Integrated Power and Energy Master Plan (IEPMP) (Interim Report)

A review from clean energy perspective

Presentation by
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1. Background

IEPMP 2021

Led by
Ministry of Power Energy and Mineral Resources (MoPEMR)

Technical Support by
Japan International Cooperation Agency
(JICA)

Consultant
Institute of Energy Economics, Japan (IEEJ)

Objectives
A long-term energy plan covering
(a) Every sector and energy source in consideration of the present conditions in Bangladesh
(b) The global momenta toward low-carbonization and/or decarbonization.

2. Analytical Frame of IEPMP 2021

2.1 Contextual Issues

IEPMP

- Key policies have been discussed
- Some of the policy related targets are mentioned
- Renewable energy related targets are less focused
- Advanced technologies have been referred as ‘questionable’

CPD

- CPD pressed to refer all relevant policies
- Discussion avoids clean energy perspectives in detail
- Not having a conclusive scenario on power and energy demand based on major policies

PSMP16

- From, the contextual aspect between PSMP 16 and IEPMP, PSMP focused more on attaining the efficient energy goal while IEPMP additionally incorporated some pathways towards achieving sustainable clean energy

2.2 Scenario Setting

IEPMP

- Reference Scenario (REF)-
  - Gas remains as a major fuel in the mix along with oil and coal
  - Nuclear power will also be a part of the mix.
  - Imported fuels is predicted to increase by 2050
- Advanced Technology Scenario (ATS)-
  - The fuel mix is similar to that of REF scenario.
  - Notably after 2030 it is predicted that solar, hydro and clean energy will be a part of energy mix.
  - Ammonia will be adopted also in ATS, but it will be much more moderate than in NZS
- Net Zero Scenario (NZS)-
  - Coal-fired power will shift to ammonia after its introduction as co-firing fuel.
  - Gas-fired power, will be replaced by hydrogen fired power very rapidly after its introduction

CPD

- There should be a new scenario based on the RE; RE Scenario
- Govt. should focus on domestic resources in spite of relying on imported fuels
- Govt. should gradually step aside from socially and economically expensive fuel
- There should be a roadmap regarding how the fuel mix can be gradually transferred from coal to renewables

PSMP16

- No scenario was

2.3 Methodological Approaches

IEPMP

- Technological assessment model
  - Bottom-up approach
- Econometric modeling
  - Regression analysis
- Micro level demand forecasting was adopted

CPD

- Recommended to follow a bottom-up approach for demand forecast
- A simple forecast was not enough and suggested for an inclusive regression model rather than using Correlation analysis, Electricity Intensity Method, GDP Elasticity Method

PSMP 16

- Correlation analysis, Electricity Intensity Method, GDP Elasticity Method were mostly used in PSMP 16 which was further improved in IEPMP by applying bottom-up approach with regression analysis

2.4 Key Variables

IEPMP

- The power demand forecast in IEPMP is not entirely based in the GDP growth rate rather includes several variables such as GDP, Population, Energy Prices, Previous Demand, Exchange Rates and International Trade

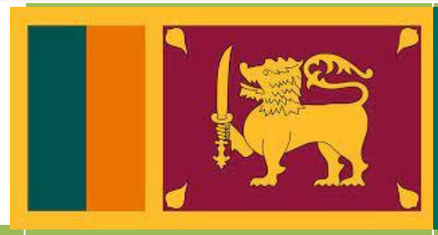
CPD

- It was strongly recommended that projection based on only GDP is a faulty way rather variables such as the income of a household, population, historical load data weather or temperature can be incorporated in the projection

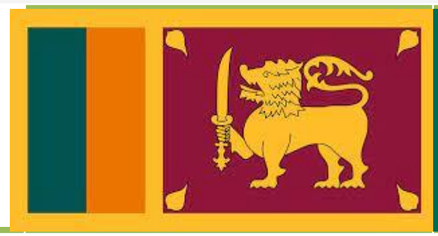
PSMP 16

- PSMP 16 incorporates mostly projections based on GDP while IEPMP improves it by adding six more variables.

2.5 Cross-Country Evaluation

					
Timeframe	Power Development Plan (PDP) **2018-2037** aims to improve energy efficiency and enhance energy security in Thailand.	Vietnam's ministry of industry and trade (MoIT) has been asked to finalise the National Power Development Plan (PDP) VIII from **2021 till 2030 with a vision till 2045**, focusing on reducing coal-based power.	In the 6th Strategic Energy Plan (SEP), the key theme is to realize carbon neutrality by **2050** and reduce greenhouse gas emissions by 46% in FY 2030 from its FY 2013 levels.	Sri Lanka's Energy Sector Development Plan for Knowledge–based Economy, **2015-2025** places a strong emphasis on energy security from both national and individual perspectives.	The draft IEPMP has been prepared based on the plan to turn Bangladesh into a developed country by **2041**.
Energy Mix (RE)	The 10-Year Alternative Energy Development Plan 2012 – 2021 is targeting on increasing the share of RE and alternative energy uses by **25%** instead of fossil fuels within the next 10 years.	Currently, power production is dominated by RE, with a share of **40%** in electricity generation,	The 6th SEP increased the country's RE generation target from the previous **22%-24% to 36%-38% by 2030**.	Renewable energy to make up **20%** of energy generation in **2023**.	Renewable energy makes up **3.68%** of energy generation.

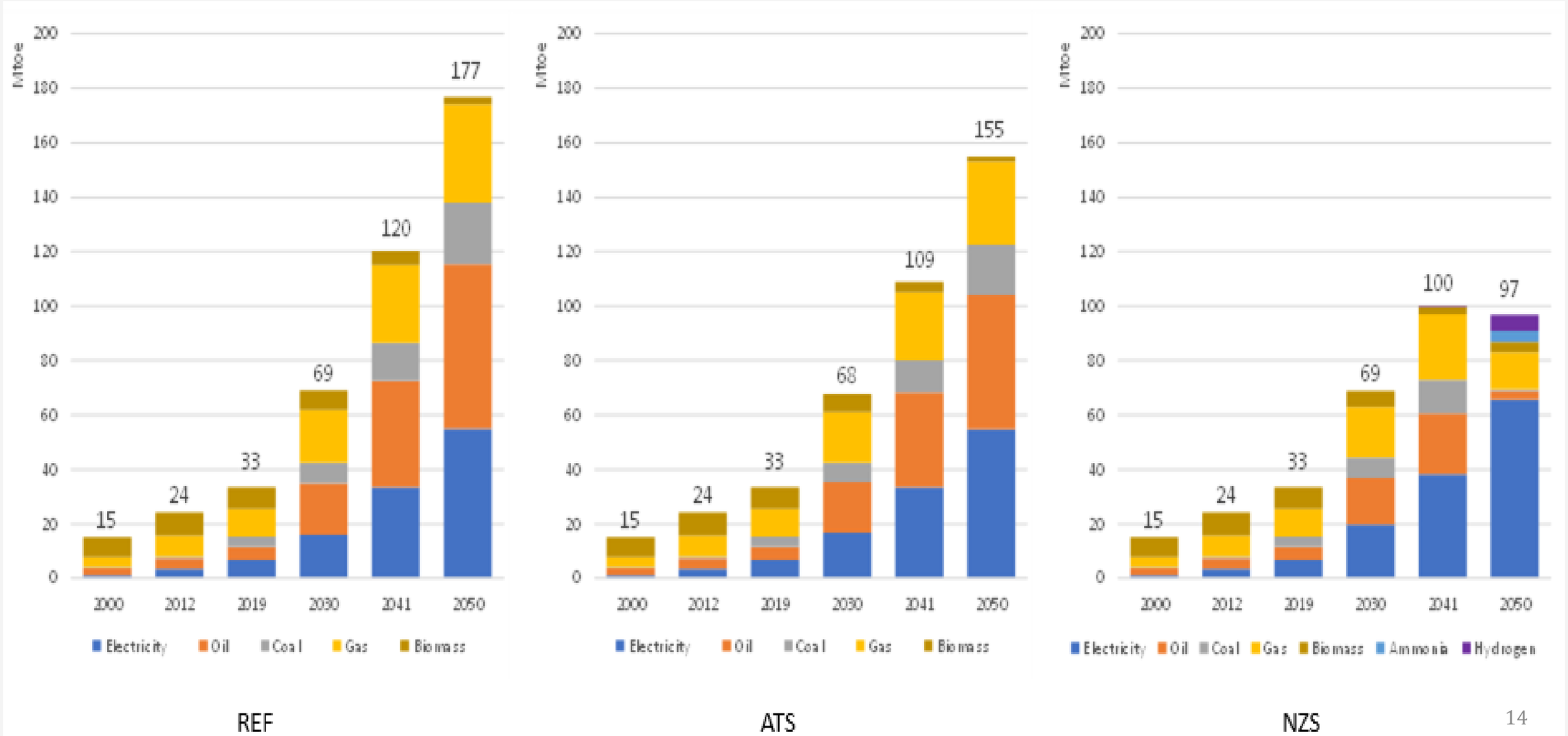
2.5 Cross-Country Evaluation

					
Energy Efficiency & Conservation (EEC)	The 20-Year Energy Efficiency Development Plan 2011 – 2030 is targeting on **25 per cent reduction of energy intensity** (ratio of energy consumption to GDP) of the country within 20 years (2011 – 2030).	Vietnam Energy Efficiency Program (VNEEP 3) expects to **save 8-10% of national energy consumption** and a 6.0% power loss reduction through 2030.	The goal is to **improve energy efficiency by about 40% between 2012-2030**.	A **10% reduction** in total energy demand will be realised by 2020 through EEC.	Under the Energy Efficiency and Conservation Master Plan, the government aims to **lower energy intensity in 2030 by 20% compared to the 2013 leve**l.
Technological Advancement – Carbon capture technology (CCT)	Thailand's **first CCT** project will be put into operation by **2026**.	Vietnam is **yet to adopt CCT**.	Japan's industry ministry plans to **create a legal framework for CCT** to enable companies to start storing CO2 underground or under the seabed by 2030.	Techno-economic **feasibility studies** of implementing CCT are being carried out.	Neither Bangladesh have CCT installed in any power plants, nor have any feasibility studies been carried out on the topic of CCT.

3. Energy Security

3.1 Scenario Analysis of Energy Mix

Fuel Mix Scenario based on IEPMP



3.1 Scenario Analysis of Energy Mix

Coal Reserve (as discussed in the IEPMP)

Coal Field	Area (sq. km)	Depth (m)	Reserve (mil. Ton)	Status
Barapukuria U/G	6.68	118-509	390	In operation
Barapukuria O/C				F/S ongoing
Digipara U/G	24	328-455	706	F/S completed
Jamalganj U/G	11.5	640-1158	5,450	F/S completed
Phulbari O/C	16	150-240	572	F/S completed
Kalaspir U/G	7.5	222-516	685	F/S not yet
Total			7,803	

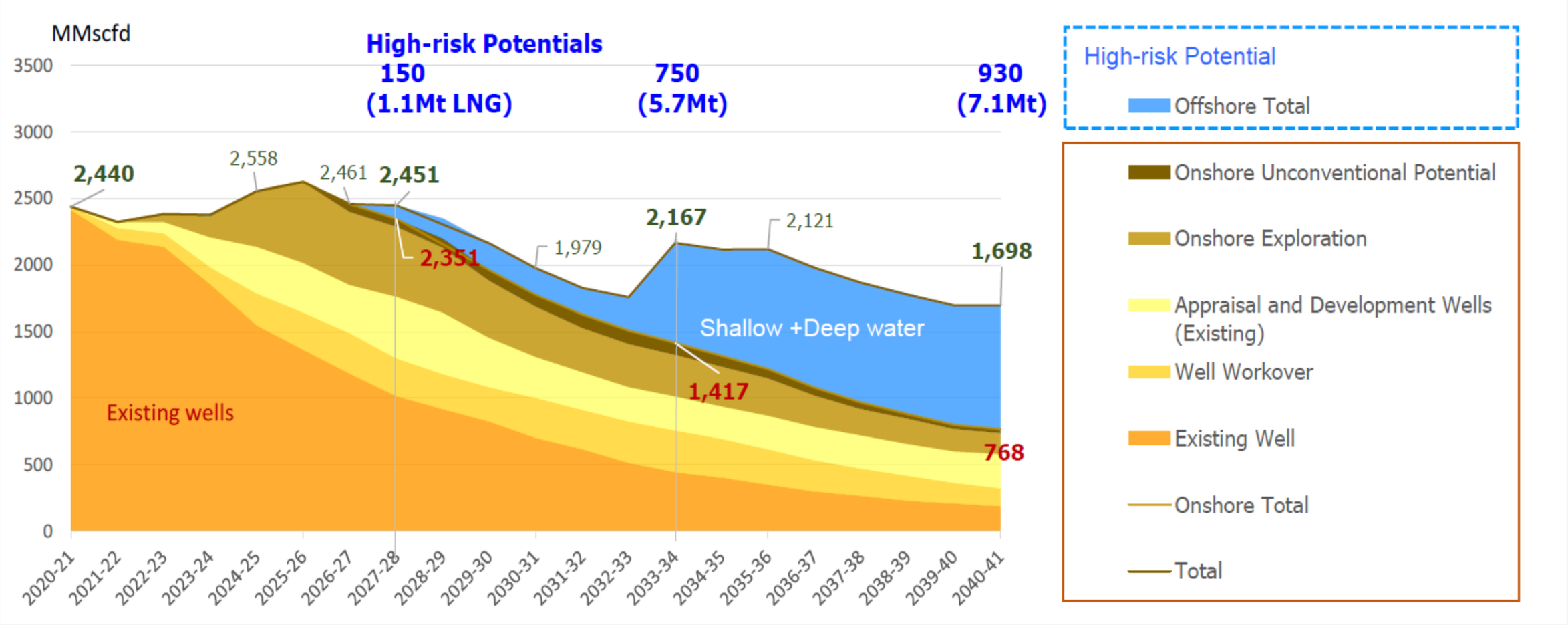
3.1 Scenario Analysis of Energy Mix

3.1.1 Coal

Issues Discussed in IEPMP	Comments
• Updated version of the IEPMP tries to promote coal based energy • Bangladesh's total coal reserves are 7.8 billion tons, which equates to 200 Tcf of natural gas (even with a 10% recovery rate, this still amounts to 20 Tcf, or 2,730 million cf/d for 20 years). • Feasibility study has been completed- Expansion plan of Barapukuria Coal Mine (BCMCL), Development plan for Dighipara coalfield, CBM at Jamalgonj. • The government strongly believes that new development of domestic coal should be avoided due to the problems faced by local residents and environmental issues.	❑ The dependency on imported coal needs to be reduced and substituted by alternative renewable energy sources to achieve the goal of clean energy. ❑ Feasibility study reports need to integrate the perception of SEA for several untapped coal mines. ❑ The policy must adhere to the global “Just Transition "coal phasing out momentum to have a sustainable and clean energy supply.

3.1 Scenario Analysis of Energy Mix

Domestic Natural Gas Production as Projected in the IEPMP



3.1 Scenario Analysis of Energy Mix

Domestic Natural Gas Supply Balance as Projected in the IEPMP

Outlook of Natural Gas Supply Balance

	2019	2022	2030	2035	2040	2045	2050
Gas Demad	mmcfd	mmcfd	mmcfd	mmcfd	mmcfd	mmcfd	mmcfd
PP2041	2,870	2,987	3,384	4,008	4,985	5,823	8,142
In-Between	2,870	2,989	2,879	3,213	3,717	3,982	4,545
Production							
Low Risk Potential	2,494	2,386	1,779	1,221	768	580	470
High Risk Potential			200	900	930	1,080	1,230
Total	2,494	2,386	1,979	2,121	1,698	1,660	1,700
LNG Demand (mmscfd)							
PP2041: Base	376	601	1,405	1,887	3,287	4,163	6,442
Without High Risk Potential	376	601	1,605	2,787	4,217	5,243	7,672
In-Between: Base	376	603	900	1,092	2,019	2,322	2,845
Without High Risk Potential	376	603	1,100	1,992	2,949	3,402	4,075
LNG Demand (million tonnes)	Mt	Mt	Mt	Mt	Mt	Mt	Mt
PP2041: Base	2.9	4.6	10.8	14.5	25.2	31.9	49.4
Without High Risk Potential	2.9	4.6	12.3	21.4	32.3	40.2	58.8
In-Between: Base	2.9	4.6	6.9	8.4	15.5	17.8	21.8
Without High Risk Potential	2.9	4.6	8.4	15.3	22.6	26.1	31.2

3.1 Scenario Analysis of Energy Mix

3.1.2 Natural Gas

Issues Discussed in IEPMP	Comments
• Onshore and offshore production from new sources is anticipated to increase existing production. • The production that will be attained by the current drilling program is one of these new sources. • Exploration efforts have not yet established offshore potential. • Loop systems and trunk pipelines must be built to guarantee a steady and secure supply of natural gas. • To stabilize the supply of gas in the system, the national gas pipeline network should be upgraded with larger diameter pipes, a measuring system, and pipeline loops with multiple input points.	❖ Exploration of off-shore and on-shore natural gas sources needs to be done properly ❖ Evaluate the transmission module for gas supply. ❖ Transmission lines would require to be less if LNG demand is not so high

3.1 Scenario Analysis of Energy Mix

3.1.3 LNG

Issues Discussed in IEPMP	Comments
• IEPMP promotes LNG • Following the completion of the Matarbari onshore LNG terminal, more pipeline connections to Dhaka will be required as LNG imports rise. • The shallow topography of Bangladesh restricts the options for locations for LNG receiving terminals. • Due to this, a total of 1,000 mmcfd of LNG vaporized gas has been delivered to the pipeline by two offshore LNG receiving terminals using FSRUs	❖ LNG based energy development needs to substituted by domestic natural gas ❖ Reconsider the country's current strategy to the increasing reliance on LNG imports for electricity generation and the accompanying infrastructure development plans. ❖ From a macroeconomic challenges point of view, there is demand for shifting towards renewable energy rather than focusing on LNG.

3.1 Scenario Analysis of Energy Mix

3.1.4 Oil

Issues Discussed in IEPMP	Comments
• Major planned projects include • Distillation unit 2 at the ERL U2 • New SPM • One LPG import terminal • Petroleum products import pipeline from India • IEPMP assumes following additional supply capacity projects until 2050: • Additional crude distillation unit • New SPM • Additional LPG terminals	❖ Oil is heavily based on imports which need to be replaced by clean energy sources ❖ The supply capacity projects need to have a proper monitoring and evaluation module. ❖ Feasibility studies of renewable energy replacing oil should be constructed in terms of efficiency, affordability and sustainability.

3.1 Scenario Analysis of Energy Mix

Petroleum Supply Plan according to the IEPMP

Unit: million tons per year	2021FY	2030FY	2041FY	2050FY
Total liquid fuel demand	**12.3**	**17.5**	**30.4**	**43.1**
Refinery production	**2.0**	**5.0**	**10.0**	**8.5**
ERL-1	1.5	1.5	1.5	
ERL-2		3.0	3.0	3.0
ERL-3 (replace ERL-1)			5.0	5.0
Other small refineries	0.5	0.5	0.5	0.5
Product import (excl LPG)	**8.9**	**10.0**	**15.4**	**24.6**
BPC@Chittagong	4.5	5.0	5.0	5.0
IBFPL		1.0	1.3	1.3
SPM-1@Chittagong		3.0	9.0	9.0
New SPM@TBD (excl crude oil)			0.1	9.3
HSD/FO for IPP	4.4	1.0	0.0	0.0
LPG	**1.4**	**2.5**	**5.0**	**10.0**
Existing LPG terminal	1.4	1.5	2.0	2.0
ERL	0.0	0.1	0.3	0.2
New LPG Terminals@TBD		0.9	2.7	7.8

3.2 Power Development Plan

Methodological Approaches

IEPMP

- Technological assessment model
  - Bottom-up approach
- Econometric modeling
  - Regression analysis
- Micro level demand forecasting was adopted

CPD

- Recommended to follow a bottom-up approach for demand forecast
- A simple forecast was not enough and suggested for an inclusive regression model rather than using Correlation analysis, Electricity Intensity Method, GDP Elasticity Method

Remarks

- ❖ The forecasted demand is somewhat questionable which needs to do a thorough revision.
- ❖ Other methodologies need to be incorporated in the final draft.

3.2 Power Development Plan

Key Variables

IEPMP

- The power demand forecast in IEPMP is not entirely based in the GDP growth rate rather includes several variables such as GDP, Population, Energy Prices, Previous Demand, Exchange Rates and International Trade

CPD

- It was strongly recommended that projection based on only GDP is a faulty way rather variables such as the income of a household, population, historical load data weather or temperature can be incorporated in the projection

Remarks

- ❖ Needs to incorporate the projections from global sources like IMF
- ❖ Needs to address the global energy crisis connected with dollar market volatility.

3.2 Power Development Plan

Estimation of Maximum electricity Demand

IEPMP

- The annual maximum electricity demand (MW) estimation is obtained using the electricity energy demand (GWh) estimation
- Subtract from the final electricity consumption the supply from captive power and roof-top solar power, because these will not be supplied by grid-connected generators

CPD

- Power consumption of captive power should be excluded from the national demand

3.2 Power Development Plan

GDP Case Setting

IEPMP

- 3 GDP cases (1 main and 2 exercise): REF, PP2041, in between
- Real GDP: Perspective Plan 2041
- GDP In- between case
- IMF Ext Case

CPD

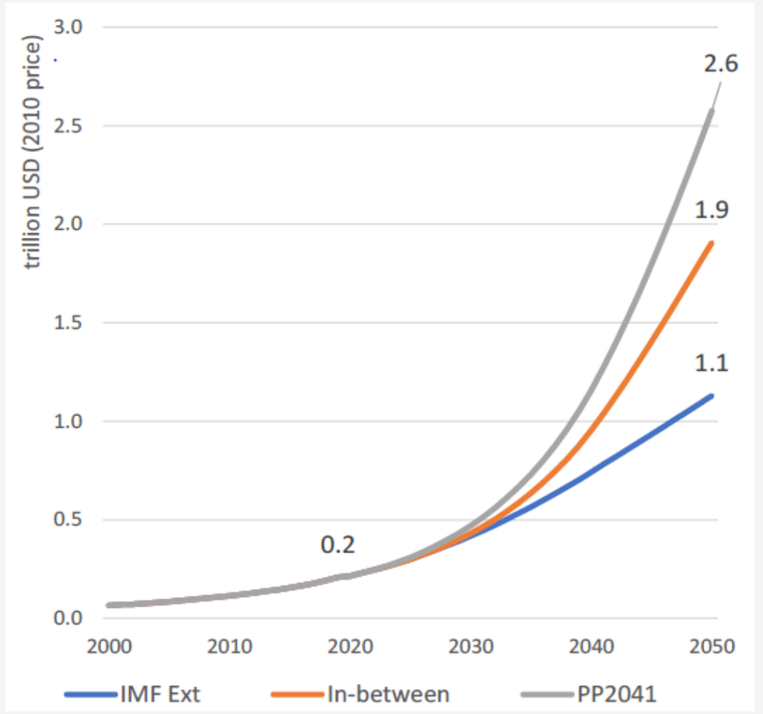
- GDP growth rate used in previous PSMPs seemed overestimated and unrealistic.
- It was suggested that the projection of power demand should be based on a more practical growth rate

3.2 Power Development Plan

GDP Case Setting

Assumption of GDP Growth

Year	PP2041	In- between	IMF Ext.
2000		5.30%	
2012		6.50%	
2019		8.20%	
2020		3.50%	
2021		6.90%	
2025	8%	6.90%	7.20%
2030	8.90%	7.70%	6.60%
2035	9.40%	8.20%	6.00%
2041	9.90%	8.70%	5.30%
2045	8.50%	7.30%	4.30%
2050	6.80%	5.60%	3.60%

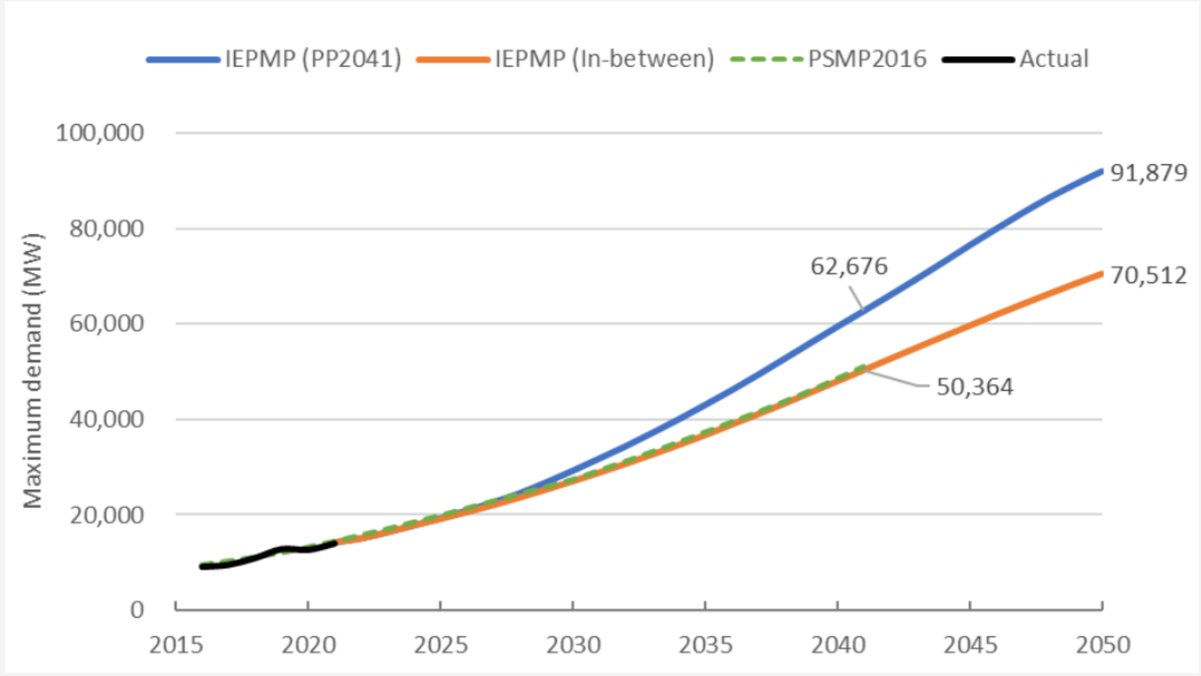


3.2 Power Development Plan

Electricity Demand Forecast

	2019		2030		2041		2050	
	Growth Rate	Maximum demand (MW)	Growth Rate	Maximum demand (MW)	Growth Rate	Maximum demand (MW)	Growth Rate	Maximum demand (MW)
PP2041	7.70%	12,893	7.20%	29,257	4.30%	62,676	6.50%	91,879
In- between	7%	12,893	5.80%	27,087	3.80%	50,364	5.60%	70,512

Maximum Demand Forecast



3.2 Power Development Plan

Sectoral Approach for Demand projection

IEPMP	• The energy consumption of these sectors have been segregated in electricity and non- electricity criteria and the sectors are industry, transport, residential, commercial, agriculture and non-energy sector.
CPD	• Suggested that IEPMP should do a micro prediction by a sectoral and sub- sectoral approach for power demand estimation.

3.3 Final demand (Technology Settings)

Under NZS

Issues	June Draft	December Updates	Remarks
Energy Conservation in Industry Sector	-43.2% (-2.0%/year) in 2050 from the REF level w/o price effect.	-43.2% (-2.0%/year) in 2050 from the REF level, holding other conditions constant.	No change.
Electrification in Industry Sector	+20.0% points in 2050 from the REF level w/o price effect.	+15% points in 2050 from the REF level, holding other conditions constant.	Deteriorated.
Hydrogen in Industry Sector	Non-electricity energy will shift to hydrogen through 2050.	Non-electricity energy will shift to hydrogen through 2050.	No change.
Fuel Economy in Road Sector	IMF Ext: +149% in 2050 from the 2019 level In-between: +174% in 2050 from the 2019 level PP2041: +201% in 2050 from the 2019 level	IMF Ext: +130% in 2050 from the 2019 level, In-between: +170%, PP2041: +200%	Deteriorated.
Evs in Road Sector	100% of passenger light-duty vehicles (PLDVs) and 90% of trucks and buses (TRBSs) will shift to electric vehicles (EVs) in 2050.	100% of passenger light-duty vehicles (PLDVs) and 90% of trucks and buses (TRBSs) will shift to electric vehicles (EVs) in 2050.	No change.
Hydrogen in Road Sector	10% of TRBSs will become fuel-cell vehicles (FCVs) in 2050.	10% of TRBSs will become fuel-cell vehicles (FCVs) in 2050.	No change.
Energy Conservation in Residential Sector	-34.5% (-1.5%/year) in 2050 from the REF level w/o price effect.	-34.5% (-1.5%/year) in 2050 from the REF level, holding other conditions constant.	No change.
Electrification in Residential Sector	100% electrification.	100% electrification.	No change.
Energy Conservation in Commercial Sector	-43.2% (-2.0%/year) in 2050 from the REF level w/o price effect.	-43.2% (-2.0%/year) in 2050 from the REF level, holding other conditions constant.	No change.
Electrification in Commercial Sector	100% electrification.	100% electrification.	No change.

3.3 Final demand (Technology Settings)

Advanced Technology Scenario

Issues	June Draft	December Updates	Remarks
Energy Conservation in Industry Sector	-24.5% (-1.0%/year) in 2050 from the REF level w/o price effect.	-24.5% (-1.0%/year) in 2050 from the REF level, holding other conditions constant.	No change.
Electrification in Industry Sector	+10.0% points in 2050 from the REF level w/o price effect.	+10% (+5%*) points in 2050 from the REF level, holding other conditions constant.	Deteriorated.
Hydrogen in Industry Sector	-	-	
Fuel Economy in Road Sector	IMF Ext: +6% in 2050 from the 2019 level In-between: +34% in 2050 from the 2019 level PP2041: +65% in 2050 from the 2019 level.	IMF Ext: +5% in 2050 from the 2019 level, In-between: +35%, PP2041: +65%.	Deteriorated.
Evs in Road Sector	About 40% of PLDVs and 10% of TRBSs will shift to EVs in 2050.	About 40% of PLDVs and 10% of TRBSs will shift to EVs in 2050.	No change.
Hydrogen in Road Sector	-	-	
Energy Conservation in Residential Sector	-13.1% (-0.5%/year) in 2050 from the REF level w/o price effect.	-13.1% (-0.5%/year) in 2050 from the REF level, holding other conditions constant.	No change.
Electrification in Residential Sector	+15.0% points in 2050 from the REF level w/o price effect.	+15% (+7.5%*) points in 2050 from the REF level, holding other conditions constant.	No change.
Energy Conservation in Commercial Sector	-13.1% (-0.5%/year) in 2050 from the REF level w/o price effect.	-13.1% (-0.5%/year) in 2050 from the REF level, holding other conditions constant.	No change.
Electrification in Commercial Sector	+1.3% points in 2050 from the REF level w/o price effect.	+1% points in 2050 from the REF level, holding other conditions constant.	Deteriorated.

* ATS In-between & ATS IMF Ext cases

3.4 Supply side of Power Generation (Technology Settings)

Under NZS

Issues		Interim Report	SHM3	Remarks
Renewables	Solar PV (Solar Park, Irrigation)		16 GW in 2050 with land use restriction	Has been added
	Solar PV (Rooftop)	45 TWh (25.7 GW considering 20% LoE) in 2050 with land use restriction	12 GW in 2050 on rooftops of the buildings	Deteriorated
	Onshore wind	10 TWh (0.6 GW considering 20% LoE) in 2050 on rooftops of the buildings	5 GW in 2050, mainly coasts	Deteriorated
	OFFshore wind	130 (74.2 GW considering 20% LoE) TWh in 2050, mainly coasts	50 GW (near seas + EEZ) in 2050 excl. heritage	Improved
Nuclear	Eight (8) units by 2050		Eight (8) units by 2050	No change
Coal-fired	50% ammonia co-firing around 2030 and 100% ammonia single-firing around 2042		50% ammonia co-firing around 2030 and 100% ammonia single-firing around 2042	No change
Gas-fired	100% hydrogen single-firing will start around 2035 and replace 70% of gas-fired power through 2050.Gas-fired with CCS will start around 2036 and achieve 30% of the gas-fired power in 2050		100% hydrogen single-firing will start around 2035 and replace 70% of gas-fired power through 2050.Gas-fired with CCS will start around 2036 and achieve 30% of the gas-fired power in 2050	No change
Oil-fired	For about 1% of grid net power generation in 2041, oil-fired power will remain through 2050.		For about 1% of grid net power generation in 2041, oil-fired power will remain through 2050.	No change
Captive	Conventional captive power will be zero in 2050.		Conventional captive power will be zero in 2050.	No change
Import			15% of total electricity demand through 2050	Has been added

3.5 Supply side of Power Generation (Technology Settings)

Under ATS

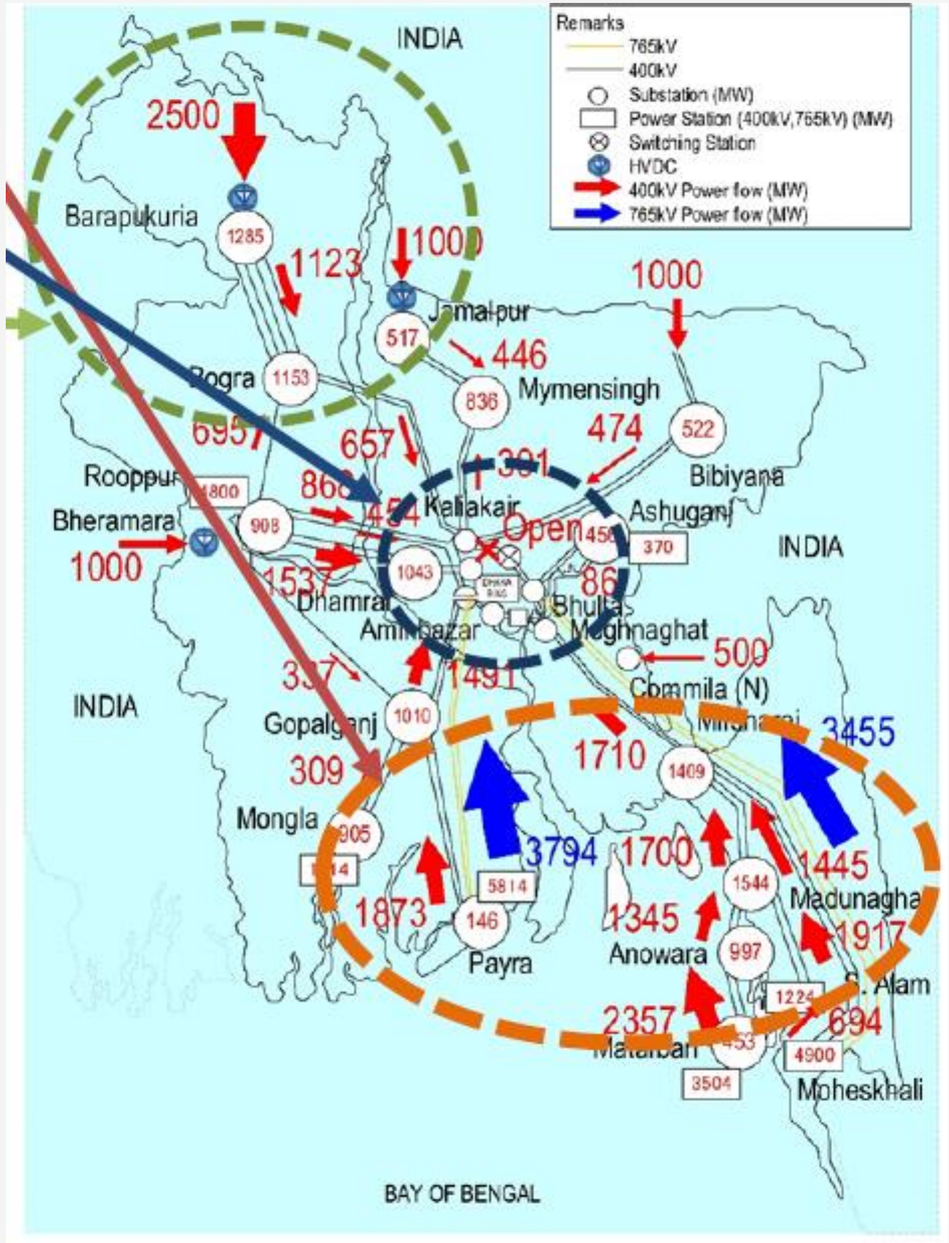
Issues		Interim Report	SHM3	Remarks
Renewables	Solar PV (Solar Park, Irrigation)		6 GW in 2050 with land use restriction	Has been added
	Solar PV (Rooftop)	30 TWh in 2050(18 GW considering 20% LoE)	12 GW in 2050 on rooftops of the buildings	Deteriorated
	Onshore wind	10 TWh in 2050 (0.6 GW considering 20% LoE)	5 GW in 2050, mainly coasts	Deteriorated
	Off shore wind	40 TWh in 2050 (24 GW considering 20% LoE)	15 GW (near seas + EEZ) in 2050 excl. heritage	Deteriorated
Nuclear	Six (6) units (four (4) units*) by 205050%		Six (6) units (four (4) units*) by 205050%	No change
Coal-fired	50% ammonia co-firing around 2030 and 100% ammonia single-firing around 2049		20% ammonia co-firing around 2030 (2035*) and 50% ammonia co-firing around 2035 (2040*)	Improved
Gas-fired	100% hydrogen co-firing will start around 2035 (2037*), 50% hydrogen co-firing will start around 2040 (2045*).Gas-fired with CCS will start around 2036 (2040*) and achieve 77 TWh (38 TWh**) in 2050.		20% hydrogen co-firing will start around 2035 (2037*), 50% hydrogen co-firing will start around 2040 (2045*).Gas-fired with CCS will start around 2036 (2040*) and achieve 77 TWh (38 TWh**) in 2050.	Partially Improved
Oil-fired	For about 1% of grid net power generation in 2041, oil-fired power will remain through 2050.		For about 1% of grid net power generation in 2041, oil-fired power will remain through 2050.	No change
Captive	Conventional captive power will remain a little in 2050, while high-efficiency co-gen system will be introduced from 2031 and reach 300 MW (app. 30 MW*10 towns) in 2050 nationally.		Conventional captive power will remain a little in 2050, while high-efficiency co-gen system will be introduced from 2031 and reach 300 MW (app. 30 MW*10 towns) in 2050 nationally.	No change
Import			Less than 12% of total electricity demand through 2050	Has been added

3.5 Supply Reliability and Reserve Margin

	Interim Report (June 2022)		SHM3 (November 2022)			Remarks
	2030	2050	2030	2040	2050	
Reserve capacity rate	22%	11%	30%	25%	20%	The upward revision of the reserve capacity is not encouraged while we are bearing the burden of excess installed capacity. The access reserve capacity ratio will further add the financial burden of power sector
LOLE target (hours/year)	24	24	24	24	24	
Unplanned outage rate	8% or less	1% or less	12% or less	11% or less	10% or less	The targeted unplanned outage has been increased drastically. The target should be lowered and technical measures should be taken accordingly for limiting the power outage

3.6 Transmission and Distribution System

- **Increase of South to North Power Flow**
- **Reliability improvement of supply network to Capital Dhaka**
- **Interconnection**



3.6 Transmission and Distribution System

The following is a summary of how to deal with the three important issues in this IEPMP

a. Increase of South to North Power Flow

The future electricity demand growth shall basically be for the industrial demand of economic zones mostly outside of Dhaka

Crossing the Padma Bridge and narrow Feni region are constraints in constructing the transmission lines

Since this is the issue of long-distance transmission from large-capacity power sources, IEPMP plan to construct precisely simulating on the dynamic characteristics of the generators mainly on the large-capacity power sources

b. Reliability improvement of supply network to Capital Dhaka

For this issue, it is necessary to secure underground transmission line route from 400kV transmission ring to the center of Dhaka

It is important to simplify the relationship between demand points and underground transmission line routes through a radial system, and to maintain close cooperation between power generation, transmission and distribution utilities and share a common concept.

c. Interconnection

The interconnectivity lines to be introduced will be decided as a result of coordination with neighboring countries from the aspect of energy security and the aspect of securing the amount of renewable energy to be introduced

As a power transmission system plan, the effect of mitigating the instability of the system due to the issue can be expected, so it is important to establish and respond to the technology that precisely simulates the dynamic characteristics of the generator as in the issue

3.6 Transmission and Distribution System

- All the three aspects are matters of importance and to be emphasized upon but there is still lack of a strong, digital and smart national grid system
  - IEPMP team recommended to establish a smart grid with GIS and SCADA as components in order to reduce distribution system losses, theft and leakage.
- As for DMS or Smart Grid, each company will be on the stage to consider full-scale introduction in the future.
  - DPDC and DESCO are currently preparing to introduce DMS (Distribution Management System) together with the smart grid project. is also planning to introduce it
  - BREB has completed feasible study
- More aggressive, active and planned approach is required to introduce the Smart grid and smart metering system

3.7 Electricity Tariffs

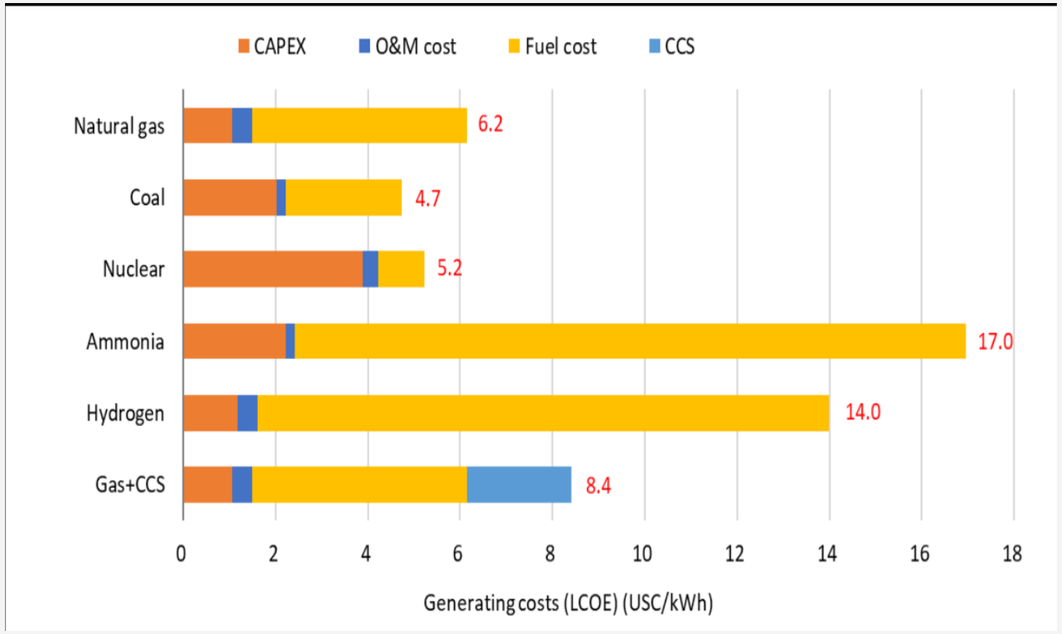
- Under ATS, the IEPMP interim report decided to operate 50% ammonia co-firing around 2030 and 100% ammonia single-firing around 2049.
  - Later on, the plan was further developed and it has been decided that 20% ammonia co-firing around 2030 (2035*) and 50% ammonia co-firing around 2035 (2040*)
- Under NZS, 50% ammonia co-firing around 2030 and 100% ammonia single-firing around 2042 has been decided

- The findings from JICA study team demonstrates that the generating cost of ammonia and hydrogen based power plants are more than double than the generating cost of natural gas based power plants

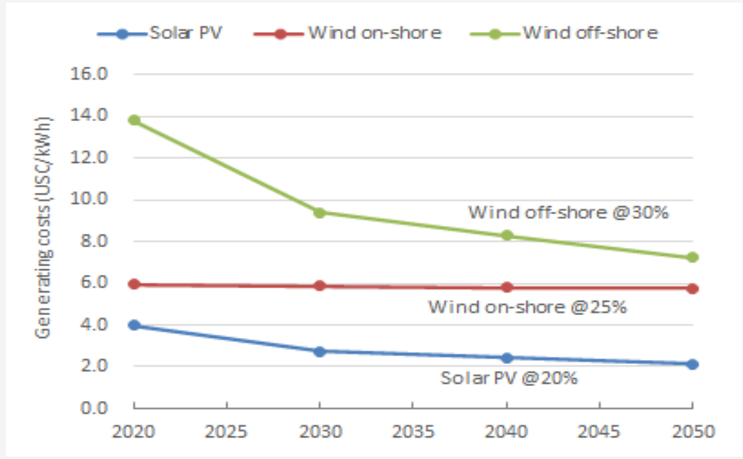
- On the other hand, the generating cost of electricity from RE based sources are lower compared to that of thermal energy and even shoes a further decreasing trend in future

- So there doesn't seem any logical reason to obtain the costly thermal energy based power generation over the cheaper RE ones

Generating costs of thermal power plants



Generating costs of RE power plants



Source: JICA- IEPMP Third Stakeholders Meeting

4. Energy Transformation

4.1 Energy Efficiency (EE)

- Under the *Energy Efficiency and Conservation Master Plan*, the government aims to lower energy intensity (national primary energy consumption per unit of GDP) in 2030 by 20% compared to the 2013 level.
  - A total of 95 million toe (113 billion m3 of gas equivalent) is expected to be saved during the period.

Issues Discussed in IEPMP	Comments
• A chapter dedicated to "*Improving Energy Efficiency*", where energy efficiency policies were discussed in the industrial, residential, and commercial sectors. • No sector-wise energy efficiency targets were shared. • Challenges of energy efficiency and conservation (EEC) policy in the industrial sector were shared. • The targets set in EECMP2016 for total energy consumption in the residential and building sectors were highlighted.	• The chapter does not sufficiently address sector-specific targets or plan to achieve low energy intensity by 2030. • No proposition was given on overcoming the challenges of adopting EEC policies in the industrial sector. • The reflection of EECMP2016 in IEPMP is appreciative; however, proper framework or guidelines on attaining those targets could have been worked out.

4.2 Low Carbonization & Decarbonization

Issues Discussed in IEPMP	Comments
• In the power sector, clean energy such as renewables, nuclear and decarbonization technologies including ammonia co-firing, hydrogen single-firing and gas-fired power with CCS are expected to start to diffuse in both net-zero scenario (NZS) and advanced technology scenario (ATS).	• The objective of IEMPMP mentions about low-carbonization and/or decarbonization. • The target of achieving 40 percent of the country's energy from clean sources by 2041 • A timeline was shared for the introduction of decarbonization technologies. • IPEMP includes coal and other fossil fuel based energy with advanced technologies as ‘clean’ • IEPMP should exclude technology based hydro-carbon as clean energy • It should replace RE as the prime source of clean energy: only 12GW out of 26GW is planned to be generated from RE

4.2 Low Carbonization & Decarbonization

CO2 Emission Targets

- **June Draft**
  The emissions will be the largest in REF, followed by ATS and NZS. The emissions of REF will significantly grow to around 515 million tons-CO_2 in 2050. The emissions of ATS will be much more moderate at 355 million tons- CO2 in 2050, which is almost a two third of the REF level. The emissions of NZS will be, by definition, almost zero in 2050.
- **December Update**
  The emissions of ATS PP2041 will be much more moderate at 305 million tons-CO2 in 2050 compared with 486 million tons-CO2 in REF PP2041.
  As well, that of ATS In-between will be even lower at 266 million tons-CO2 in 2050.

4.2 Low Carbonization & Decarbonization

GHG emission reduction scenario

UNFCCC Sector	Sub-Sector	GHG Emission		GHG Reduction by Mitigation (2030)							
		BAU 2030		Unconditional			Conditional			Combined	
		MtCO2e	In %	MtCO2e	Reduction MtCO2e	In %	MtCO2e	Reduction MtCO2e	In %	Reduction MtCO2e	In %
Energy	Power	95.14	23.24	87.13	8.01	29.06	51.4	35.73	57.72	43.74	48.9
	Transport	36.28	8.86	32.89	3.39	12.30	26.56	6.33	10.23	9.72	10.86
	Industry (energy)	101.99	24.91	95.33	6.66	24.17	94.31	1.02	1.65	7.68	8.58
	Other energy sub-sectors:										
	Households	30.41	7.43	28.78	1.63	5.91	24.77	4.01	6.46	5.64	6.3
	Commercial	3.35	0.82	2.94	0.41	1.49	2.51	0.43	0.69	0.84	0.94
	Agriculture	10.16	2.48	9.37	0.79	2.87	10.13	0.03	0.05	0.82	0.92
	Brick Kilns	23.98	5.86	20.7	3.28	11.90	12.82	7.88	12.73	11.16	12.47

UNFCCC Sector	Sub-Sector	GHG Emission		GHG Reduction by Mitigation (2030)							
		BAU 2030		Unconditional			Conditional			Combined	
		MtCO2e	In %	MtCO2e	Reduction MtCO2e	In %	MtCO2e	Reduction MtCO2e	In %	Reduction MtCO2e	In %
	Fugitive	8.31	2.03				4.03	4.28	6.91	4.28	4.78
	F Gases	2.92	0.71	0.78	2.14	7.76	0.03	0.75	1.21	2.89	3.23
Total Energy		312.54	76.34	286.23	26.31	95.46	226.56	59.71	96.46	85.98	96.1
IPPU	Cement and Fertilizer	10.97	2.68	10.97			10.97				
AFOLU	Agriculture and Livestock	54.64	13.35	54	0.64	2.32	53.6	0.4	0.65	1.04	1.16
	Forestry	0.37	0.09	0.37			0.37				
Total AFOLU		55.01	13.44	54.37	0.64	2.32	53.97	0.4	0.65	1.68	1.16
Waste	MSW and wastewater	30.89	7.55	30.28	0.61	2.21	28.44	1.84	2.97	2.45	2.74
Total Emission		409.41		381.85			319.94				
Total Reduction					27.56	6.73		61.9	15.12	89.47	21.85

4.3 Strategic Environment Assessment (SEA)

Strengths	Comments
• In the early stage, meaning consultation with stakeholders is conducted to promote broader participation to a reasonable extent and to ensure transparency and accountability of the master plan.	• In Bangladesh, SEA is not legally required, and the local laws and regulations do not stipulate specific procedures; however, the application of SEA is encouraged in National Environmental Policy (NEA) (2018) etc. In this study, SEA is conducted with consultation with Department of Environment (DoE) etc.
• This study will examine three scenarios: Reference Scenario (REF), Advanced Technology Scenario (ATS), and Net-Zero Scenario (NZS). SEA will assess each scenario (especially, power mix as of 2030 and 2050) through evaluation of environmental and social impacts and examination of mitigation measures and monitoring methods.	• Less feasibility studies based on this.
• SEA will provide recommendations for institutional improvement from environmental and social viewpoints to achieve the above-mentioned scenarios (e.g., suggestions for promotion of renewable energy), as well as examining management system of cumulative impacts in the areas such as Matarbari where lots of developments are planned.	• No outlined time frame and costing approach is identified in the SEA Plan.

4.3 Strategic Environment Assessment (SEA)

Sectors	Proposed Plans in IEPMP	Comments
Natural gas	Although natural gas-fired power plants emit less greenhouse gases than coal-fired power plants and other types of power plants, it is necessary to pay attention to environmental aspects such as air quality, water quality, and ecosystems, as well as to resettlement and accidents that may occur when securing land for the plants.	• No Technological aspect with proper planning has been mentioned. • Less information about expertise team conducting SEA. • Costing burden are also not distributed.
Coal	In the SEA, the evaluation will take into account the following points: (1) development of port facilities, (2) construction of coal-fired power plants, and (3) construction of power transmission and distribution networks. Particular attention will be paid to the climate change impacts and air pollution associated with coal-fired power generation.	• No inclusion of Carbon Capture Technology in the methodology. • Less of particular feasibility study Budget. • Post-combustion carbon capture (the primary method used in existing power plants), pre-combustion carbon capture (largely used in industrial processes), and oxy-fuel combustion systems are not mentioned.
Oil	SEA will pay attention to climate change, air and water pollution, ecosystems, land acquisition and resettlement, accidents, etc	• The government should invest more funds in capacity building, by providing the necessary training of staff government environmental parastatals and also making available necessary facilities and legally empowered to do their duties effectively • Comparative studies between technologies need to be covered.

4.3 Strategic Environment Assessment (SEA)

Sectors	Proposed Plans in IEPMP	Comments
Wind	1.Bangladesh is located on two migratory bird routes: the East Asian-Australasian Flyway (EAAF) and the Central Asian Flyway (CAF), and the impacts on migratory birds associated with wind farms will be considered. 2. From a livelihood perspective, the impact on inland and marine fisheries, as well as aquaculture and other industries in coastal areas, should be taken into account	• Multidisciplinary approach including experts from ecology is not counted. • Gap in baseline study for collecting necessary data.
Nuclear	In SEA, nuclear power generation emits less greenhouse gases than coal-fired power generation, etc.; however, the evaluation will take into account safety aspects, especially accidents during nuclear power plant operation, and management of radioactive materials (waste, exhaust gas, wastewater, etc.).	• Extreme Safety measure plan is not mentioned. • No technology has been mentioned for a toxic burst out or accident. • No proper stages are mentioned for SEA.
Ammonia	it is necessary to consider the impact of production process, such as the procurement of hydrogen as a raw material	• No outline of feasibility plan and technological costings.

4.3 Strategic Environment Assessment (SEA)

Sectors	Proposed Plans in IEPMP	Comments
Hydrogen	• SEA will consider environmental and social impacts of hydrogen production, hydrogen power generation, and transmission and distribution. Hydrogen emits no greenhouse gases during power generation. • In addition, for green hydrogen made from renewable energy sources, etc., environmental and social impacts at the electricity procurement stage, such as wind and solar power generation, will also be examined. • In addition, from a social perspective, hydrogen is an extremely flammable and combustible gas, so as an environmental and social risk related to hydrogen, the attention must be paid to safety management during storage and transportation.	• Further study for the scope of hydrogen as a renewable by product has not been empirically addressed. • Risk mitigation measurement in the factories is missing.

4.3 Strategic Environment Assessment (SEA)

June Draft IEPMP vs December Updates

Issues	December Updates
SEA	• A work plan and schedule has been added, which was not present in the June draft. • Four level (policy, plan, program, and project) segregation was added. • Balanced approach involving characteristics, policy, and technology in the three scenarios – REF, ATS, and NZS were included. • Alternatives regarding economic affordability, environmental sustainability, and energy supply security were added. • Strategic environmental objectives including the parameters biodiversity, fauna, and flora, air and climate factors, labor and land acquisition were added.

4.4 Carbon emission

IEPMP	Comments
• By utilizing cutting-edge technologies, such as hydrogen as a clean replacement for fossil fuels, the draft IEPMP seeks to achieve net zero carbon emissions. • Targets:	• On the basis of net-zero principles, where zero carbon emission will have prime importance, emerging technologies should be employed to handle supply and demand issues in the energy and power sector.

4.5 Technological Advancement, Research and Development

IEPMP	Comments
• A chapter was dedicated for Energy Data Management	• No particular mention of data management.
• Hydrocarbon Unit takes several days to re-enter data from different energy supply companies.	• It is necessary to improve work efficiency by eliminating re-entry.
• Bangladesh Bureau of Statistics does not have any energy experts, but two staff in charge of mining and quarrying and power are compiling energy data.	• Qualified staffs need to be recruited for specific data management jobs and they should be trained regularly.
	• Neither Bangladesh have carbon capture technology (CCT) installed in any power plants, nor have any feasibility studies been carried out on the topic of CCT.

5. Renewable Energy

5.1 RE in IEPMP

Issue	Interim Report (June 2022)	SHM3 (November 2022)	Remarks
Perspective on RE	Initially the draft IEPMP report didn't seem to give enough importance towards RE, the discussion has been more focused on the challenges and limitations rather focusing on the expansion	The possible scopes to explore existing solar, wind, waste energy based on Solar Energy Roadmap, Wind Energy Plan and other RE based researches. It particularly defines that the targeted power generation from RE sources is possible	The total discussions seem to be limitation and challenge based rather than looking for the opportunity and chances for expanding and promoting RE in Bangladesh. The presented paper in the SHM3 includes the recommended possible scopes to explore existing solar, wind, waste energy but it doesn't necessarily mention the way to attain the 40 per cent clean energy by 2041 goal
Target	No target was set	40 per cent clean energy target has been set	The ambitious goal of achieving 40 percent from clean energy is praise worthy, at the same time it should be more clearly pointed out that whether these 40 per cent should come from renewable or from some other cleaner sources
Solar	IEPMP rightfully mentioned the importance of solar PV in Bangladesh, it is necessary to promote the introduction of solar parks as aggressively as possible. IEPMP discusses the limitations of expanding the use of solar PV in Bangladesh, which is the constraint of lands	Justifies the possible options discussed in several	As the characteristics of the solar power plant sites have been identified, the feasibility test should be executed for understanding the actual situation

5.1 RE in IEPMP

Issue	Interim Report (June 2022)	SHM3 (November 2022)	Remarks
Rooftop PVs	IEPMP recommended the following measures to promote the introduction of Rooftop PV be considered Public Sector Mandatory introduction of Rooftop PV	Currently the installed Rooftop solar PV is 400 MW which is targeted to increase at 2000 MW by 2030 and 12000 MW by 2050	Less ambitious target has been set. By 2030 and 2050 much more electricity can be generated from Rooftop solar PVs
Wind	Data collection of wind power has been emphasized in IEPMP, as there is a lack of progress in the wind in Bangladesh	The IEPMP acknowledges that forecasted value of 5,000 MW of on-shore wind power by 2050 is not excessive	The target seems fine but the technical aspects needs to be looked into such as the height of the wind turbine should be based on the international standard
Hydro	IEPMP projected that around 2041, approximately 5,000 MW of hydropower could be imported, mainly from Bhutan, Nepal and north-eastern India.	in 2030 the target is 230 MW and by 2050 it is 330 MW	
Waste to energy	IEPMP defines that usefulness of Waste to Power from the perspective of 3R (Reduce, Reuse, Recycle) and expected to expand the introduction of several MW class in rural areas, in addition to the introduction of power plants of the same scale in metropolitan areas such as Chattogram	in 2030 the target is 93.5 MW, by 2041 150, and by 2050 it is 230 from three committed power plants at Nrayonganj, Aminbazar and Dhaka	

6. Adequacy of the Objectives in the Overall IEPMP

6. Adequacy of the Objectives in the Overall IEPMP

6. Adequacy of the Objective in the overall IEPMP (5 BEST, 1 WORST)

	Scope of the policy	Feasibility Study	Way Forward Guidelines	Time Frame
Objective 1	**Moderate** • The targeted goals of each section has been well defined • Some specialized sectors regarding transition to Renewable energy were not adequately addressed.	**Moderate** • Feasibility studies along with the proposed plans are mostly in process or completed. • Evaluation of feasibility policy needs to be revised.	**Below average** • Each chapter needs to have separate “way forward” guidelines.	**Moderate** • A well defined long term goal but needs to address the short and medium term benchmarks.
Objective 2	**Below average** Less goals regarding the pathway of decarbonization have been addressed.	**Poor** Very less feasibility studies targeting technological advancement.	**Poor** Need to have multiple portions significantly focusing on the way forward of RE.	**Below average** No significant short or medium term benchmark has been addressed.

7. Concluding Remarks

7. Concluding Remarks

- The IEPMP 2021 formulation process is found to be distinctive in number of accounts
  - A comprehensive plan which accommodate energy and power related issues
  - A specialized research organization has been involved in providing technical support
  - A consultative process has been followed though it is not reached to the level of partnership
- The Plan considers carbon neutral economic perspective though it is not fully reflected in operational issues
- The Plan has made revision since the first draft was available in May/June 2022
  - A revised version is available in November 2022
  - Findings have been presented to different stakeholder groups
  - Taking into consideration of number of issues
  - Some are positive and some are negative
- The plan though found to be relatively rigorous but cannot come out from a number of biasness
  - Over reliance on GDP estimates
  - Reliance on coal and LNG as important fuel mix

7. Concluding Remarks

- GDP estimate based on PP2041 made the whole exercise unreliable
  - To reduce the biasness an alternate scenario ‘in-between’ is proposed which also seems high
  - A more realistic assumption on GDP estimates is highly important
- This GDP estimate has made a highly ambitious energy demand for 2040 and 2050
  - This has made some demand projections in energy mix, power demand and supply
- The commitment of 40% of RE has been shifted to 40% of clean energy
  - This apparently seems logical
  - This however includes coal and other hydrocarbon based energy mix with advanced technologies as ‘clean’ which is not acceptable
- It is expected that an alternate scenario called ‘40% RE by 2040’ needs to be set
  - Necessary modeling and exercise needs to be undertaken
- The Plan directly and indirectly promote coal and coal based energy
  - This should is not accepted
- The Plan does not take into account the fiscal burden due to use of fossil fuel and excess reserve margin
  - The Plan is not properly discussed the impact and implications on energy tariff – proposed technological choice would raise energy price significantly

Thank you.