and become marginal after the coal-based power plants become operational in the early 2020s.

[17] According to International Energy Agency (IEA), energy security is defined as "the uninterrupted availability of energy sources at an affordable price." In PSMP2016, energy security is translated into "risk of sudden shortage in energy supply" and "risk of GDP loss".

Figure 3-5 Long-term Power Generation Development Plan (2017-2041)

Source: PSMP2016

In this long-term plan, the share of natural gas and coal fired power generation would become the same, i.e. 35% respectively. The share of the latter would be substantially lowered than what was proposed in the previous PSMP2010 in which the gas and coal were 25% and 50%, respectively.[18] This change resulted from two factors: the downward trend of natural gas price and the growing concern over climate change impacts that are symbolized in the 2015 Paris Agreement.[19]

In addition, power imports from neighbouring countries were closely studied in parallel with the PSMP2016 and the findings from the study was incorporated in the above power development plan.

2.2 Renewable energy power generation increased

Renewable energy power generation consist of a part of power generation, and could be included in Intermediate Outcome 2.1. However, the Government is keen on increasing renewable energy power generation, since this contributes to multiple purposes – climate change mitigation, energy access, and energy security. Achieving a more sustainable energy program is a desired goal of the Government and efforts are underway to increase share of renewable energy in fuel mix during the 8FYP plan and beyond. The Government has set an ambitious target of achieving 10% of total required power generation capacity to meet total power demand from renewable energy. This is an important target and a prerequisite for sustainable development.

Whilst more than 6 million system for households have been installed to date, it should be noted that Bangladesh has limited land availability for utility-scale solar PV power and its contribution to global trends of renewable energy policy should not be expected. However, Bangladesh's aspiration to utilize hydropower potential could be considered as renewable energy and hydropower imports could be expanded to 5,000MW by 2040. The potential of other renewable energy sources such as waste-based energy and off-shore and wind-based power should also be explored in Bangladesh. To achieve targeted generation as per the Government's policy from renewable energy, solar energy - especially rooftop solar and Solar Home Systems (SHS) may be the most important option for

[18] In PSMP2010, it was assumed to utilize domestic coal and import coal.

[19] Following the US and Europe, Asian utility companies become more aware of the risk of long-term LNG contract, and non-conventional LNG traders have started to supply destination free cargos on a spot basis, through swapping operation or purchasing from spot market. With that increased flexibility and dynamism, a downward trend for LNG prices in Asia can be expected.

Bangladesh. The Government's support for availability of land from reclaiming river estuary as mentioned in 'Delta Plan' and innovation in PV and battery storage technological can play an important role in installation of utility scale solar power development.

2.3 Availability and efficiency of thermal power plants improved

While power generation development has been one of the priorities for Bangladesh, the energy efficiency improvement of thermal power generation has not yet to be attracted much attention as it deserves.

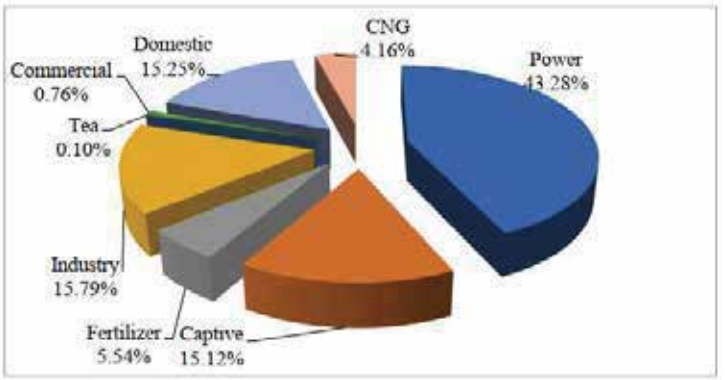
It is unfortunate that scheduled inspection and maintenance of publicly-owned thermal power plants has been neglected. As a result, those plants suffer from under-utilized capacity, lower than expected thermal efficiency, and resulted in only average 32% of expected output. It is estimated that, if these power plants improve thermal efficiency to the international standards, approximately 52 BCF can be saved per year, worth the fuel for 1,300 MW combined cycle power plants.

It is evident from Figure 3-6 that the power sector is the major consumer of gas followed by the industry sector (both industry and captive). The other major demand sources were domestic users, followed by fertilizer and Compressed Natural Gas (CNG) stations. The tea estates along with commercial users have also been using gas as energy source.

Among various approaches, repowering of existing gas-based steam turbines to the state-of-the-art combined cycle power plants will contribute to both efficiency improvement and increase in output with least-cost compared with other feasible options (*e.g.*, a newly built combined cycle gas power plant in the same location or coal Ultra Super Critical with import coal). Therefore, subject to a feasibility study, repowering of existing gas-based steam power plants should be given higher priority in public investment.

At the same time, periodic maintenance of public thermal power plants is a critical action to prevent deterioration of plant efficiency overtime.

Figure 3-6 Gas Consumption by Sector in FY2020



Source: 8FYP based on Petrobangla data

2.4 Ensure efficient O&M of power plant, including periodical inspection

The main cause of underperformance in public thermal power plants is that lower priority is given to proper maintenance in comparison with the expansion of power system infrastructure. As a result of low maintenance practices, public sector thermal power plants suffer from high maintenance and forced outages, and that causes low availability and increased per unit cost of electricity.

The BERC has already introduced the Electricity Maintenance and Development Fund to address this issue. However, PSMP2016 pointed out that appropriate funding and maintenance practices supported by an established legal framework for publicly owned power plants is required to conduct scheduled maintenance as technically required and improve their availability and efficiency.

2.5 Technical and non-technical loss reduced

In terms of transmission system loss (technical loss), Bangladesh has already achieved an international good practice of around 2.5–3.0%. However, the average distribution system loss of publicly-owned distribution entities (BPDB, Northern Electricity Supply Company Limited (NESCO), and BREB stagnates at around 9-10% despite its historically downward trend over the last two decades. Two corporatized distribution companies in Dhaka areas have managed their system loss at some 7-8%.

Efforts will also be made to continue further reducing distribution system losses from 9.35% in FY2019 to below 7.5% by FY2025. To this end, improvement of the quality of power supply, such as stabilization of network voltage and frequency, is a prerequisite. In addition, large transmission and distribution development programmes will be needed to ensure uninterrupted power distribution and achieve the target of quality 24/7 power supply for all.

2.6 Power transmission and distribution network expanded

As Intermediate Outcome 2.1 outlines, Bangladesh is expecting to expand its installed generation capacity more than three times in the next 20 years. To achieve this, supply chain of electricity (transmission and distribution) to the end user needs to be expanded as well.

PSMP2016 recommends special design consideration for some facilities, including 765kV transmission lines and substations, and the 400kV circuits from Ruppur nuclear power station (PSMP2016, Section 15.5).

During the 8FYP period, the Government will continue to maintain proper coordination of investment in transmission and distribution to ensure that the benefits of generation investments reach people. For meeting the growing electricity demand, the Government places priority for transmission network development and plans to construct 3,358 km during FY2021-25 for a maximum power transfer. A reliable distribution network is critical to provide desired quality of power to the end-user 24/7. The Government aims to provide 100% access to electricity to all households.

2.7 Access to power increased

The Government has aspired to provide electricity to all citizens by 2021. According to the situational analysis and current progress, Government has already achieved 99.5% (including off-grid renewables) of the access to the electricity in FY2021. As of June 2020, about 37 million consumers have been connected to the grid through 0.581 million km distribution lines.

While the 100% target is technically achievable, coordination between on-grid and off-grid approaches should be improved to achieve the "last one mile" electrification. On-grid electrification of the last one-mile area remains 140,000km (BREB has so far developed 300,000km) and tends to be less technically or financially viable than the existing grids. This means that the Government subsidy and/or off-grid solution would need to be considered as alternative means to achieve the target.

2.8 More stable and high-quality power supplied

Bangladesh's economic development will require a transformation of the industrial structure from the current low value-added to higher value-added industries. This will inevitably require better quality of power supply with better stability of frequency that is essential for high value-added industrial products (PSMP2016, Section 16.2.2).

When power supply capacity is insufficient or the system operator does not have power generation units under its full control, it is not capable of managing power output and power frequency adjustment is less prioritized than load following (or load shedding). Consequently, Bangladesh experiences quite large frequency fluctuations (plus/minus more than 1.0 Hz/second or 2.0% frequency change). This is in fact the deviation of the Bangladesh Grid Code 2019 which stipulate that the system frequency should be controlled within 50Hz (±0.5Hz) under normal conditions.

Furthermore, stable frequency is an important pre-requisite for continuous operation of synchronous power generators, including a nuclear power plant that normally requires power stability within plus/minus 0.5 Hz.

To improve this situation, a two-step approach may be considered: (i) more responsive generators are integrated into the enhanced NLDC system operation; and (ii) stronger authority is given to NLDC to execute its order. First, several large units of coal-fired and gas-fired generation will become on-line in the early 2020s, and the generation capacity will have a wider reserve margin for frequency control (in this sense, Intermediate Outcome 2.9 is dependent on Intermediate Outcome 2.1). Such an additional margin (power plants) should be equipped with frequency control functionality, in the form of governor-free operation and additional equipment such as Supervisory Control and Data Acquisition (SCADA), Load Frequency Control (LFC), or Automatic Frequency Control (AFC) if they are expected to function as frequency adjuster.[20]

[20] It should be noted that coal-based power plants are principally base load, hence not appropriate for frequency control. Those who have fast start-up and flexible output capacity, such as simple cycle gas turbine will be good candidates as reserve marine.

Second, the power plants that contribute to frequency control through governor-free operation[21] and ancillary services should be compensated or incentivized appropriately to recover their investment (*e.g.*, equipment) and variable costs (*e.g.*, low availability of plant). In Bangladesh, a simulation suggests that the mode of operation needs to be approximately 5% of total installed capacity to achieve plus/minus 0.5Hz by 2024 under normal conditions (see PSMP2016 Ch.16 for details).

Furthermore, managing voltage profile of grid and distribution network within standard allowable range according to 'Electricity Grid Code' is essential for system stability. The NLDC and SCADA (in distribution network) plays a very important role in this regard.

2.9 Electricity Grid Code implemented and strictly followed by the grid users to improve network power quality

To achieve frequency control, there is a need to integrate power plants to the NLDC system operation, clarify and enforce legal obligations and penalties, and provide appropriate financial incentive to comply with legal obligations.

The BERC approved "BERC (Electricity Grid Code) Regulations 2019". In the 'Grid Code', the NLDC is empowered to order power plants to engage in output adjustment, develop a day-ahead plan and frequency control (instructions to follow during rising frequency and during falling frequency) for maintaining demand-supply balance. Proper implementation of 'Grid Code' is crucial for stabilizing frequency within +/- 0.5 Hz band. Also, proper training on 'Grid Code' to the 'Users of Grid Network' is very important to ensure quality power supply with better 'frequency and voltage management'.

2.10 International Atomic Energy Agency (IAEA) recommendations implemented, including strengthening of safety management, nuclear fuel cycle including waste management, ratification of international laws of civil liability of nuclear damage

As the Fukushima Daiichi nuclear accident in Japan in 2011 has shown, nuclear power plants could cause tragic situations to the public if proper safety nets are not in place. Especially the compensation system and emergency preparedness system in case of severe accident are essential, and they should be established and enhanced as soon as possible. In fact, Japan did not ratify the Convention on civil liability for nuclear damage, which makes it difficult for the Tokyo Electric Power Company (TEPCO) to address promptly the compensation issue.

Nuclear power plant's safety management and nuclear fuel cycle, including waste management, are also important operational issues. The details of these issues and recommendations are described in IAEA reports.

[21] Governor free operation refers to a system where generators in the grid participate in governing the change in frequency by increasing or decreasing the power generation.

2.11 Private financing promoted and increased for power infrastructure investment (except oil-based power plants)

The investment need for the energy sector discussed in Intermediate Outcome 1.7 is also applicable for the power sector. Furthermore, the power sector requires active private sector participation to overcome the limitation of public investment or foreign assistance by DPs.

While recognising the critical need for increased private financing for power infrastructure investment, the government acknowledges that there are challenges to overcome. For instance, there are issues with high-risk premium of the single buyer due to limited transparency of the procurement process. There are also issues with prolonged delays in contracting which discourage private investment in the power sector, as well as relatively limited financing available from local banks. Some of these challenges have been and will be tackled partially through other intermediate outputs (*e.g.*, raising power tariff for final consumers is one of such achievements). It will go some way towards reducing overall subsidy to power generation, and hence reduce the risk premium (implementation strategies are covered in Section 4). With regard to the latter, it is important to address the legal and regulatory issues around increased access to local financing and improvements to the procurement process. Dedicated efforts will also be required under this Intermediate Outcome to promote private financing.

2.12 Power tariff responding to the increase of supply cost

Similar to the energy sector, Bangladesh also needs to face up to the reality that power tariff should be raised to address the financial need for the expansion and quality enhancement of power infrastructure. The cost of expensive imported fuel should be incorporated into power tariff as well.

PSMP2016 proposes that a slow, steady, yet continuous tariff raise (10.3% in nominal BDT) could realize financial sustainability of the energy sector and mitigate negative impact on economic development (see PSMP2016, Ch.21).

Sector Outcome 3: Well-articulated Demand Side Management (DSM) policy adopted and implemented

The following intermediate outcomes must be achieved to realize Sector Outcome 3. In line with internationally accepted terminology, the references to 'energy efficiency' in the following covers both primary and secondary energy (power).

Intermediate Outcomes

3.1 Energy Efficiency Conservation Promotion Programmes including energy management, labelling, green building and awareness raising implemented

Bangladesh will need to meet a massive increase in the demand for energy and power consumption and infrastructure that would likely be accompanied with cost increase arising from increased imports. In such a case, it is critical to reduce energy and power consumption on the demand side to narrow the demand-supply gap.

The Government is aware of this need and 8FYP places the improvement of energy efficiency as its policy priority. Especially for the demand-side management (DSM), the JICA-supported Energy Efficiency and Conservation Master Plan (EEC-MP 2015) articulated that Bangladesh could reduce power demand by 20% by 2030 compared with a 'business as usual' case if it successfully implements EEC programmes. This can be translated into roughly 8,000MW avoided capacity.

It should be noted, however, that the EEC-MP did not address the issues of the transport and fertilizer sectors, although the former is the largest contributor to the demand increase in primary energy (oil products), and the latter is potentially a major contributor to improve energy efficiency. These are dealt with in Intermediate Outcomes 3.3 and 3.4 below.

3.2 Preferential taxation on energy efficient appliances in place

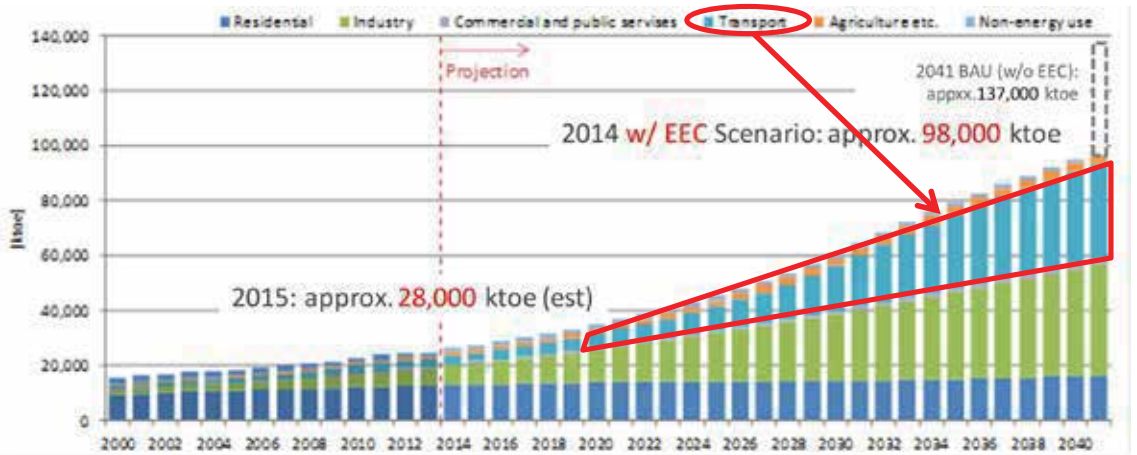
There should be some financial incentives when the EEC programme is implemented to bring behavioural changes among people. Financial incentives may include, for example, concessional loan, preferential tax, and subsidies. When providing preferential taxes such as tax reduction, exemption and accelerated depreciation, the Government will need to consider how to cover the loss of tax revenues when tax collection is reduced.

3.3 Energy efficiency of vehicles improved

The transport sector will be one of the most rapidly growing sectors in terms of energy demand (Figure 3-7). This will be caused by rapid motorization and the increase in car ownership along with income growth, similar to many growing middle-income countries in Asia. The transport sector will contribute mostly to the demand growth for oil products (Figure 3-8).

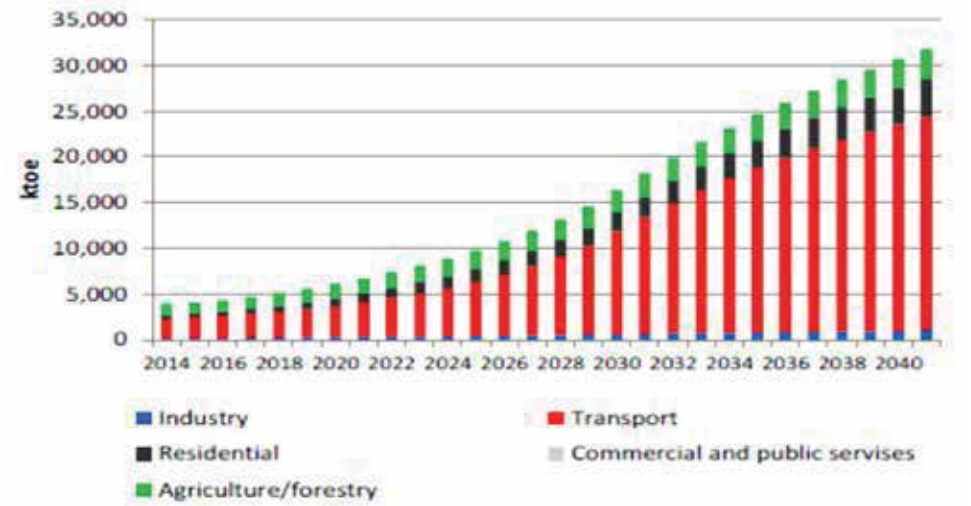
Hence, Bangladesh will need to promote energy efficient vehicles. Such regulations and incentive systems are observed in Thailand that in the past has taken an economic growth path similar to that of Bangladesh (see PSMP2016 Section 6.4 for Thailand's experience).

Figure 3-7 Final Energy Consumption Projection with EEC Scenario 2015-2041



Source: PSMP2016

Figure 3-8 Oil Demand Projection for Non-Power Sectors, 2014 to 2041



Source: PSMP2016

3.4 Energy efficiency in fertilizer factories improved

The fertilizer sector in Bangladesh is another major source of inefficient use of gas, and therefore has a large potential to improve energy efficiency.

Although the fertilizer sector was outside the scope from the EEC-MP, the Government must take an action to address the inefficiency of this sector. The return will be mitigation of waste of natural gas that is worth a unit of nuclear power generation.

4 IMPLEMENTATION STRATEGIES

4.1 Strategies to Achieve 8FYP Targets

This section presents key regulatory and institutional reforms which are required to achieve the sector objectives outlined in Chapter 3. Regarding the latter, specific arrangements for the coordination of key DPs within the sector are specified and sector coordination on cross-cutting areas is outlined, including coordination mechanisms between and among MDAs themselves, as well as with non-government actors.

Challenges under 8FYP

Legal and Regulatory Issues

Building on the progress above, the Government of Bangladesh will address additional legal and regulatory issues in the 8FYP. These include, among others:

- Further unbundling where feasible along the functional line;
- Functional separation of 'Single Buyer' business under BPDB legal framework;
- Strengthening generation and distribution companies already in place to improve operating performance and customer satisfaction;
- Implementing the power sector restructuring plan;
- Adjusting electricity price gradually to average cost level;
- Strengthening BERC to be able to perform its agenda on licensing, energy pricing, quality of utility performance including energy efficiency, and consumer satisfaction/dispute resolution.

Develop regulations on safety and security standards for nuclear power plants. The Bangladesh Atomic Energy Regulatory Authority (BAERA) will develop those regulations in close collaboration with the MoST. Those regulations will be aligned with broader issues including the ratification of, and compliance with (i) international laws and standards, such as civil liability for nuclear damage; and (ii) IAEA recommendations, such as safety standards and spent fuel management cycle establishment.

Develop laws and rules for the improvement of power quality. This could be addressed, for example, by adopting and implementing 'Electricity Distribution Code' regulations by BERC.

Legal framework for preventive maintenance and O&M. Some amendments of electricity-related Acts regarding several obligation rules and their penal provision could be undertaken to enhance effectiveness, improve customer service, and ensure quality supply of electricity for end users. There are challenges to ensure and suspend operations of power generation facilities and inspect them regularly. Those challenges have been acute under a shortage of power supply and caused by insufficient legal framework for preventive maintenance and O&M of facilities. Because of these reasons, the power generation facilities are not operating at their optimal performance level in terms of, for instance, power output and thermal efficiency. Since a periodic inspection is not stipulated by legal binding, it tends to be postponed due to budget shortages or tight electricity demand, resulting in unplanned and undesirable shutdown. Thus, there is a clear need to institutionalize periodic inspection. There is also a need to institutionalize technical standards to regulate and help reduce the

amount of accidental trouble and disasters. To this end, there should be a legal framework for O&M in place.

Develop regulations on periodical maintenance of power plants. These regulations will stipulate the right for on-site inspection by a governmental body.

Develop legal framework for the National Load Dispatch Centre (NLDC). This will enable the NLDC to be further developed its role as a transition system operator.

Develop rules and systems for DSM. The rules and systems for DSM will include such components as follows: (i) Amended New Building Code that incorporates the concept of the Green Building Code; and (ii) Energy Management/Audit Programme and Energy Efficiency Labelling Programme.

Institutional Issues

Besides the legal and regulatory framework conducive to achieving sector objectives, some institutional issues in the following will be addressed in the 8FYP period.

- ***Adopt a comprehensive National Energy Policy.*** This policy will address energy security in Bangladesh and how to boost energy (primary and secondary) production from indigenous resources to limit excessive reliance on energy import. The Theory of Change in Chapter 3 discussed this issue in detail, stressing the importance of this policy to achieve a reliable, affordable, and efficient energy supply.
- ***Amend the Renewable Energy Policy 2008.*** To cope with the fast-advancing renewable energy and battery technology and their falling prices, it is time to amend the Renewable Energy Policy 2008 to increase a share of clean energy in the fuel mix of power generation. The amendment of this policy will ensure an increase of renewable energy generation in Bangladesh, thereby helping to reduce carbon di-oxide emission to fight against climate change.
- ***Adopt Integrated Energy and Power Sector Master Plan (IEPSMP) 2021.*** The IEPSMP will guide long-term planning of the PE sector to achieve Vision 2041. The IEPSMP 2021 needs to be prepared in light of the experience during the 7FYP period and also to account for possible changes in demand situation, particularly in the aftermath of the COVID-19 pandemic and associated uncertainties in the supply side of primary energy. The IEPSMP will examine new and alternate technologies for power generation for selecting candidate power plants to ensure safe, affordable, and clean energy. It will also examine availability of primary fuel from both indigenous sources and global market at reasonable price for sustainable energy supply in the future.
- ***Effective coordination mechanism to synchronize power and primary energy needs***. There is also an urgent need to consider putting in place a new institutional structure that can comprehensively reflect primary energy needs to support power development plan that synchronizes effectively with the energy supply plan in a dynamic way. There is no organizational structure that supervises overall energy supply and demand in Bangladesh comprehensively. Establishing an institutional framework is necessary to develop and implement both plans comprehensively by involving all relevant stakeholders for these plans to share information.
- ***Need to strengthen data management of the energy sector to support evidence-based policy making.*** To have better access to data for overall energy policy making, there is a need to establish an "Integrated Statistics Bureau" under the MoPEMR, a central management unit of all data from the organizations under the jurisdiction of the Power Division and the EMRD. One of the tasks could be to revise and update the power and energy master plan periodically.

Development Partners (DPs) Coordination Mechanisms

The Energy Sector Working Group (SWG) under the Local Consultative Group mechanism will be a venue for dialogues on the PE sector and facilitate coordination and cooperation between the Government and DPs.[22] The members of DPs of the Power SWG include Asian Development Bank (ADB) (Chair), Japan, Korea, Norway, UN Agencies, USA, and World Bank (WB).

Sector Coordination

The SDG mapping document (Prepared by GED) emphasises the importance of other institutional actors to achieve sector objectives of the PE sector. Those actors are listed in the following:

- MoST on issues related to nuclear power generation;
- MoFA on issues related to energy and power imports; and
- ERD on issues related to facilitation of mobilization of resources from DPs.

Addressing specific topics will require close coordination among key actors such as the following:

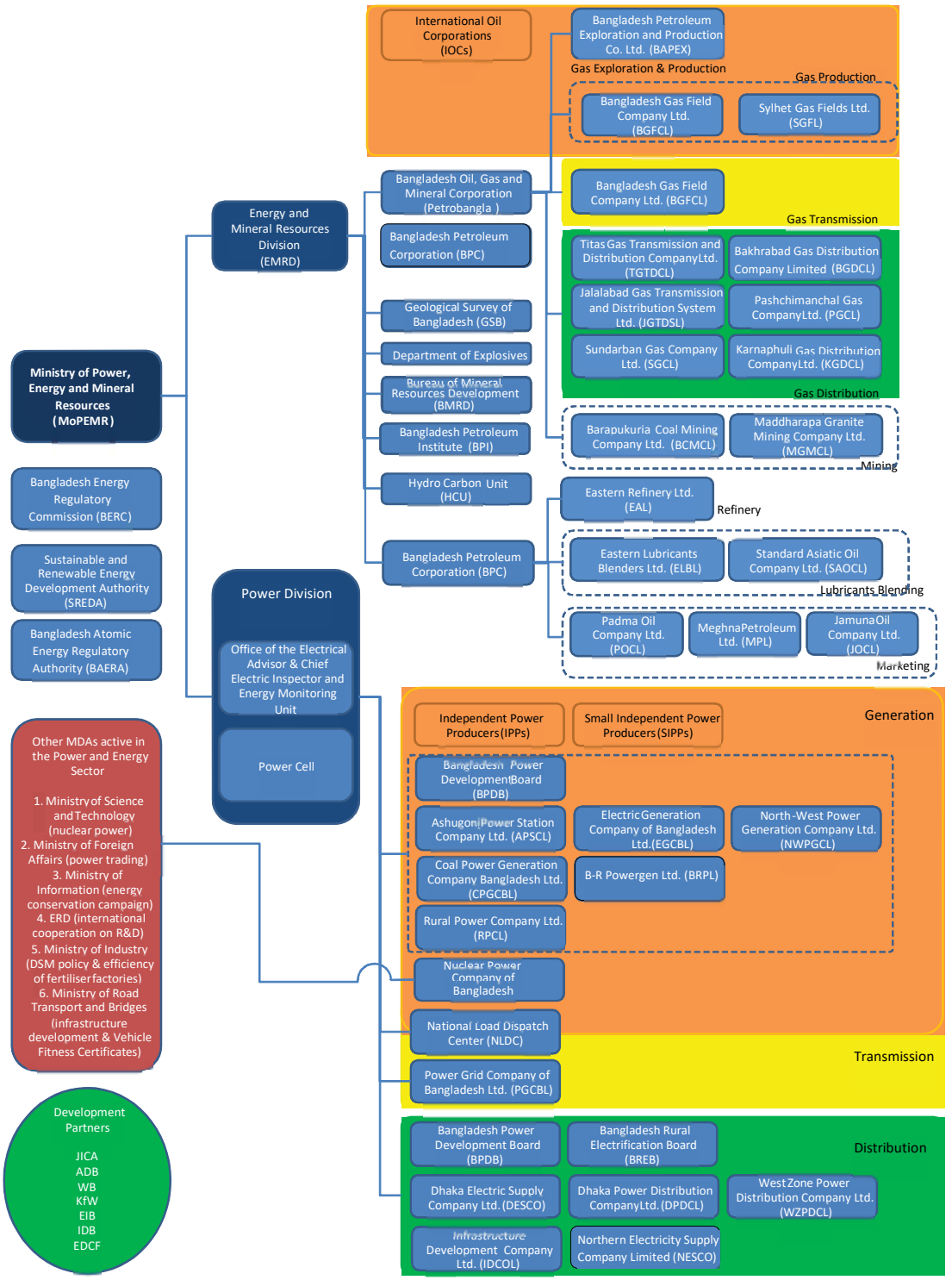
- MoPEMR and Ministry of Road Transport and Bridges -- Proper planning and execution of infrastructure construction projects for imported coal, LNG, LPG and oil.
- MoPEMR and Ministry of Railways – Proper planning and execution to facilitate transportation of liquid fuel for power generation and heavy machineries for power plant construction.
- MoPEMR and Bangladesh Road Transport Authority (BRTA) -- Improving energy efficiency of vehicles, perhaps through revised Fitness Certification measures.
- MoPEMR and Ministry of Industries -- Adopting and implementing a comprehensive, well-articulated DSM policy. This will take into consideration the improvement in technology to achieve more efficient energy use in existing fertilizer factories under the purview of the Ministry of Industries.
- Power Division and EMRD under MoPEMR -- Ensure that fuel supply is available to meet power generation initiatives contained in various policy documents.
- MoPEMR and Local Government Engineering Department (LGED) – The MoPEMR needs to coordinate with LGED on off-grid renewable energy solutions.

Figure 4-1 overleaf presents an institutional map of the range of MDAs and DPs in the PE sector.

Civil Society Organisations (CSOs) such as Non-Governmental Organizations (NGOs) and Non-Political Organisations (NPOs) play an important role in interacting with the Government particularly in the area of nuclear power plant energy, and the social and environmental impacts that could be potentially caused by power plant development. Although such interaction may be perceived as time consuming, it is critical to increase transparency of public activities and enhance mutual trust between civil society and the Government.

[22] Economic Relations Division. 2015. Bangladesh Joint Cooperation Strategy 2010-2015.

Figure 4-1 Institutional Map of the Power and Energy Sector



4.2 Linkages between ADP and Sector Objectives

Introduction

In this section, the ADP is structured along the Theory of Change for the PE sector discussed in Chapter 3. The Theory of Change for the PE sector is based on three types of interventions: i) investment interventions, ii) development of policy, and iii) regulatory interventions. Table 4-1 shows that a majority of Intermediate Outcomes can be achieved through investment interventions. A few sector Intermediate Outcomes require mostly policy or legal issues rather than investments. This section will largely focus on sector Intermediate Outcomes that require investment interventions. Figure 3-1 above provides an overview of the different sector Intermediate Outcomes.

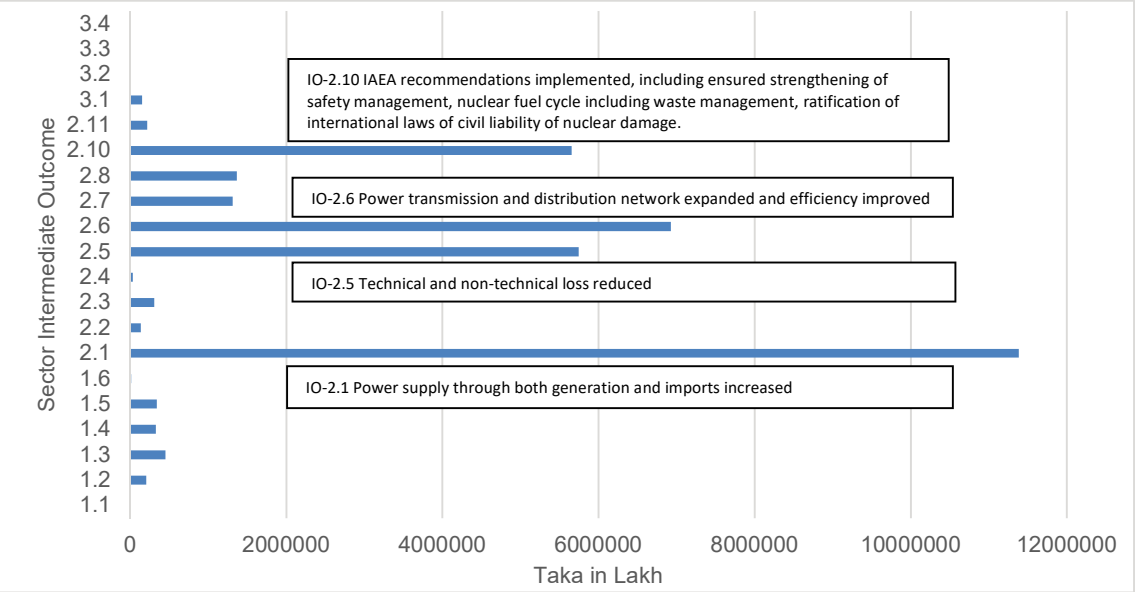
Table 4-1 Sector Outcome & Sector Intermediate Outcomes and their types of interventions

	Investment interventions	Policy development	Regulatory interventions
Sector Outcome 1	1.2, 1.3, 1.4, 1.5, 1.6, 1.7	1.1	1.8
Sector Outcome 2	2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.11	2.10	2.9, 2.12
Sector Outcome 3	3.1, 3.3, 3.4	3.2	

Analysis

Figure 4-2 provides an overview of the ADP FY 2020-21 allocation by Intermediate Outcome under three Sector Outcomes in the PE sector.

Figure 4-2 Total ADP FY2020-21 allocation by Sector Intermediate Outcome (Taka in Lakh)



Note: Financial resources are allocated in the following way: For each project at most two intermediate outcomes are identified. If a project is linked to one intermediate outcome, the total costs of that project will be allocated to that intermediate outcome. If a project is linked to two intermediate outcomes, the total costs will be divided by two – and one half will be allocated to each of the two intermediate outcomes, respectively. Out of the 80 projects, 16 projects are linked to one intermediate outcome, while the other 64 projects are linked to two intermediate outcomes. Furthermore, this analysis is not a base for strong conclusions for several reasons as there are several challenges for the analysis: 1) Currently the MYPIP is not covering all projects of the ADP. The data in MYPIP/ADP Management System (AMS) only includes public investment projects. Public investments are just a part of the total The Government efforts to achieve the objectives; 2) There are a number of public investment projects are outside the ADP (private sector, donors, international financial institutions, Green Climate Fund etc.); 3) The analysis provides a partial picture as other important information on recurrent budget, subsidies, policy regulations etc. is missing; 4) Some regulations and support cannot be quantified in financial terms (such as legal amendments or policy regulations); 5) Linking the title of the project to one specific intermediate/sector outcome can be difficult as several projects cover multiple objectives.

A majority of ADP resources are allocated to achieve sector Outcome 2 "Reliable, affordable, efficient and quality power supply achieved and sustained". More specifically, the largest ADP budget is allocated for Intermediate Outcome 2.1 (Power supply through both generation and imports increased), which is followed by Intermediate Outcome 2.6 (Power transmission and distribution network expanded and efficiency improved) and Intermediate Outcome 2.5 (Technical and non-technical loss reduced). It should be noted that the "Construction of Ruppur Nuclear Power Plant Project (1/7/2016 - 30/12/2025)" constitutes almost 33% of the total value of the PE ADP portfolio in the ADP 2021-22 and supports Intermediate Outcome 2.1 and Intermediate Outcome 2.10.

Table 4-2 presents the ADP 2021-22 PE allocations over the sector intermediate outcomes, confirming the importance of sector intermediate outcomes 2.1 and 2.6.

Table 4-2 Sector Intermediate Outcomes – Past Expenditures, Present Allocations and Remaining Budget

BDT In Lakh

Sector Intermediate Outcome	Cumulative Expenditure up to June 2021[23]	ADP 21-22 Allocation	Remaining Budget (until end of project)[24]
1.1	-	-	-
1.2	83.833.50	8,829.00	112,263.00
1.3	265,357.00	49,500.00	137,527.00
1.4	154,387.00	47,850.00	126,176.50
1.5	218,893.50	52,350.00	69,699.50
1.6	-	-	-
2.1	4,425,043.50	1,735,863.00	5,256,057.00
2.2	8,474.00	65,924.00	65,058.00
2.3	158,093.00	41,324.00	105,585.00
2.5	1,700.00	550.00	30,374.50
2.6	1,340,493.00	728,569.00	3,674,015.50
2.7	2,314,931.50	944,928.50	3,666,103.00
2.8	915,583.00	163,050.00	231,826.50
2.10	34,861.50	61,232.00	1,268,619.00
2.11	2,076,916.00	921,308.00	2,656,421,50
3.1	129,567.50	15,118.00	100,137.50
3.2	51,282.00	44,463.50	55,041.00
3.3	-	-	-
3.4	-	-	-

4.3 Financing Strategy

Financing Projection under 8FYP

The PE sector financing needs for the 8FYP period are substantial. This financing strategy is based on a combination of PPP financing for power generation and measures to contain energy subsidies. The ADP allocation needs for the PE sector in the 8FYP period is presented in Table 4.3 below.

[23] The starting dates of projects varies. Earliest starting date is 1/1/2013.
[24] The completion dates of projects varies. Latest completion date is 30/06/2026.

Table 4-3 8FYP ADP Allocations for Power & Energy Sector (constant FY2021 prices, Tk. billion)

Ministry	FY2021	FY2022	FY2023	FY2024	FY2025	Total
Energy & Mineral Resources Division	20.0	23.4	25.7	28.6	32.7	130.4
Power Division	245.1	251.0	327.4	360.7	413.2	1597.4
Total	**265.1**	**274.4**	**353.1**	**389.3**	**445.9**	**1727.8**

Source: 8FYP (p.375)

It is important to note that Table 4-3 does not include the allocation for the "Construction of Rooppur Nuclear Power Plant Project (1/7/2016 - 30/12/2025)". Up to June 2022, Tk. 57083.25 cr has been spent on nuclear power development, with a further Tk. 13,395.6 cr allocated in the ADP 2022–23 for the first phase of the construction of the Rooppur Nuclear Power Plant. [25] Moreover, the cumulative cost for the nuclear power plant up to 2040 is estimated to be over 2,600 billion Taka just for the plant cost alone (*i.e.*, excluding spending for others such as security measures, nuclear waste cycle management, or compensation allowance).

Financing gaps are evident in the financial accounts of the PE sector agencies. For instance, the latest available Annual Report for FY2019-2020 of BPDB shows a net loss of 0.09 billion Taka (including both operating expenses and non-operating expenses).[26] The net loss in the FY2019-20 decreased to 0.09 billion Taka from 1.75 billion Taka in the previous year. The decline in net loss was mainly due to a decrease in diesel and HFO based generation and electricity purchase from Rental & Quick Rental power plants from the previous year.[27] These losses will need to be absorbed by the Government which creates addition burden on overall national budget.

Estimating "Fiscal Space" using MYPIP

The financing projection under the 8FYP indicated that a large funding shortfall would be expected in the PE sector in the 8FYP period. The MYPIP, which is being developed by Programming Division under SPIMS, can offer a more up-to-date projection based on the information from ADP/RADP, and Development Project Proposals (DPPs)/ Technical Assistance Project Proposals (TAPPs) in this sector.

Table 4.4 presents an indicative summary of MYPIP in the PE sector. The Ruppur Nuclear Power Plant project and its nuclear power-related costs are included in the MYPIP calculation and in the calculation of the fiscal space. In the MYPIP, fiscal space of the PE sector is calculated in a simple formula in the following:

Fiscal Space = Sector budget ceiling – Forward baseline estimates.

The sector budget ceiling is a top-down hard ceiling over the next three years at the sector level in the MTBF, whereas forward baseline estimate is the resource needs of ongoing projects of MDAs for the

[25] According to the ADP FY2022-23, pg. 109
[26] BPDB Annual Report 2019-2020, p. 90-91
[27] BPDB Annual Report 2019-2020, p. 90-91

next three years. Fiscal space, therefore, assesses the "fiscal room" for adding new projects in the PE sector over the next three years.[28]

Table 4-4 Summary of MYPIP in the Power and Energy sector

Unit: Crore Taka

MTBF Ceiling / ADP Allocation	FY2021-22 (actual) [(1)]	FY2022-23	FY2023-24	FY2024-25
Power and Energy Sector				
1) Budget Ceiling	45,270	49,796	54,776	60,254
2) Forward Baseline Estimates	45,270	75,387	56,593	25,815
3) Fiscal space (=1 – 2)	**0**	**-25,591**	**-1,817**	**34,439**
Power Sub-Sector				
1) Budget Ceiling	43,261	47,587	52,346	57,580
2) Forward Baseline Estimates	43,261	73,503	54,459	25,815
3) Fiscal space (= 1 – 2)	**0**	**-25,916**	**-2,113**	**31,765**
Energy Sub-Sector				
1)Budget Ceiling	2,009	2,209	2,430	2,673
2) Forward Baseline Estimates	2,009	1,885	2,134	0
3) Fiscal Space (= 1- 2)	**0**	**324**	**296**	**2,673**

It should be noted that the current MYPIP dataset does not capture either self-financed projects of MDAs and autonomous organisations, or own fund contributions.

A few observations can be made from Table 4-4:

- ***Fiscal space of the PE sector is negative in FY2022-23 and FY2023-24.*** This indicates that the estimated total cost of ongoing projects in the coming three years exceeds the sector budget ceiling during those periods if those ongoing projects are completed on time and the project budget is disbursed as planned. The negative fiscal space means that financing ongoing projects from the development budget will not be sufficient to cover total cost of those projects in the coming two years.

- ***There is clear need to expand fiscal space by exploring other sources of financing.*** Expanding fiscal space will allow the PE sector to implement ongoing projects with adequate levels of funding and complete them on time. The potential other sources of financing may include, but not limited to: (i) increasing self-finance by autonomous bodies under MoPEMR; (ii) increasing PPP arrangements; (iii) adjusting electricity tariff policies; (iv) enhancing efficiency of the PE sector; and (v) increasing sector-specific foreign assistance.

- ***Adoption of new projects will require careful analysis of fiscal space.*** Negative fiscal space means that there is no 'fiscal room' for new projects in the coming three years. This is not to imply that new projects should not be adopted in the PE sector in the coming three years. It

[28] The methodology to estimate forward baseline estimates and fiscal space is explained in detail *the Guidelines for Formulating and Using MYPIP* under SPIMS.

is certainly possible to adopt new projects, and yet there should be stronger justifications than the time of "positive fiscal space," by conducting careful analysis on the implication of a new project on fiscal space.

Self-financed projects

The PE Sector has the largest amount of self-financed projects equal to about 7% of the ADP allocation to the PE sector.

Own-fund contributions

For the power sub-sector, the Power Division aims to provide an own contribution (Not less than 5% of project cost) in project costs, mainly used for land acquisition. The energy sub-sector aims at own contributions as well, but a generalised proportion of this has yet to be determined.

Private Financing

As seen in Chapter 3 of this SSP, both sub-sectors could require investment in the order of some trillion Taka (in the current price) in the long-run. Though such financial requirements do not immediately mean huge investment needs in the short-run, there is a need for the Government to start taking action to further accelerate private financing as soon as possible, such as conducting feasibility studies and increasing accountability and sustainability through sector reforms. Such reforms may include (i) addressing legal and regulatory issues around improving access to local financing, and (ii) improving the procurement process to increase transparency and reduce irregularities. Those actions will help Bangladesh avoid delay in enhancing private financing that is required in the 8FYP period.

5 SECTOR RESULTS FRAMEWORK

This Chapter presents an updated SRF of the PE sector for the 8FYP period in 2021-2025. Following the recommendations from the SSP mid-term evaluation, the updated Sector Results Matrix (SRM) presented below aims to improve usability of the Performance framework: limiting the number of performance indicators. One of the strength of the PE sector SRM is that it captures long-term targets.

Table 5.1: Sector Results Matrix

Results Chain	Indicators (including unit of measurement)	Baselines		Intermediate Targets												Final Targets		Ratio of ADP disbursement to FYP allocation (%)	Lead Institutional Responsibility	Sources
				2020-21		2021-22		2022-23		2023-24		2024-25		2025-26		2026-27				
		Year	Value	Planned	Actual	Planned	Actual	Planned	Actual	Planned	Actual	Planned	Actual	Planned	Actual	Planned	Actual			
Sector Goal:																				
Ensure sustainability in production, consumption and use of energy and mineral resources	Total primary energy supply (ktoe/year)	2020	43,390	46,122		50,982.5		53,456.0		55,929		58,403.0		60,876.5		63,350.0			[redacted]	
	Per capita POL consumption (Per capita Kg Oil Equivalent, KgOE)	2020	39.02	40.77		41.77		42.77		43.77		44.77		45.77		46.77				
	Per capita electricity Generation (kWh/year)	2020	426.23	429		410		391		372		353		335		316				
Sector Outcomes:																				
1.Reliable, affordable and efficient energy supply achieved and sustained	Amount of domestic gas produced (BCF/year)	2020	837	837		812		792.3		772.6		752.9		733.2		713.5			[redacted]	
	Amount of domestic coal extracted (Million M.T/year)	2020		0.65		0.56		0.47		0.38		0.29		0.2		0.11				
	Amount of oil (crude oil + oil products) imported (thousand tons/ year)	2020	6.200	6.20		4.95		4.39		3.83		3.27		2.71		2.15				
	KM of gas transmission pipeline installed (km)	2020		3,324		3,437		3,550		3,663		3,776		3,889		4,002				
	KM of gas distribution pipeline installed (km)	2020	2,372	2,396		2,401		2,406		2,410		2,415		2,419		2,424				
	KM of gas service line installed (km)	2020	16,603	16,927		16,987		17,047		17,107		17,168		17,228		17,288				

Results Chain	Indicators (including unit of measurement)	Baselines		Intermediate Targets												Final Targets		Ratio of ADP disbursement to FYP allocation (%)	Lead Institutional Responsibility	Sources
		Year	Value	2020-21		2021-22		2022-23		2023-24		2024-25		2025-26		2026-27				
				Planned	Actual	Planned	Actual	Planned	Actual	Planned	Actual	Planned	Actual	Planned	Actual	Planned	Actual			
	Renewable energy increased in total final energy consumption (% of Total Electricity production)	2020	3.24																	
2. Reliable, affordable, efficient and quality power supply achieved and sustained	Total installed power generation capacity (within Bangladesh territory) (MW)	2020	14,999	26,246		28,644		31,041		33,439		35,836		38,234		40,631				
	Installed Renewable Energy Capacity (on and off-grid) (MW)	2020	1,724	811		914		1,016		1,119		1,221		1,324		1,426				
	Transmission loss (%)	2020		3		3		2.75		2.75		2.6		2.6		2.5				
	Distribution system loss (%)	2020		8		7.75		7.6		7.5		7.4		7.3		7.2				
	% of the total population with access to Electricity	2020	94%	100		100		100		100		100		100		100				
3. Well-articulated Demand Side Management (DSM) policy adopted and implemented		2020																		

6 ASSUMPTIONS AND RISKS

The following risks and assumptions were identified:

Table 6-1 Risks and Mitigation Measures

Description of Risk	Affected Sector Outcome (SO)/ Intermediate Outcome (IO)	Means of Mitigation
Failure to eliminate operational deficits through price rises and/or efficiency gains leads to further weakening of the sector's financial viability.	All infrastructure (investment)-flagged Intermediate Outcomes	Lobbying to ensure that tariff rises are allowed Enhanced focus on strengthening generation efficiency
Cost overruns with development projects reduce the fiscal space at the sector level.	All infrastructure (investment)-flagged Intermediate Outcomes	Strengthening formulation of DPPs, including accuracy in costing Enhanced project implementation capacity including procurement
Delays with project implementation lead to shortfalls in required infrastructure expansion/enhancement.	All infrastructure (investment)-flagged Intermediate Outcomes	Appropriate "early warning" signals in place so that delays are identified early, and swift measures can be taken to rectify problems
Development of the deep-sea port for coal and LNG imports is delayed	IO 1.3 Infrastructure to import coal, gas, and oil products developed	Developing Floating Storage and Regasification Unit infrastructure for the imports of LNG to reduce the impact of possible delays in deep-sea port.
Little consideration for O&M cost does not sustain the periodical maintenance over plant life.	IO 1.5 Gas transmission and distribution pipeline expanded and efficiency improved (loss reduced and condensate production increased) IO 2.3 Availability and efficiency of thermal power plants improved	Measures to explicitly identify and allocate O&M funding, for both on-going and planned investment projects
Increases in the international prices of import fuels	SO 1. Reliable, affordable and efficient energy supply achieved and sustained	Maximum use of domestic energy resources as well as renewable energy sources Measures to increase energy efficiency in both supply and demand sides
Depreciation of Taka against foreign currencies	SO 1. Reliable, affordable and efficient energy supply achieved and sustained All infrastructure (investment)-flagged Intermediate Outcomes	Enhanced project implementation capacity including procurement to shorten the project duration and avoid project delay Maximum use of domestic energy resources as well as renewable energy sources Measures to increase energy efficiency in both supply and demand sides

7 ANNEXES

ANNEX I – BIBLIOGRAPHY

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Annex II: Sector Results Monitoring Matrix

Result Chain	Indicators	Lead Responsible Institution	Typer of Project	Baseline		Reference source for Baseline	Intermediate Targets/Values										Reference Source for targets	Cumulative ADP Contributions Year 1-5 (Estimated)
			I: Infrax P: Policy and/or Reform, I&P: Hybrid	Year	Value		Yr 1 2021-2022	Value	Yr 1 2022-2023	Value	Yr 1 2023-2024	Value	Yr 1 2024-2025	Value	Final Target Yr 2025-26	Value		
Sector Goal: Ensure sustainability in production, consumption and use of energy and mineral resource																		
	Total primary energy supply (ktoe/year)	MoPEMR	I&P	2021														
	Per capital POL cumption (per capital Kg Oil Equivalent, KgOE)	BPC		2021														
	Per capital eletricity Generation (kWh/year)	MoPEMR	I&P	2021														
	Energy Entensity (teo/million taka)	MoPEMR	I&P	2021														
Sector Outcomes 1: Reliable, affordable and efficient energy supply achieved and sustained																		
1.1 Clear policy on long-term energy source including security and fuel source diversification developed and approved	Clear policy on long-term energy source including security and fuel source diversification developed and approved	MoPEMR	P	2021														
1.2 Production of domestic gas and coal efficiently increased	Success ratio of exploratory drilling (TBD)	PertoBangla	I	2021														
	Amount of domestic gas produce (BCF/year)	PertoBangla	I	2021														
	Amount of domestic coal extracted (Million M.T/year)	PertoBangla	I	2021														
	Amount of condensate produced (MT/year)	PertoBangla	I	2021														
1.3 Infrastructural to import coal, gas and oil products developed	A deep see port for coal and LNG import	Ministry of Shipping and MoPEMR	I	2021														
	Number of coal (transphiment terminals)	MoPEMR	I	2021														
	Number of tanks at land-based LNG terminal (1tank= 180 million litter LNG)	MoPEMR	I	2021														

Result Chain	Indicators	Lead Responsible Institution	Typer of Project	Baseline		Reference source for Baseline	Intermediate Targets/Values										Reference Source for targets	Cumulative ADP Contributions Year 1-5 (Estimated)
			I: Infrax P: Policy and/or Reform, I&P: Hybrid	Year	Value		Yr 1 2021-2022	Value	Yr 1 2022-2023	Value	Yr 1 2023-2024	Value	Yr 1 2024-2025	Value	Final Target Yr 2025-26	Value		
	Number of FSRU	MoPEMR	I	2021														
	Capacity of Oil production storage (mton)	BPC	I	2021														
	Amount of coal "efficienty " imported" (million ton/year)	PertoBangla	I	2021														
	Amount of gas imported (MMSCFD/year)	PertoBangla	I	2021														
	Amount of oil (crude oil+oil products) imported (thousand tons/year)	BPC	I	2021														
1.4 System loss for oil import reduced	Number of SPM installed	Energy Division	I	2021														
	Amount oil pilferage reduced (ton/year or ktoe/year)	Energy Division	I	2021														
1.5 Gas transmission and distribution pipeline expaned and efficiency improved (loss reduced and condensate production increased)	KM of gas transmission pipeline installed (km)	PertoBangla	I	2021														
	Km of gas distribution pipeline installed (km)	PertoBangla	I	2021														
	KM of gas service line installed (km)	PertoBangla	I	2021														
	Pre-paid meter installed (number)	PertoBangla	I	2021														
1.6 Access to renewable energy increased (biogas for cooking and improved cooking stove(ICS)	Number of clean cook stove installed (million)	SREDA	I	2021														
	Amount of biogas produced (thousand m3/day as capacity)	SREDA	I	2021														
	In total final energy consupition (% of total Electrisity production)	SREDA	I	2021														
	Amount of biogas produced added (thousand m3/day as capacity)	SREDA	I	2021														
1.7 Private financing promoted and increased for energy infrastructure investment	Percentage of private financing to infrastructure development incresed (% of GDP)	MoPEMR	I&P	2021														
1.8 Energy tariff responding to the increase of supply cost	Ratio of gas traiff coverage to the supply cost (%)	BERC	P	2021														
	Ratio of oil tariff coverage to the supply cost (&)	BERC	P	2021														

Result Chain	Indicators	Lead Responsible Institution	Typer of Project	Baseline		Reference source for Baseline	Intermediate Targets/Values										Reference Source for targets	Cumulative ADP Contributions Year 1-5 (Estimated)
			I: Infrax P: Policy and/or Reform, I&P: Hybrid	Year	Value		Yr 1 2021-2022	Value	Yr 1 2022-2023	Value	Yr 1 2023-2024	Value	Yr 1 2024-2025	Value	Final Target Yr 2025-26	Value		
	BPC Annual Report every year publised	BPC	P	2021														
Sector Outcome 2: Reliable, affordable and quality power supply achieved and sustained																		
2.1 Power Supply throught both generation and importants increase	Total installed power generation capacity (within Bangladesh territory) (MW)	Power Division	I	2021														
	Proportion of private-owned generation (IPP only, rental exclude) (%)	Power Division	I&F	2021														
	Rental/Quick-rental power plant (Number, or MW)	Power Division	I	2021														
2.2 Renewable energy power generation increased	Installed Renewable Energy Capacity (on and off-grid) (MW)	SREDA	I&F	2021														
	On-grid renewable generation capacity (MW)	SREDA	I&F	2021														
	Off-grid renewable power generation (MW)	SREDA	I&F	2021														
2.3 Availability and efficiency of thermal power plants improved	Capacity of power plant repowered and/or converted (added MW)	Power Division	I	2021														
	Average thermal efficiency of power plants (%)	Power Division	I	2021														
	Loss of Load Expectation (LOLE) (%)	Power Division	I	2021														
2.4 Electricity Act and BERC Act 2013 revised and implemented to ensure operation and maintenance of power plant including periodical inspection	Regulations for periodical maintenance developed and approved (Electricity Act and/or BERC Act 2013 revised)		P	2021														
	Rights of the on-site inspection by a governmental body established		P	2021														
2.5 Technical and non- technical loss reduced	Transmission loss (%)	PGCB	I	2021														
	Distribution system loss (%)	Distribution Companies	I	2021														
	Distribution commercial loss (%)	Distribution Companies	I&F	2021														
	Non-technica loss (commercial loss) (%)	Distribution Companies	I	2021														

Result Chain	Indicators	Lead Responsible Institution	Typer of Project	Baseline		Reference source for Baseline	Intermediate Targets/Values										Reference Source for targets	Cumulative ADP Contributions Year 1-5 (Estimated)
			I: Infrax P: Policy and/or Reform, I&P: Hybrid	Year	Value		Yr 1 2021-2022	Value	Yr 1 2022-2023	Value	Yr 1 2023-2024	Value	Yr 1 2024-2025	Value	Final Target Yr 2025-26	Value		
2.6 Power transmission and distribution network expanded and efficiency improved	Length of new transmission lines commissioned (circuit Km)	PGCB	I	2021														
	Capacity of transmission substations (MVA)	PGCB	I	2021														
	Length of new distribution lines commissioned (Km)	Distribution Companies	I	2021														
2.7 Access to power, both on- grid and off-grid, increased	Access to Electricity	Power Division	I	2021														
2.8 More stable and high-quality power supplied	Fluctuation of system frequency (Hz plus/minus 50Hz, OR % change of system frequency)	Power Division	I&P	2021														
	SAIFI (System Average Interruption Frequency Index)	Power Division	I&P	2021														
	SAIDI (System Average Interruption Duration Index)	Power Division	I&P	2021														
	SAIDI (System Average Interruption Duration Index)	Power Division	I&P	2021														
	Introduction of Economic Load Dispatch (ELD)	Power Division	I&P	2021														
2.9 Electricity Act, Grid Code, NLDC operational rules revised and implemented to improve network power quality	Electricity Act amended	Power Division	P	2021														
	Electricity gride code amended	Power Division	P	2021														
	NLDC operational rule amended	Power Division	P	2021														
	Number of governor-free generator (newly installed)	Power Division	P	2021														
2.10 IAEA recommendations implemented, including strengthening of safety management, nuclear fuel cycle including waste management, ratification of	Bangladesh Atomic Energy Regulations Act 2011 adopted	BAERA	P	2021														
	Independent regulatory body established	BAERA	P	2021														
	Other IAEA Safety Standards met	BAERA	P	2021														
	Nuclear fuel cycle incl. waste management established	BAERA	P	2021														

Result Chain	Indicators	Lead Responsible Institution	Typer of Project	Baseline		Reference source for Baseline	Intermediate Targets/Values										Reference Source for targets	Cumulative ADP Contributions Year 1-5 (Estimated)
			I: Infrax P: Policy and/or Reform, I&P: Hybrid	Year	Value		Yr 1 2021-2022	Value	Yr 1 2022-2023	Value	Yr 1 2023-2024	Value	Yr 1 2024-2025	Value	Final Target Yr 2025-26	Value		
international lows of civil liability of nuclear damage	Ratification of the Int'l treaties completed (e.g. Vienna Convention on Civil Liability for Nuclear Damage)	BAERA	P	2021														
	Public acceptance obtained (% of public opinion favourable to NPP)	BAERA	P	2021														
2.11 Private financing promoted and increased for power infrastructure investment (except rental/quickrental power plants)	Percentage of private financing to infrastructure development increased (except rental/quick-rental power plants) (% of GDP)	MoPEMR	P	2021														
2.12 Power tariff responding to the increase of supply cost	Ratio of tariff coverage to the supply cost (%)	BERC	P	2021														
	Ratio of tariff change to the supply cost change (%)	BERC	P	2021														
Sector Outcome 3. Well-articulated Demand Side Management (DSM) policy adopted and implemented																		
3.1 Energy Efficiency Conservation promotion programs including energy management, labelling, green building and awareness raising implemented	Amount of concessional loan disbursed under Energy Management program	SREDA	P	2021														
	Amount of concessional loan disbursed under Green Building program	SREDA	P	2021														
3.2 Preferential taxation on energy efficient appliances in place	Preferential taxation (including tax reduction and exemption, and accelerated depreciation) approved and implemented	SREDA	P	2021														
3.3 Energy efficiency of vehicles improved	Introduction of Eco-car program	MoPEMR?	P	2021														
	Fuel consumption efficiency (km/l or miles per gallon)	MoPEMR?	P	2021														
3.4 Energy efficiency in fertilizer factories improved	Fuel consumption efficiency to produce a unit of fertilizer (MCF of natural gas/ton of fertilizer)	MoPEMR	I&P	2021														

Programming Division
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August 2022