The People's Republic of Bangladesh
Ministry of Power, Energy and Mineral Resources

The Project for Development of Energy Efficiency and Conservation Master Plan in Bangladesh

Final Report

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Japan International Cooperation Agency

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TABLE OF CONTENTS

APPENDICES

ANNEX (SEPARATE VOLUME)

Energy Efficiency and Conservation Master Plan up to 2030

LIST OF TABLES

LIST OF FIGURES

ABBREVIATION

AC	Air Conditioner
ACEA	Accredited Energy Auditor
ADB	Asian Development Bank
AFD	Agence Française de Development
APF	Annual Performance Factor
APP	Asia Pacific Partnership
BAB	Bangladesh Accreditation Board
BAU	Business as Usual
BB	Bangladesh Bank
BBS	Bangladesh Bureau of Statistics
BCCF	Bangladesh Climate Change Resilience Fund
BCIC	Bangladesh Chemical Industries Corporation
BCSA	Bangladesh Cold Storage Association
BCSIR	Bangladesh Council of Scientific and Industrial Research
BDS	Bangladesh Standard
BERC	Bangladesh Energy Regulatory Commission
BGMEA	Bangladesh Garment Manufacturers & Exporters Association
BJMA	Bangladesh Jute Mills Association
BNBC	Bangladesh National Building Code
BNBC [Revised]	New Version of Bangladesh National Building Code
BOCM	Bilateral Offset Credit Mechanism
BPC	Bangladesh Petroleum Corporation
BPDB	Bangladesh Power Development Board
BREB	Bangladesh Rural Electrification Board
BRESL	Barrier Removal for Energy Standards and Labeling
BRMA	Bangladesh Re-Rolling Mills Association
BSFIC	Bangladesh Sugar & Food Industries Corporation
BSTI	Bangladesh Standardization and Testing Institute
BTMA	Bangladesh Textile Mills Association
BUET	Bangladesh University of Engineering and Technology
CASBEE	Comprehensive Assessment System for Built Environment Efficiency
CBM	Condition Based Maintenance
CC	Climate Change
CCEB	Catalyzing Clean Energy in Bangladesh
CDM	Clean Development Mechanism
CEA	Certified Energy Auditor
CEM	Clean Energy Ministerial
CFL	Compact Fluorescent Lamp
CNG	Compressed Natural Gas
COP	Co-efficient of Performance
CP	Counter Part
CPP	Critical Peak Pricing
CSPF	Cooling Season Performance Factor
CSR	Corporate Social Responsibility
CUM	Cubic Meter
DB	Data Base

DC	Designated (Large Energy) Consumer
DNCRP	Directorate of National Consumer Rights Protection
DoE	Department of Environment
DSM	Demand-side Management
EC	Energy Conservation
ECCJ	Energy Conservation Center, Japan
ECR	Environment Conservation Rules
EE	Energy Efficiency
EE&C	Energy Efficiency Improvement and Conservation
EECMP	Energy Efficiency Improvement and Conservation Master Plan
EER	Energy Efficiency Ratio
EGCB	Electricity Generation Company of Bangladesh
EIB	European Investment Bank
EM	Energy Manager
EMS	Energy Management System
ERD	Economic Relations Division (Ministry of Finance)
ESCO	Energy Service Company
FS	Feasibility Study
FY	Fiscal Year
GBG	Green Building Guideline
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GIZ	German International Development Corporation
GoB	Government of the People's Republic of Bangladesh
GoJ	Government of Japan
GW	Gigawatt
HBRI	Housing and Building Research Institute
HR	Human Resources
HVAC	Heating, Ventilating and Air Conditioning
IAP	Interim Action Plan
ICS	Improved Cooking Stove
ICT	Information Communication Technology
IDCOL	Infrastructure Development Company Limited
IEA	International Energy Agency
IEC	International Electrotechnical Commission
IPCC	Intergovernmental Panel on Climate Change
IPEEC	International Partnership for Energy Efficiency Cooperation
IPP	Independent Power Producer
IRENA	International Renewable Energy Agency
ISO	International Organization for Standardization
JCC	Joint Coordination Committee
JCM	Joint Crediting Mechanism
JERI	Japan Economic Research Institute Inc.
JICA	Japan International Cooperation Agency
J-POWER	Electric Power Company Co., Ltd.
kgoe	Kilo gram oil equivalent
kWh	Kilo watt hour
KPI	Key Performance Indicators

ktoe	Kilo ton oil equivalent
LDC	Least Developed Country
LGED	Local Government Engineering Department
LED	Light Emitting Diode
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
MAC	Marginal Abatement Cost
MDG	Millennium Development Goal
MEPS	Minimum Energy Performance Standard
METI	Ministry of Economy, Trade and Industry (Japan)
MFI	Micro Finance Institute
MGI	McKinsey Global Institute
MIC	Middle Income Country
MOC	Ministry of Commerce
MOEF	Ministry of Environment and Forest
MOHPW	Ministry of Housing and Public Works
MOI	Ministry of Industry
MPEMR	Ministry of Power, Energy and Mineral Resources
MW	Megawatt
NBFI	Non-bank Financial Institution
NCTB	The National Curriculum and Text Book Board
NGO	Non-government Organization
ODA	Official Development Assistance
OECD	Organization for Economic Co-operation and Development
OJT	On the Job Training
PDB	Power Development Board
PF	Power Factor or Plant Factor
PFI	Participating Financial Institution
PGCB	Power Grid Company of Bangladesh
PMU	Project Management Unit
PSCDP	Power Sector Capacity Development Program
PV	Photovoltaic
PWD	Public Works Department
RAJUK	Rajdhani Unnayan Kartripakkha; Capital Development Authority of the Government of Bangladesh
RE	Renewable Energy
SAARC	South Asia Association for Regional Cooperation
SCADA	Supervisory Control And Data Acquisition
SDG	Sustainable Development Goal
S&D	Sales and Distribution
SED	Sustainable Energy Development
SHS	Solar Home Systems
SLA	Subsidiary Loan Agreement
SME	Small and Medium size Enterprise
SREDA	Sustainable and Renewable Energy Development Authority
SWH	Solar Water Heater
TA	Technical Assistance (Capacity Development)
TBM	Time Based Maintenance

toe	Ton of oil equivalent
TOU	Time of Use
TPP	Technical Project Proposal
TSL	Two-step Loan
UNDP	United Nations Development Program
UNIDO	United Nations Industrial Development Organization
USAID	United States Agency for International Development
WB	World Bank

Executive Summary

Executive Summary

1. Objectives of the Project

The Government of Bangladesh (GoB) recognizes the importance of strengthening energy supply capacity to meet a rapidly increasing energy demand. GoB also understands energy efficiency and conservation (EE&C) as useful climate change mitigation and adaptation measures. In January 2014, GoB announced to carry out "The Project for Development of Energy Efficiency & Conservation Master Plan," (hereinafter referred as "the Project"), during the period from January 2014 to March 2015, targeting these achievements:

Development of EE&C Master Plan (hereinafter referred as "EECMP") to be recognized by the Government as a national plan, and action plan formulation to implement nationwide EE&C policy

Support for optimizing organization structure of the Sustainable and Renewable Energy Development Authority (SREDA), which has a responsibility for promoting EE&C in Bangladesh

Support for formulating EE&C awareness raising program in public and private sectors

Capacity development of Power Division in Ministry of Power, Energy and Mineral Resources (MPEMR) and SREDA

The Project focused on industrial, residential and commercial sectors, as the major energy consumer in Bangladesh, excluding the transportation sector and energy supply side.

The Project was carried out through on-site energy audits, market researches, interviews with relevant organizations, comparison/simulation study and identification of obstacles for EE&C promotion and proposal of useful measures to break through the obstacles.

The practical targets for major issues under this Project are summarized in Table 1-1.

Table 1-1 Targets for Major Issues under the Project

Program	Targets of the Project	Lead by
EE&C Master Plan	To draft Master Plan and Roadmap up to 2030	SREDA
Energy Management Program	To draft a framework of the program, including designation of large energy consumers, mandatory energy management and certification system	SREDA
EE Labeling Program	To draft a framework of the program, including data verification, laboratory test, measurement methods and star rating criteria	SREDA
EE Building Program	To propose eligible measures for the promotion of EE&C in buildings	MOHPW/SREDA

Program	Targets of the Project	Lead by
EE&C Finance Program	To propose EE&C financial incentive mechanism	SREDA/MOF
Economic and financial analysis	To conduct economic and financial analysis on major EE&C programs and projects	
Capacity development and awareness raising	To propose programs for capacity development and awareness raising	SREDA
IT infrastructure	To develop SREDA's webpage and energy consumption data collection mechanism	SREDA

2. Major Outputs of the Project

2.1 EE&C Master Plan (EECMP)

The structure of the documents on national EE&C implementation is shown in Figure 2-1. EECMP should be positioned at the top of organizations, actions and documents for national EE&C planning and implementation.

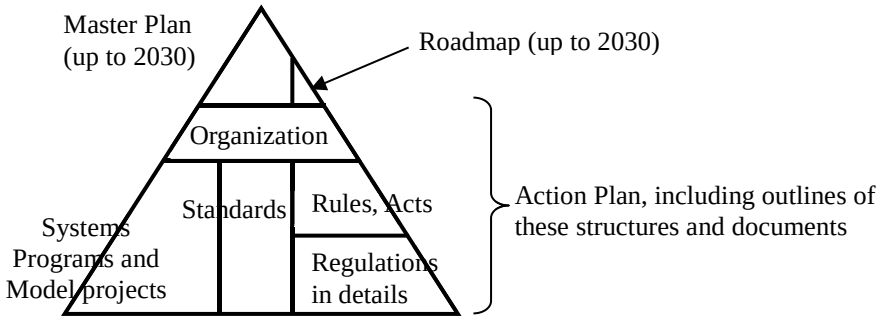


Figure 2-1 Documents' Structure on National EE&C Implementation

EECMP is Bangladesh commitment on EE&C implementation and will be officially presented to the country and the world. Figure 2-2 shows the core parts of EECMP, including EE&C target, roadmap, roles and responsibilities of parties, which is aimed to be read by Bangladesh people and establishments widely.

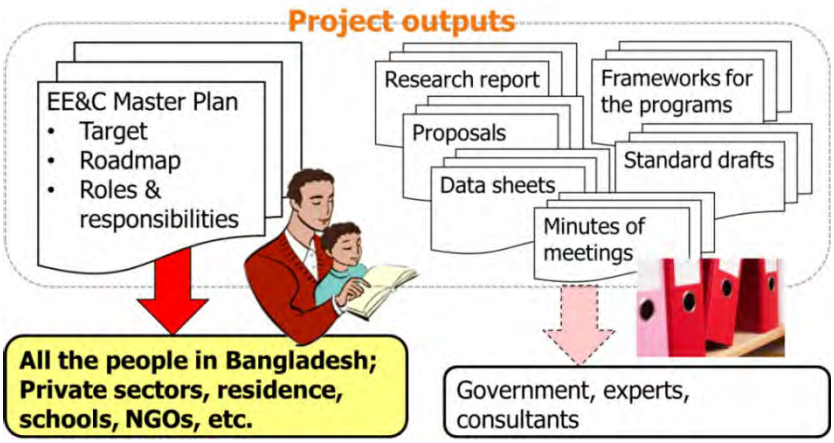


Figure 2-2 Objectives of EECMP

In EECMP, Bangladesh situation on energy supply/consumption, EE&C target, action plans, including many EE&C programs with specific roles and responsibilities of parties, capacity development, awareness raising and economic analysis methodology on EE&C programs, are described.

2.2 Energy Management Program

Introduction of suitable energy management is quite effective to promote EE&C for both industrial and commercial sectors. In Bangladesh, about 50% of primary energy is consumed in industrial sector. Thus, in order to accelerate EE&C in the industrial sector, the best way is to introduce energy management system. In this context, SREDA decided to establish a national program on energy management (Energy Management Program). The components of Energy Management Program are as follows:

- Definition of Designated Large Energy Consumers (DCs)
- Certification of Energy Manager (EM), Certified Energy Auditor (CEA) and Accredited Energy Auditor (ACEA).
- Periodical reporting system for DCs
- Benchmarking on energy efficiency by industrial sub-sector and/or production process

"Framework of Energy Management Program" was prepared sorting the program components. The framework can be the base of regulation on the program.

(1) Designation of large energy consumers

The designation criteria of DCs' annual primary energy consumption were decide, based on the energy consumption data and the results of energy audits for typical large energy consumers. Considering the limitation of SREDA's human resource, the number of DCs for the first stage was targeted around 100. After the related analysis, DC's criteria are proposed as 3 categories as 10,000 toe, 6,000 toe and 3,000 toe. For electricity, energy consumption amount should be calculated at generation level/point with 30% thermal efficiency. The estimated target number of

companies is 110 to 120, which covers 31% of primary energy consumption in industrial sector. The DCs must conduct regulatory energy management. These coverage areas of DCs will be expanded time to time.

(2) EM, CEA and ACEA

The obligatory energy management for DCs includes appointment of EMs and implementation of energy audits conducted by CEA and ACEA. Competency standards for EM, CEA and ACEA are drafted in the framework.

(3) Periodical reporting system for DCs

Format of the periodical (annual) report is attached in the framework. Application system through SREDA web-site has been developed. The form can be widely used by establishments in both DCs and non-DCs.

(4) Benchmarking on energy efficiency by industrial sub-sector and/or production process

Benchmarking aims to show the best practice and distribution pattern of energy intensity (efficiency) by industrial sub-sector. It also aims to make every establishment to improve its energy efficiency. This program will be applied on cement manufacturing, printing paper, board paper, soda, steel-making, chemical fertilizer, etc.

Actual benchmark targets should be defined by SREDA, with prior consent of industrial sub-sectors (relevant establishments and/or associations), which will be affected. The benchmark targets should be up-dated based on the actual energy intensity data in Bangladesh and/or advanced case in foreign countries.

2.3 EE Labeling Program

In Bangladesh, about 30% of primary energy is consumed in residential sector, mostly by electric home appliances. Introduction of EE Labeling Program is quite effective to promote EE&C in residential sector. SREDA decided to establish national EE Labeling Programs. Following items were studied to draft framework of the program.

(1) Role-share among related organizations

Bangladesh Standardization and Testing Institute (BSTI) has been initially engaged as a leader in UNDP-BRESL (Barrier Removal for Energy Standards and Labeling) Project in Bangladesh. BSTI has issued BDSs on EE measurement methods, but couldn't issue regulation, and the initial EE Labeling Program didn't work well under the project. SREDA has been newly established with an objective to promote, coordinate and assist Renewable Energy and Energy Efficiency activities in the country. SREDA's most important role is to issue regulations and fully manage the program.

BSTI will concentrate on standardization (issue of BDSs) and conduction of EE measurement tests. Bangladesh Accreditation Board (BAB) will join in the program for maintaining laboratories' test reliability by issuing accreditation. It has received international recognition for laboratory accreditation (APLAC).

Key players/ stakeholders of the program are manufactures and importers. They are expected to join in the program voluntarily, complying with the labeling rules. Also, they are expected to join in stakeholder meetings for developing and/or improving the program elements such as EE measurement method and star rating criteria, due to their technical skill and information about market condition.

(2) Assurance of EE label's reliability (verification system)

There are two types of labeling procedure. One is that manufacturers can affix EE label on their products by themselves, referring to their in-house laboratories' EE measurement test data. The other is that the manufacturers must get label certification, which is given by the authority, referring to 3rd party laboratories' EE test. Japan has introduced the former one, and dominant South East Asian countries adopt the later one, which can assure EE label's reliability more tightly. Bangladesh is going to adopt the latter one.

(3) Framework of EE Labeling Program

The "Framework of EE Labeling Program" was drafted. "Framework Part 1: General" is a set of common rules, covering all appliances. Part 2 to 8 stipulates mainly technical issues by appliance (CFL, refrigerator, AC, TV, electric fan, electronic ballast, induction motor). The regulation can give administrative power on the relevant Bangladesh Standards (BDSs) by means of introducing BDSs, in which EE measurement methods are fully stated. Star rating criteria will be directly shown in the regulation, and will not be issued as BDSs, because star rating criteria must be designed considering social and economic viewpoints, besides BDSs mainly stipulates technical issues.

(4) Capacity development of laboratories for applying mandatory program

SREDA will start EE Labeling Program as a voluntary basis and shift to mandatory, in order to spread the program through all parties. In case of the mandatory program, the Government must provide EE testing service for the all manufacturers and importers, which want to get EE data on their products. Therefore, governmental testing agencies, including BSTI have to develop EE test capacity urgently.

(5) Review of current BDSs on EE measurement method

BSTI has issued several BDSs on EE measurement method under UNDP-BRESL Project.

However, almost all of them are just copies from foreign standards and don't suit to Bangladesh present market condition. Comprehensive review of the BDSs is needed.

(6) Holding stakeholders meetings (Committees and WGs) inviting foreign manufacturers

EE Labeling Program will give impact on foreign manufacturers, because many foreign products are sold in Bangladesh market. The program may cause a discussion of NTV (Non-Tariff Barrier). Committees and/or WGs on the program should be held fairly and often not only gathering governmental officers, but also inviting many stakeholders including foreign manufacturers.

2.4 EE Building Program

The energy consumption is rapidly increasing in building sector of Bangladesh. Therefore, it is needed to implement an effective counter measures to mitigate this issue in this sector. Besides, New Version of Bangladesh National Building Code (hereinafter referred as "BNBC [Revised]") is going to be published by Ministry of Housing and Public Works (HOHPW), taking into consideration energy consumption in building as well. Since BNBC [Revised] is the core program for promoting EE buildings, it is focused in the Project.

In parallel, for not only energy efficiency and conservation but also reduction of overall environmental impact and betterment of indoor air environment in buildings, MOHPW is developing Green Building Guideline (GBG). Since green building program is important as one of international movements, GBG is also discussed in the Project

(1) Implementation of BNBC [Revised]

BNBC [Revised] is going to be issued. BNBC [Revised] should be implemented in a phased manner in order to be properly applied nationwide. Besides, surrounding developed countries standards are directly quoted in BNBC [Revised], and they are not suitable for Bangladeshi condition. These standards should be reviewed step by step, during the implementation stage.

On the other hand, for proper and effective BNBC [Revised] implementation, all stakeholders should understand and play their roles and responsibilities. MOHPW in cooperation with SREDA should formulate awareness raising and capacity development programs for the stakeholders. Firstly, awareness raising and capacity development programs for the Government, as the front line of BNBC [Revised] implementation, should be formulated. Secondly, awareness raising and capacity development programs for building owners and users, designers and constructors, who are actual EE&C implementation bodies, should be structured by the Government. For proper and effective implementation of awareness raising and capacity development, the manual explaining concrete construction methods for EE&C measures is also prepared.

In addition, the building permit under the building codes is focusing on only checking the building design and not focusing on the operation stage, which is the most important for EE&C. In order to

promote EE&C in buildings, operation and maintenance of EE&C equipment should be focused. Thus, notification and periodical report system is strongly recommended to be introduced in Bangladesh.

(2) Development and implementation of GBG

Green Building Guideline (GBG) is the voluntary program that provides recommendations on not only energy and water use efficiency, but also reduction of overall environmental impact caused by building construction, usage and demolition. GBG, as a guideline for design and construction of upper-grade EE&C and low environment impact buildings than the ones of BNBC [Revised], will be completed by 2025.

Since GBG is a voluntary system, an evaluation system to evaluate the performance and grade is needed on the implementation stage. Green building assessment system for GBG has to be developed. In the future, the assessment system will be adopted as an evaluation method for the certification of "Green building" and/or "Net zero energy building". The assessment system will also be applied as evaluation criteria to give incentives for green buildings.

(3) Check and review of program development and implementation

MOHPW in association with SREDA and related organizations should regularly check and review BNBC [Revised] implementation and GBG development. And, if needed, they should review the schedules and conduct proper counter-measures.

In addition, for grasping the situations of building EE&C implementation, statistical data should be needed. MOHPW in cooperation with SREDA should also develop and manage the statistical database.

(4) Coordination with Energy Management Program and EE Labeling Program

Energy Management Program will be applied on large buildings in parallel with BNBC. On the other hand, EE Labeling Program will also be applied for equipment, including ACs, lighting fixtures and ceiling fans, in parallel with BNBC [Revised]. BNBC [Revised] and GBG should be well coordinated and implemented with these programs.

2.5 EE&C Finance Program

In order to promote EE&C effectively, financial incentive mechanism is necessarily introduced in Bangladesh, as well as regulatory measures. During the project, JICA Project Team studied through discussions with stakeholders how to propose effective finance incentive mechanisms to foster EE&C policies. Study items are shown below:

- Types of financial incentives for EE&C promotion and applicability in Bangladesh
- EE&C Finance Program for Bangladesh with JICA ODA loans
- EE&C support activities by international donor agencies

(1) Types of financial incentives for EE&C promotion and applicability in Bangladesh

Financial incentives are monetary rewards which can provide economic benefits for implementation of EE&C projects through changes in people's behavior. Mainly, there are three types of financial incentives which are considered as the most effective financial measures to promote EE&C: subsidies, preferential taxation and low-interest loans.

Investment subsidies are what the government or government-related organization pays to companies and/or individuals in order to reduce their investment costs. Rebate program and buy-down grants (investment subsidies for loans) are examples of the subsidies. It is effective to stimulate economic effects because beneficiaries can purchase goods with lower prices when they receive subsidies. However, to implement the measure, it requires high administrative and transaction costs, which means it is necessary to establish an organization to manage funding source for subsidies and to create application processes and procedures for receiving money.

Preferential taxation includes tax reduction and exemption, and accelerated depreciation. This measure applies to anyone who makes investments according to the criteria. It is easy to implement because there is no need to add special procedure on the normal taxation process. However, the economic impacts of tax measures such as accelerated depreciation and tax reductions on EE&C are hard measure as they are accounting procedure to reduce taxable income. Thus, the government also needs to consider how to cover its income when reducing such tax collection.

As for low-interest loans, financial institutions will provide loans to their customers with lower interest rate than the market rate. The government and/or international donor agencies will provide concessional funds to financial institutions in order to promote specific policies, which make financial institutions capable of providing loans with low interest. On the other hand, disadvantage of this measure is that beneficiaries are limited: the borrowers are to be screened by the eligibility criteria.

(2) EE&C Finance Program in Bangladesh with JICA ODA loans

The bottlenecks of EE&C promotion in Bangladesh are considered below:

- Lack of urgency of energy saving among individuals and companies: The Government highly subsidizes energy and power sector to lower the costs of fuel and electricity for the household and industries
- Tight budget constrains: The Government does not have enough budget to implement subsidies or tax incentive measures

To take into considerations of above circumstances, JICA Project Team designed and proposed low-interest loan program, the "EE&C Promotion Loan Program," for Bangladesh. This measure will create low financial burden for the government and long-term financial support for end users.

The main goal of EE&C Promotion Loan Program is to promote the adoption and dissemination of

the three EE&C policies and programs by stimulating EE&C investments in EE equipment/ appliances and green buildings/ EE buildings. However, in the current market situation, due to the low costs of electricity, there is lack of urgency among the public and private industries to save energy. Therefore, EE&C Promotion Loan Program will be designed into two phases: the first phase for implementing flagship EE&C projects to prove their economic viability, and the second phase for the nationwide dissemination of EE&C investments.

(3) EE&C support activities by international donor agencies

In Bangladesh, there are several donor agencies which are actively supporting demand side management for promoting EE&C, such as GIZ, UNDP, World Bank, etc. They are trying to reduce energy consumption by providing energy efficient equipment and conducting capacity development for energy regulatory body to strengthen their operation. Also, Japan is capable of providing ODA loans and technical assistance to promote EE&C according to its accumulated experiences in Asian countries. SREDA will have to coordinate with donors and government-related organizations to avoid duplication of the support from donors and to make effective implementation of EE&C activities by clarifying roles and responsibilities among government-related organizations.

2.6 Global Warming Considerations

It is also important to reduce CO_2 emission in Bangladesh, though Bangladesh contribution in carbon emission or global warming is negligible. The Government is very concerned on this issue. Global concern about CC is widespread and many recommendations about it have been incorporated in foreign external aid regulation in general and, in particular, in the availability of international money addressed to CC mitigation. Since Bangladesh infrastructure development must rely in external financing to speed up its installation, the country strategic approach cannot ignore CC implications.

In order to attract external grants and financing, it is our understanding that CC must be considered for all energy activities in the country.

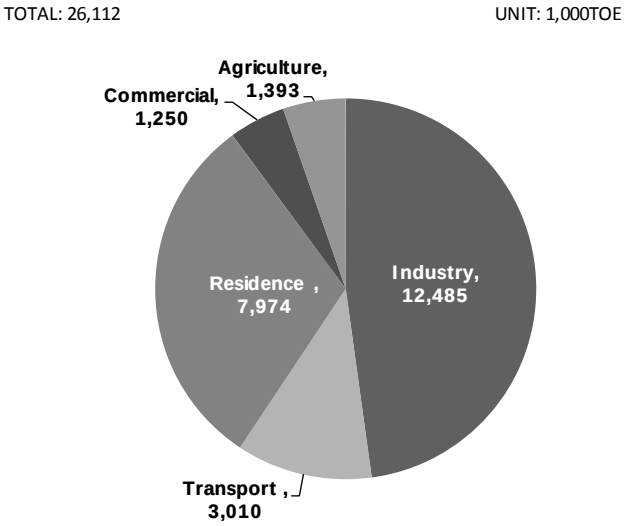
The countermeasures against global warming may be discussed jointly with EE&C Finance Program and economic analysis.

2.7 Energy Data, EE&C Scenarios and IT Infrastructure

(1) Energy data

A lot of reports focusing on energy supply and demand are issued by many institutes including academies, associations and governmental organizations. However they are usually collected independent and these data have not been integrated and cross checked. Therefore, defining the original data source is very important to establish and maintain accuracy and reliability of the energy data used for EE&C programs.

Present annual energy consumption by sector (primary energy basis) is shown in Figure2-3. It is noted that the most energy consuming sector is industry (about 50%) and the second one is residence (about 30%).

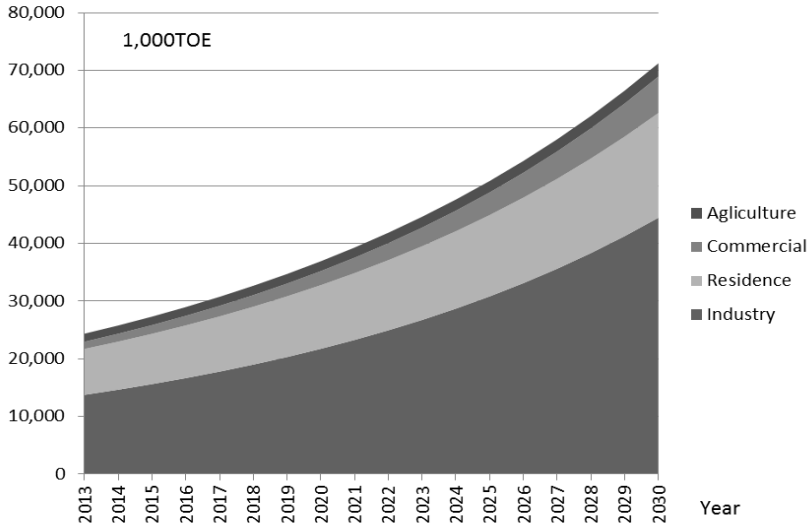


Source: Electricity; MPEMR, Gas; Petrobangla, Oil; BPC, Coal; IEA

Figure 2-3 Present Energy Consumption by Sector (Primary Energy Basis, Excluding Biomass)

(2) Forecast of primary energy consumption up to 2030

Forecast of primary energy consumption by sector up to 2030 is shown in Figure 2-4. In 2030, national primary energy consumption in industrial, residential, commercial and agricultural sectors will be 2.9 times larger than in 2013. Industrial growth rate by sub-sector, growth of residence units, electrification, etc. are taken into account in the forecast. This case was set as BAU (baseline), and comparisons with several EE&C scenarios were made.



Source: Electricity; MPEMR, Gas; Petrobangla, Oil; BPC, Coal; IEA
Note: As for growth rate by sector/sub-sector, data of IPCC 2nd National Communications,2012 was derived

Figure 2-4 Forecasts on Baseline of Primary Energy Consumption by Sector

(3) EE&C potential

"EE&C potential" means the expected energy reduction potential gained by best energy management, complete replacement of present equipment/appliance by EE types and complete application of EE&C measures in building all over the country. Rough estimation of EE&C potential in industrial sector is 21%, residential sector at 28.8%, buildings at 10% and Agricultural sector at 20%. It is recommendable to set EE&C target, considering EE&C potential and practical achievable ratio to this potential. (EE&C potential includes an economically feasible potential and also an economically infeasible/ theoretical potential, which cannot be paid back by energy cost reduction. Hereinafter "EE&C potential" means mainly economically feasible potential).

(4) EE&C target and scenarios up to 2030

There are several indicators to evaluate the improvement of future national energy efficiency, such as a) the actual reduction amount of energy consumption, b) reduction ratio (value) for future BAU value, c) energy consumption per capita and d) energy consumption per Gross Domestic Product (GDP), etc. However there is less data for structuring a) and b) values in Bangladesh. Evaluation in terms of energy reduction amount is not easy since the national baseline has to be fixed for the future. Energy consumption per capita is not suitable for developing countries like Bangladesh. Energy consumption per GDP can consider both energy efficiency and increases in national economy. In this EECMP, therefore we apply "primary energy consumption per GDP" as an indicator to evaluate future national energy efficiency.

While identifying a huge EE&C potential, we should take practical approach to gradually realize it in a phased manner, since EE&C implementation requires a huge amount of money and time. With the formulation of suitable regulatory measures and incentive mechanisms in accordance with nationwide actions for energy conservation, "primary energy consumption per GDP" can be reduced below 2013 level. In the Master Plan, EE&C target and roadmap are set as Table 2 -1. The targets for 2021 and 2030 are set at 15% and 20% reduction compared with 2013 value, with due consideration of the EE&C potential and current energy consumption status: low electrification ratio, industries' insufficient environmental protection measures, improvement in work conditions and modernization of life styles, etc. The final goal of EE&C policies is to realize a self-reliant cycle in which people proactively and voluntarily save energy, rather than through compulsory EE&C activities. We aim to accomplish the target for realizing the self-reliant EE&C society by 2030.

Table 2-1 EE&C Implementation Roadmap (2015-30)

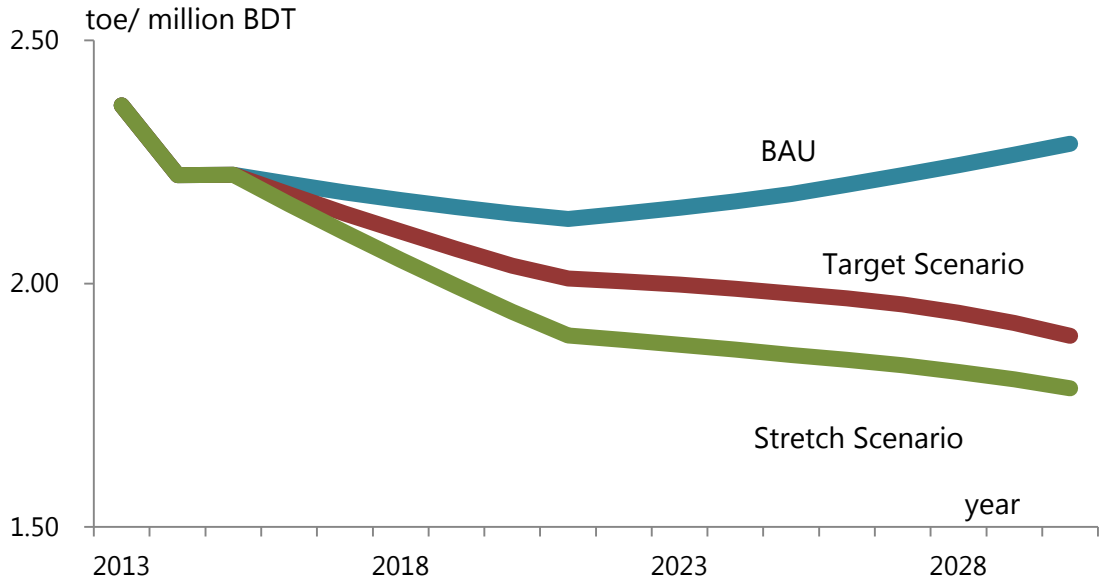
It is expected that the primary energy consumption per GDP will slightly decrease until 2021 and then gradually increase up to 2030. And in order to achieve the above mentioned target in 2021 and 2030, the following scenarios are to be recognized.

Table 2-2 shows the outline of investigated E&C Scenarios

Figure 2-5 shows the forecast of estimated values of primary energy consumption per GDP (toe/million BDT) for both scenarios. EE&C realization rate for the EE&C potential and expected EE&C amount by sector is summarized in Table 2-2 and 2-3.

Table 2-2 Outline of Investigated EE&C Scenarios (2015-30)

Scenario	Conditions
Target Scenario	In 2016, EE&C regulations will be enforced by the Government, and EE&C measures will be implemented gradually. In 2021 and 2030, primary energy intensity (toe/GDP) will be 15％and 20％ less than that in 2013-14 basis, respectively. (EE&C realization rate for the EE&C potential is 20-30% and 60-80% in 2021and 2030, respectively.
Stretch Scenario	In 2016, EE&C measures will be implemented gradually. EE&C realization rate for the EE&C potential is 50% and 100% in 2021and 2030, respectively.



Source: Compiled by JICA Project Team, based on the present energy consumption data and forecast of future growth rate by sub-sector derived from UNFCCC Second National Communications, Oct. 2012, GDP growth rate is assumed at 7.0% till 2011 and 6.0% up to 2030

Figure 2-5 Future Scenarios of Primary Energy Consumption in 2030 (BAU Case, Excluding Transportation and Biomass)

Table 2-3 Efforts Needed to Achieve EE&C Target

Target Scenario

Sector	Realization rate for EE&C potential			
	2021		2030	
	%	EE&C amount (ktoe)	%	EE&C amount (ktoe)
Industrial	30	1,474	80	7,497
Residential	20	670	80	4,197
Commercial	20	54	80	380
Agriculture	20	75	80	296
Total		2,273		12,370

Stretch Scenario

Sector	Realization rate for EE&C potential			
	2021		2030	
	%	EE&C amount (ktoe)	%	EE&C amount (ktoe)
Industrial	50	2,453	100	9,372
Residential	50	1,676	100	5,247
Commercial	50	134	100	633
Agriculture	50	188	100	493
Total		4,451		15,745

(5) Forecast of electricity load curve and EE&C impacts

Figure 2-6 shows the estimated daily load curve on 31 May 2014 of the grid electricity, giving break down by sector and electric appliance. And based on this figure and considering the

expected growth by industry and penetration of EE&C measures, BAU and EE&C case load curves in 2030 were estimated. It was found that 25% peak cut will be able to be brought by EE&C measures (Stretch Scenario). EE&C measures for lighting and TV which contribute evening peak should be focused.

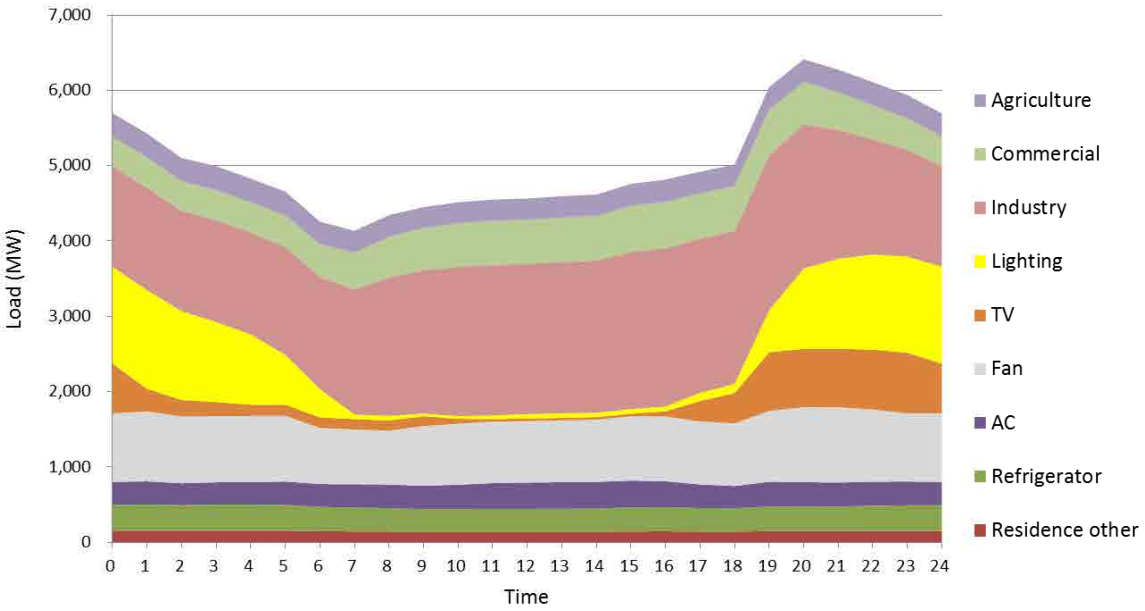


Figure 2-6 Estimated Breakdown of Grid Electricity Daily Load Curve (31 May 2014)

(6) IT infrastructure and energy consumption data collection mechanism

IT infrastructure should be developed and used for collecting energy data, making statistics and disclosing. For that purpose, website for SREDA has been firstly developed in the project. As the next step, prototype of "periodical energy consumption data collection mechanism" was developed and linked with the SREDA website. Designated large energy consumers (DCs) in Energy Management Program can report their energy consumption and EE&C activities to SREDA through the system. SREDA will analyze the data, process them for statistics purpose and disclose on the system.

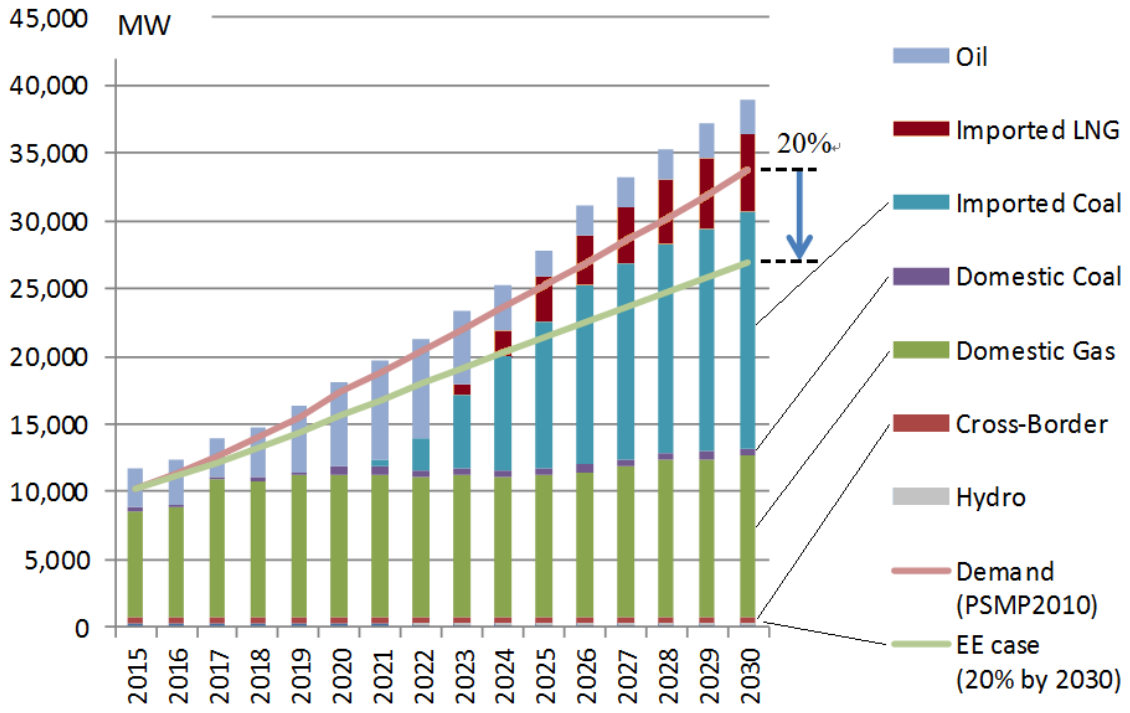
Utilization of "Big Data" will be a necessity. IT infrastructure should be developed taking account the utilization of big data which includes huge amount of energy consumption data, EE&C implementation samples, peoples conscious and action relating with energy. Expertise to analyze and utilize the big data should be simultaneously developed.

2.8 Economic and Financial Analysis

(1) Economic impact of EE&C programs as a whole

As shown in Figures 2-7, in EE&C scenario (20% reduction in power demand by 2030 compared with BAU case) additional power supply capacity development will be reduced by 2.9%/yr from

27,147MW to 19,147 (8,000MW reduction) between 2015 and 2030. As a result, the amount of imports of expensive fuels for power generation will decrease remarkably; the savings would amount to 2.3 trillion taka (or an annual average of 135 billion taka) between 2015 and 2030 in terms of reduced fuel costs, which is equivalent of 6% of national budget and 1% of GDP (2013).



Source: Power Supply/Demand Database compiled by Mr. Kazushige YASHIRO, JICA Expert (May 2014)

Figure 2-7 Impact on Power Demand and Supply

(2) Cost effectiveness analysis of target EE&C programs related projects

In order to effectively prioritize the government budget allocation, cost effectiveness analysis was conducted for several public- and private-sector EE&C projects representing each EE&C policy measures. The calculation formula is as below:

$$(a + c – d) / b$$

Where:

a: Annual investment costs for the government (BDT/year)

b: Annual energy reduction amount (toe/year)

c: Annual investment costs for the private sector EE investments (BDT/year)

d: Annual economic benefits of private-sector energy reduction (BDT/year)

(3) Results

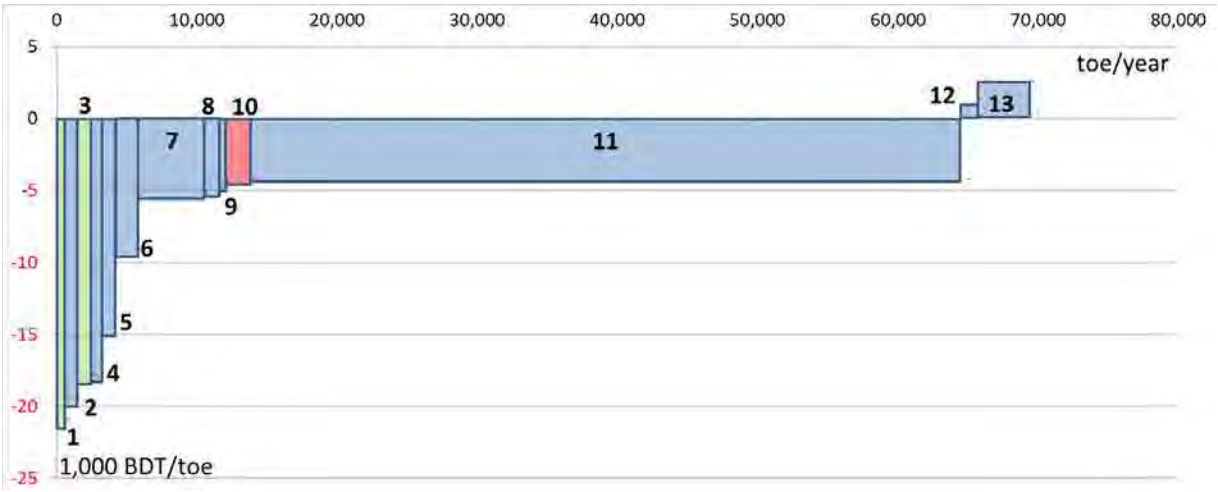
According to the calculation formula and assumptions listed above, the costs per unit of energy (BDT/toe) for the candidate projects included under EE&C Promotion Program Phase 1 (Flagship Program) were plotted into a bar chart, to create a marginal abatement costs (MAC) curve of the

selected EE&C projects. (See Figure 2-8)

The lower left of x- and y- axis shows the group of projects that are most cost effective, whereas the upper right of the axes shows the least cost effective one.

Each square area represents the net costs of an EE&C project, with the height and width representing, respectively, the unit costs and quantity of energy saved. It is obvious that most of the EE&C projects are located under the zero unit costs, implying that they can be implemented at negative costs (i.e. total energy savings surpass the total costs).

Project Nos. 2, 4, 5, 6, 7, 8, 9, 11, 12 and 13 will be promoted by the enactment and enforcement of Energy Management Program; project No. 10 will be accelerated through the implementation of EE Labeling Program; and project Nos. 1 and 3 will be accelerated by the enactment of EE Building Program.



Notes: Numbers represent the following EE&C projects: 1. New EEB (lighting, etc., 4 units), 2. Biogas power generation for poultry (2kW, 30 units), 3. New GB (lighting, etc., 4 units), 4. Ammonia cooling/ chilling for food processing (10,000t, 3 units), 5. Lighting for textiles (LED/25W, 20,000 lamps×11units), 6. Biogas power generation for poultry (400kW, 2 units), 7. Once-through boiler (6 t/h, 3 units), 8. Cement kiln (5,000 t/day, 4 units), 9. Large public buildings retrofit (AC, lighting, 4 units), 10. AC & Refrigerator (16,000 households), 11. Gas turbine cogeneration (6-10MW, 2 units), 12. High efficient weaving machine (100 sets, 1 unit), 13. Exhaust heat recovery for steel (100,000 t/h, 2 units)
Source: Compiled by JICA Project Team based on independently collected data

Figure 2-8 MAC Curve of EE&C Flagship Projects

2.9 Capacity Development and Awareness Raising

(1) Capacity development of SREDA

Staffs in charge of the EE&C programs are expected to have enough competencies. Table 2-4 shows required knowledge for staffs.

Table 2-4 Staffs' Competencies

Staff	Knowledge
Overall	■ Communication with stakeholders
Energy management	■ Energy data collection and analysis ■ Communication with industrial sector and associations
EE labeling	■ Basic knowledge in S/L (Standards and Labeling) ■ Basic EE technology on home appliances ■ Present market condition ■ Communication with manufacturers and dealers
EE building	■ Basic EE technology on buildings and houses ■ Building code ■ Communication with building owners and designers
EE&C financing	■ Available financing source for EE&C ■ Communication with financial institutions
IT	■ Skill to operate IT
Awareness	■ Communication with industries and industrial associations ■ Communication with Ministry of Education and schools/universities ■ Utilization of media
Economic analysis	■ Economy on energy ■ Outline of EE&C programs and technology
Climate change	■ Knowledge on global warming ■ Kyoto mechanism, CDM, etc.

(2) Network needed for national capacity development

Since SREDA has just been established, its human resources and budget are not sufficient at present. In order to make SREDA become a center of national EE&C implementation, besides SREDA's own capacity development, the sections in charge of EE&C should be firstly provided or assigned in all governmental organizations and establish tight relation with SREDA. Secondly, SREDA should make approaches to the stakeholders through relevant governmental organizations. Nationwide network on EE&C implementation including international donors, related associations and the academy should be finally formulated and operated setting SREDA at the center. National capacity building should be achieved through the network by means of information exchange and technology transfer.

(3) Awareness raising for industrial, commercial and business sectors

SREDA should notice possibility of energy supply shortage and energy price increase in near future to the industrial, commercial and business sectors, in order to make the establishments to take voluntary actions on EE&C implementation. The notices should be done during Electricity Week in December and monthly seminars. Also, SREDA should ask energy consumers to provide energy and/or EE&C information in their associations by industrial sub-sector, in order to get smooth information exchange and formulation of the committees and WGs on EE&C programs.

(4) Awareness raising for residential sector

Awareness raising in schools and other educational sites is most important for the residential sector. Provision of knowledge and conscious on energy and EE&C to students will influence their family through EE&C action at home, and, finally, cause awareness raising in the society.

SREDA will conduct EE&C school program, which will be a joint program with Ministry of Education. The target of this school program will be students under 15 years old in primary and secondary school.

(5) Utilization of media

SREDA should implement EE&C campaign through media such as televisions, newspapers and advertising boards, discussions, billboard, school campaigns, competitions with prizes, etc. in cooperation with related governmental and/or private organizations and program.

2.10 Remaining Issues

(1) Finalization and issue of EECMP

EE&C planning on transportation sector and energy supply side, including energy tariff system is excluded from the scope of EECMP in the Project. Transportation sector consumes primary energy at the third, following industry and residential sectors. Electricity generation and transmission efficiency must be the most important issue on energy supply side, effecting energy consumers' account on primary energy consumption. Energy tariff system can be the strongest incentive for EE&C implementation. So, EECMP is expected to include EE&C plans on these remaining sectors and issues.

Therefore, while SREDA proceed to issue EECMP drafted in the Project as the first version, it should promptly make plans on the remaining issues and draft a comprehensive master plan as the 2nd version. In the new version of EECMP, EE&C targets on all sectors including industrial, residential, commercial (building), transportation and energy supply side, should be described and coordinated with the overall target as "20% reduction of energy consumption per GDP" set in the Project.

(2) Government's own initiative on EE&C implementation

In order to make Bangladesh people and establishments understand about EECMP and take actions on EE&C, The Government should take its own EE&C actions and show it to the people as an example. SREDA should lead this action, preparing government's own EE&C plan, coordinate with other governmental organizations during finalizing EECMP and promptly start organized EE&C implementation.

3. Project Achievements

Project achievements are summarized as Table 3-1.

Table 3-1 Project Achievements

Item	Project achievement
Overall	- "EE&C Master Plan (Draft) was prepared by SREDA jointly with JICA Project Team. EE&C target and major EE&C programs were sorted and proposed. - Present situation of energy consumption by sector and industrial sub-sector was analyzed. - Stakeholders meetings (committees and WGs) have been started. - Initial introduction of EE&C Master Plan (Draft) to Bangladesh people has been carried out through seminars and other meetings. - Initial capacity development of SREDA's staffs was done through the Project.
Energy Management Program	- "Framework of Energy Management Program" was prepared. Actual procedure and criteria of the program were proposed. - Present situation of EE&C implementation was evaluated through energy audits on sites and experienced persons meeting.
Energy consumption data collection mechanism	- Proto type of periodical energy consumption data collection mechanism was developed.
EE Labeling Program	- "Framework of EE Labeling Program" was prepared. Actual procedure and criteria of the program were proposed. - Present situation of home appliance market was grasped. - Current BDS's problems were pointed. Recommendation for settlement was proposed. - Basic theory and information on S/L (Standard & Labeling) was shared by the stakeholders through the meetings.
EE Building Program	- Present situation of buildings EE&C implementation was grasped - Measures for enforcement of BNBC [Revised] were proposed. - Relation between BNBC [Revised] and GBG was confirmed.
EE&C Finance Program	- EE&C Finance Programs suitable for Bangladesh were proposed.
Capacity development and awareness raising	- SREDA's optimal organization structure was proposed. - EE&C awareness raising programs were proposed.
IT infrastructure	- SREDA's website was developed linking with the periodical energy consumption data collection mechanism.
Global warming countermeasures	- Global warming countermeasures linked with EE&C programs ware proposed.
Economic analysis on EE&C programs	- Methodology of economic analysis on EE&C programs was introduced, and monetary simulations of EE&C programs were done.
Other	- Simulation of electricity demand curves up to 2030 was carried out.

Chapter 1

Outline of the Project

Chapter 1 Outline of the Project

1.1 Objectives of the Project

The Government of Bangladesh (GoB) recognizes the importance of strengthening energy supply capacity to meet rapidly increasing energy demand in the near future. GoB also understands energy efficiency and conservation (EE&C) as a useful climate change mitigation and adaptation measure. In January 2014, GoB has announced to carry out "The Project for Development of Energy Efficiency & Conservation Master Plan," (hereinafter referred to as "the Project") which will be carried out during the period from January 2014 to March 2015, targeting the achievement of the following four (4) outputs:

1) Development of EE&C Master Plan (hereinafter referred to as "EECMP"), which will be recognized by the Government as a national official plan, and formulation of action plan for the practical implementation of nationwide EE&C policy
2) Sorting of activities included in the action plan, such as an optimal organizational structure of the Sustainable and Renewable Energy Development Authority (SREDA)
3) Support for formulating EE&C awareness raising program in public and private sectors
4) Capacity development of SREDA through the Project

The Project targets industry and residential sectors as the major energy consumer[1] in Bangladesh, excluding the transportation sector and energy supply side.

The Project was carried out through on-site energy audits, market researches, interviews with relevant organizations, comparison/simulation study and identification of obstacles for EE&C promotion and proposal of useful measures to break through the obstacles.

The practical targets for major issues under this Study are summarized in Table 1.1-1.

Table 1.1-1 Targets for Major Issues under the Project

Program	Targets of the Project	Lead by
EE&C Master Plan	To draft Master Plan and Roadmap up to 2030	SREDA
Energy Management Program	To draft frameworks of the program including designation of large energy consumers, mandatory energy management and certification system	SREDA
EE Labeling Program	To draft frameworks of the program including data verification, laboratory test, measurement methods and star rating criteria	SREDA
EE Building Program	To propose eligible measures for the promotion of EE building programs	MOHPW/SREDA

[1] For instance, gas consuming sectors are industry, petrochemical, transportation and commercial sectors; electricity consuming sectors are residential, industry and commercial sectors; and oil consuming sectors are transportation, residential, agriculture and industrial sectors.

Program	Targets of the Project	Lead by
EE&C Finance Program	To propose EE&C financial incentive mechanism	SREDA/MOF
Economic and financial analysis	To conduct economic and financial analysis on major EE&C programs	
Capacity development and awareness raising	To propose programs and projects for capacity development and awareness raising	SREDA
IT infrastructure	To develop SREDA's webpage and energy consumption data collection mechanism	SREDA

1.2 Project Implementation Structure

1.2.1 Project Implementation Structure

Project members representing SREDA and JICA Project Team are listed in Table 1.2-1.

Table 1.2-1 Member List of SREDA-JICA Project Teams

Team	SREDA	JICA Project Team
Overall	Mr. Tapos Kumar Roy, Chairman SREDA	Dr. Kimio Yoshida
Head of project implementation	Mr. Sheikh Faezul Amin	
Overall technical leader	Mr. Siddique Zobair	Mr. Kiyoshi Takashima
Overall technical officer	Mr. Shah Zulfiqar Haider	
Energy management team	Mr. Siddique Zobair Mr Shah Zulfiqar Haider Mr. Q. A. Sharhan Sadique	Mr. Norio Fukushima Mr. Yoshihiko Saeki Mr. Norio Shigetomi
EE labeling team	Mr. Siddique Zobair Mr. Shah Zulfiqar Haider	Mr. Kiyoshi Takashima
EE building team	Mr. Mohammad Bazlur Rahman	Mr. Yukihiko Nakagawa
EE&C finance and economic analysis team	Md. Abdur Rouf Miah	Ms. Hiroko Hashimoto Ms. Miyuki Sato
IT & awareness team	Md. Shazibul Houqe	IT: Mr. Yoshio Hirayama Awareness: Mr. Norio Shigetomi Prof. Jose Robert Moreira
Climate change	Mr. Siddique Zobair	

Figure 1.2-1 shows the structures of the committees and WGs.

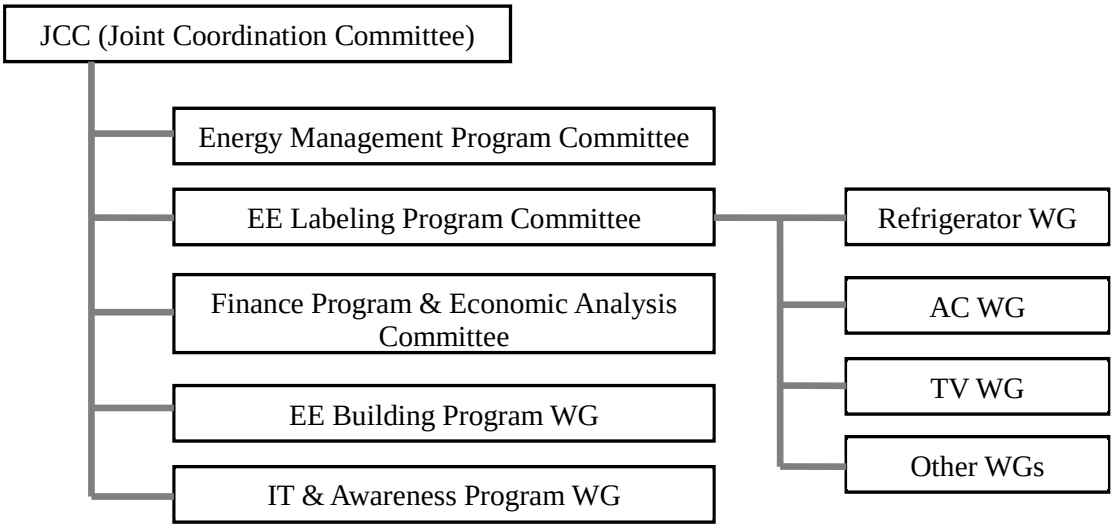


Figure 1.2-1 Project Implementation Structure

1.2.2 Project Outputs

The main output in the Project is EECMP, which was drafted, reflecting existing policy papers and outputs from round-tables and discussions performed under the Project. Table 1.2-2 shows outline of the Project outputs.

Table 1.2-2 Master Plan and Project Outputs

Output		Item	Content
Project output	EECMP (EE&C Master plan) and relevant documents	General plan	- Study on current energy consumption and EE&C activity - EE&C target with consideration of EE&C potential - Simulation of energy consumption in 2030, comparing EE&C case and BAU case - Selection of major EE&C policies
		Roadmap up to 2030	- Issue of rules and regulations - Formulation and activation of relevant organizations - Program penetration - EE&C implementation
		Organization	- SREDA and governmental organizations - Participating parties (stakeholders) in the programs - Supporting parties for the programs
		Action plan	- Detail of EE&C programs, providing frameworks for the regulations, standards and guidelines
	Output through the Project implementation		- Technology transfer through the Project implementation
			- Proposal of supporting programs
			- Dissemination of EECMP

1.3 Progress of the Project

1.3.1 1st mission in February 2014

Inception Report on the Project has been prepared by JICA Project Team and submitted to MPEMR/SREDA. The Project Team had meetings with relevant government agencies, universities, institutions and international donors. The 1st Joint Coordination Committee (JCC) and the 1st introductory seminar on the Project were held. Objectives and methodology of the Project were shared among the stakeholders.

Preparatory meetings were held to reach a common understanding of EE&C issues in Bangladesh. It was decided to formulate committees and Working Groups (WGs) for the main EE&C programs, namely, Energy Management Program, EE Labeling Program, EE Building Program, EE&C Finance Program and economic analysis, and IT and awareness raising program.

The Project Team had meetings with the candidates to carry out the sub-contracts, which consisted of three researches and an engineering work concerning 1) current energy consumption and EE&C potential, 2) home appliance energy efficiency and market situation, 3) EE&C conscious and 4) development of energy consumption data collection mechanism.

Activity record of the 1st mission is shown in Table 1.3-1.

Table 1.3-1 1st Mission Activity Record

Date	Issue	Item
Feb. 2 (Sun)	General	Meeting with JICA
	General	Meeting with MPEMR/SREDA
	General	Meeting with Dr. Hussein
Feb. 3 (Mon)	Committee	JCC in MPEMR
Feb. 4 (Tue)	Subcontract	Meeting with DDC
	Subcontract	Meeting with NewVision
	General	Meeting with Prof. Ijaz
Feb. 5 (Wed)	General	Meeting with JETRO
	Subcontract	Meeting with CMD
	Subcontract	Meeting with REED
Feb. 6 (Thu)	Subcontract	Meeting with ERI
	Subcontract	Meeting with CEGIS
Feb. 7 (Fri)		
Feb. 8 (Sat)		
Feb. 9 (Sun)	General	Preparation for meetings
Feb. 10 (Mon)	General	Meeting with MPEMR (EE Labeling Program)
	General	Meeting with MPEMR (EE Building Program)
	General	Meeting with MPEMR (Energy Management Program)
	General	Meeting with MRI
Feb. 11 (Tue)	Subcontract	Meeting with REED
	General	Meeting with FBCCI
	Subcontract	Meeting with CMD
	General	Meeting with GIZ

Date	Issue	Item
Feb. 12 (Wed)	Subcontract	Meeting with EAL
Feb. 13 (Thu)	General	Meeting with Navana
	Exhibition	Participating in DTG (Dhaka International Trade & Garment Machinery Exhibition)
	General	Meeting with JICA Expert (Energy)
Feb. 14 (Fri)		
Feb. 15 (Sat)		
Feb. 16 (Sun)	General	Meeting with Toyota Tsusyo
	General	Meeting with HBRI
	General	Meeting with MPEMR
	General	Meeting with ERD
Feb. 17 (Mon)	General	Meeting with REB
	General	Meeting with Power Cell
	General	Meeting with BUET
	General	Meeting with MPEMR
Feb. 18 (Tue)	General	Meeting with IDCOL
	General	Meeting with BTMA
	General	Meeting with BSMOA
Feb. 19 (Wed)	Seminar	Seminar in MPEMR
	General	Meeting with GIZ
	General	Meeting with JUKI
	General	Meeting with JICA
Feb. 20 (Thu)	General	Meeting with MPEMR
	General	Meeting with BB

1.3.2 2nd mission in May 2014

Three committees, namely, “Energy Management Program Committee”, “EE Labeling Program Committee”, “EE&C Finance Program and Economic Analysis Committee” and two WGs, namely, “EE Building Program WG” and “IT & Awareness WG” were created and started discussions on the Master Plan and formulation of EE&C programs. Project Team had prepared materials for the discussions. Summary of the discussions made at the respective committees and WG meetings was reported at the 2nd JCC, where the basic structures of the Master Plan were also discussed.

In addition, JICA Project Team had conducted several industrial site-visits, including iron-making factory, cold storage warehouse and spinning factories.

The Project Team signed the four sub-contracts to start the respective research works and engineering work.

Activity record of the 2nd mission is shown in Table 1.3-2.

Table 1.3-2 2nd Mission Activity Record

Date	Issue	Item
May 11 (Sun)	Subcontract	Meeting with EAL
	General	Meeting with JICA
	Subcontract	Bit (Subcontract A: Energy Consumption and EE&C Potencial)
May 12 (Mon)	General	Meeting with MPEMR/SREDA
	General	Meeting with MPEMR/SRED (Energy Management Program, EE Labeling Program, EE&C Finance Program and econimic analysis, EE Building Program, IT and awareness raising program)
	General	Meeting with GIZ
	Subcontract	Bit (Subcontract B: Equipment/Appliances Market Research and Subcontract C: EE&C Conscious and Home Appliances Possession)
May 13 (Tue)	General	Meeting with GIZ
	General	Meeting with JBCCI
May 14 (Wed)	General	Meeting with MEPMR/SREDA (Energy Management Program, EE Building Program, IT and Awearness Program)
	General	Meeting with SREDA (Finance)
	General	Meeting with BB
May 15 (Thu)	Committee	JCC in MPEMR
	Committee	Finance Program and Econimic Analysis Committee in MPEMR
May 16 (Fri)	General	Meeting with Souzitu
May 17 (Sat)		
May 18 (Sun)	Committee	Energy Management Program Committee in MPEMR
	General	Meeting with MTB
	Subcontract	Meeting with e-Gen
	Committee	EE Labeling Program Committee in MPEMR
	General	Meeting with IDLC
	General	Meeting with UCB
May 19 (Mon)	Committee	EE Building Program WG in MPEMR
	Committee	IT and Awareness Program WG in MPEMR
	Subcontract	Meeting with e-Gen, BUET, and SREDA
May 20 (Tue)	General	Meeting with IDCOL
	General	Meeting with WALTON
	General	Meeting with MPEMR/SREDA (Economic & Finance)
	General	Meeting with MPEMR/SREDA (Finance)
	General	Meeting with MK Electronics
	General	Meeting with BTMA
	General	Meeting with GIZ
May 21 (Wed)	General	Meeting with SolarEn
	General	Meeting with MPEMR/SREDA (EE Building Program)
	General	Meeting with BCSA
	General	Meeting with Seed Bangla
	General	Meeting with JICA Expert (Energy)
	General	Meeting with MPEMR/SREDA (Wrap-up)
	General	Meeting with JICA Expert (Earthquake resistant)
	General	Meeting with JICA

Date	Issue	Item
May 22 (Thu)	General	Meeting with BTMA
	General	Meeting with SITAK (Daikin)
	General	Meeting with BGMEA
	Subcontract	Bit (Subcontract D: Data Base and Energy Data Collection)
	General	Meeting with MPEMR/SREDA (Energy Management Program)
May 23 (Fri)	Subcontract	Meeting with e.Gen
May 24 (Sat)	Site Survey	Site survey in MMHI
May 25 (Sun)	Site Survey	Site survey in NR Group
May 26 (Mon)	Site Survey	Site survey in MSI
May 27 (Tue)	Site Survey	Site survey in AKH K&D
May 28 (Wed)	Site Survey	Site survey in KNIT ASIA
May 29 (Thu)	General	Meeting with Deloitte
	General	Meeting with MPEMR/SREDA (Wrap-up)

1.3.3 3rd mission in September 2014

Initial draft of the Master Plan, "Framework of EE Labeling Program" and other documents were prepared by the Project Team. These materials were shared and discussed in the 2nd meetings of three committees and two WGs, and also at the 3rd JCC. All parties agreed upon the basic structures and contents of the Master Plan.

Several on-site surveys were conducted by the Project Team. Several factories in Dhaka and Chittagong including those of steel, fertilizer and textile industries were surveyed. MPEMR's office building was also surveyed for EE&C purpose. Two "Experienced Person Meetings" were held as part of the activities included under the Sub-contract (A). Prof. Ijaz of the BUET led the discussions.

Activity record of the 3rd mission is shown in Table 1.3-3.

Table 1.3-3 3rd Mission Activity Record

Date	Issue	Item
Aug. 31 (Sun)	General	Meeting with JICA
	General	Meeting with MPEMR/SREDA
	Subcontract	Meeting with e-Gen
	Subcontract	Meeting with NewVision
	Subcontract	Meeting with SREDA and Softworks
Sep. 1 (Mon)	Committee	Energy Management Program Committee in MPEMR
	General	Meeting with GIZ
	General	Meeting with IDCOL
	Committee	EE Labeling Program Committee in MPEMR
Sep. 2 (Tue)	Site Survey	Site survey in Akji Cement
	Committee	EE&C Finance Program and Econimic Analysis Committee in MPEMR
	General	Meeting with USAID
	Committee	EE Building Program WG in MPEMR

Date	Issue	Item
Sep. 3 (Wed)	Site Survey	Site survey in Square Fashions Limited
	General	Meeting with JICA
	General	Meeting with UNDP
	Committee	IT and Awearness Program WG in MPEMR
	Subcontract	Meeting with SREDA and Softworks
	Subcontract	Meeting with NewVision
Sep. 4 (Thu)	Subcontract	Meeting with Experts
	General	Meeting with BFID
	Committee	JCC in MPEMR
	General	Meeting with SREDA
Sep. 5 (Fri)		
Sep. 6 (Sat)		
Sep. 7 (Sun)	Site Survey	Site survey in BSRM
	General	Meeting with SREDA (IT and Awareness Program)
	General	Meeting with FD
Sep. 8 (Mon)	Site Survey	Site survey in Nihou Food Company Limited
	General	Meeting with IDCOL
	Site Survey	Meeting with KAFCO
	Committee	Refrigerator WG in MPEMR
	General	Meeting with EE Building Program WG members
	General	Meeting with WB
	Subcontract	Meeting with NewVision
Sep. 9 (Tue)	Gereral	Meeting with JICA
	Site Survey	Site survey in MPEMR
	General	Meeting with GIZ
	Seminar	Global Warming Countermeasures Seminar in MPEMR
	General	Meeting with BAB
	General	Meeting with NBR (Tax Policy)
	General	Meeting with NBR (Customs)
Sep. 10 (Wed)	Subcontract	Meeting with Experts
	General	Meeting with ERD
	General	Meeting with SREDA
Sep. 11 (Thu)	General	Meeting with SREDA (Wrap-up)
	Site Survey	Meeting with BCIC
	General	Meeting with JICA (Wrap-up)
	General	Meeting with USAID

1.3.4 4th mission in November 2014

JICA Project Team submitted the Interim Report to JICA and MPEMR/SREDA. The activities that JICA Project Team had during the mission are stated below.

JCC: The 4th Joint Coordination Committee (JCC) was held to discuss and confirm the basic structure and contents of the Master Plan.

Committees and WGs: Three committees, namely, “Energy Management Program Committee”, “EE

Labeling Program Committee", and "EE&C Finance Program and Economic Analysis" and two WGs, namely, "EE Building Program WG" and "IT & Awareness WG" were held to discuss contents of the Master Plan and of EE&C programs. In addition, Two WGs, namely, "AC (Labeling) WG" and "TV (Labeling) WG" were held and frameworks of the program on AC and TV was discussed and confirmed.

Seminars: The 2nd Seminar was held and the Project Team reported the outputs of three committees and two WGs, and the outline of the draft Master Plan was introduced. The Special Seminar on Climate Change was also held and the importance of EE&C was shared with the stakeholders.

On-site surveys: The Project Team conducted two on- site surveys, including an office and a fabric factory.

Meetings: The Project Team had meetings with the three sub-contractors, e.Gen, NewVision, and Softworks to check and confirm the study results of sub-contracts. Also, the meetings with SREDA and other relevant organizations are held for the purpose of gathering and confirming required information.

Activity record of the 4th mission is shown in Table 1.3-4.

Table 1.3-4 4th Mission Activity Record

Date	Issue	Item
Nov. 13 (Thu)	Committee	AC WG in MPEMR
	Committee	TV WG in MPEMR
Nov. 14 (Fri)		
Nov. 15 (Sat)	General	Meeting with SREDA
	Subcontract	Meeting with e.Gen
	Subcontract	Meeting with NewVision
	Subcontract	Meeting with Softworks
Nov. 16 (Sun)	Committee	Energy Management Program Committee in MPEMR
	Committee	Labeling Program Committee in MPEMR
	Committee	JCC in MPEMR
Nov. 17 (Mon)	Committee	EE Building Program WG in MPEMR
	General	Meeting with AEE
	General	Meeting with Bangladesh Bank
	General	Meeting with Solar En Foundation
	Subcontract	Meeting with e.Gen and BUET
	Subcontract	Meeting with Softworks
Nov. 18 (Tue)	Committtee	EE&C Finance and EconomicAnalysis Committee in MPEMR
	General	Meeting with SREDA and e.Gen (EM additional M)
	General	Meeting with SREDA (Mr. Miah)
	General	Meeting with Union Capital
	Geneal	Meeting with JICA
Nov. 19 (Wed)	General	Meeting with GIZ
	General	Meeting with Bangladesh Bank
	General	Meeting with SREDA

Date	Issue	Item
	Site Survey	Site Survey in Institute of Engineers Bangladesh
Nov. 20 (Thu)	General	Meeting with GIZ
	Subcontract	Meeting with Softworks
	General	Meeting with HBRI
	General	Meeting with SREDA
	Site Survey	Site Survey in Unilliance Group Fabrics Limited
Nov. 21 (Fri)		
Nov. 22 (Sat)	Subcontract	Meeting with NewVision
Nov. 23 (Sun)	Committee	IT and Awearness Progam WG in MPEMR
	General	Meeting with Rahimafrooz Renewable Energy Ltd.
	General	Meeting with BSTI
	General	Meeting with Petro Bangla
	Subcontract	Meeting with e.Gen
Nov. 24 (Mon)	Workshop	Workshop in MPEMR
	General	Meeting with IDCOL
	General	Meeting with SREDA
	Subcontract	Meeting with BUET and e.Gen
	General	Meeting with HBRI
	General	Meeting with JICA
	General	Meeting with JICA (TEPCO)
Nov. 25 (Tue)	Seminar	Seminar (Climate Change) in MPEMR
	General	Meeting with SREDA
	General	Meeting with BCIC
Nov. 26 (Wed)	Seminar	Seminar (Interim) in MPEMR
	General	Meeting with SREDA
	General	Meeting with JICA

1.3.5 5th mission in February 2015

JICA Project Team submitted the Draft Final Report to JICA and MPEMR/SREDA. Final seminar was initially scheduled, but the seminar was canceled due to security reason, and mission period was shortened.

Activity record of the 5th mission is shown in Table 1.3-5.

Table 1.3-5 5th Mission Activity Record

Date	Issue	Item
Feb. 22 (Sun)	General	Meeting with SREDA
	Sub contract	Meeting with e.Gen
Feb. 23 (Mon)	Committee	JCC
	General	Meeting with SREDA
Feb. 24 (Tue)	General	Meeting with SREDA and BUET
Feb. 25(Wed)	General	Meeting with SREDA
Feb. 26(Thu)	General	Meeting with SREDA

Chapter 2

Outputs and Issues

Chapter 2 Outputs and Issues

2.1 EE&C Master Plan (EECMP)

2.1.1 Position of EECMP

The structure of the documents on national EE&C implementation was proposed by JICA Project Team as shown in Figure 2.1-1. EECMP should be positioned at the top of organization, actions and documents for national EE&C planning and implementation.

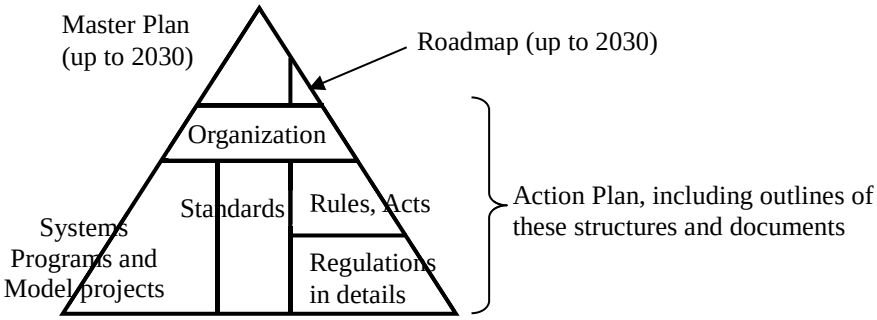


Figure 2.1-1 Structure of Documents on National EE&C Implementation

It was agreed that EE&C target in EECMP will basically follow the target set in the "Action Plan for Energy Efficiency and Conservation" issued by Power Division, MPEMR.

2.1.2 Objectives of EECMP

EECMP is Bangladesh commitment on EE&C implementation and will be officially presented to the country and the world. Figure 2.1-2 shows the core parts of EECMP, including EE&C target, roadmap, roles and responsibilities of parties, which is aimed to be read by Bangladesh people and establishments widely.

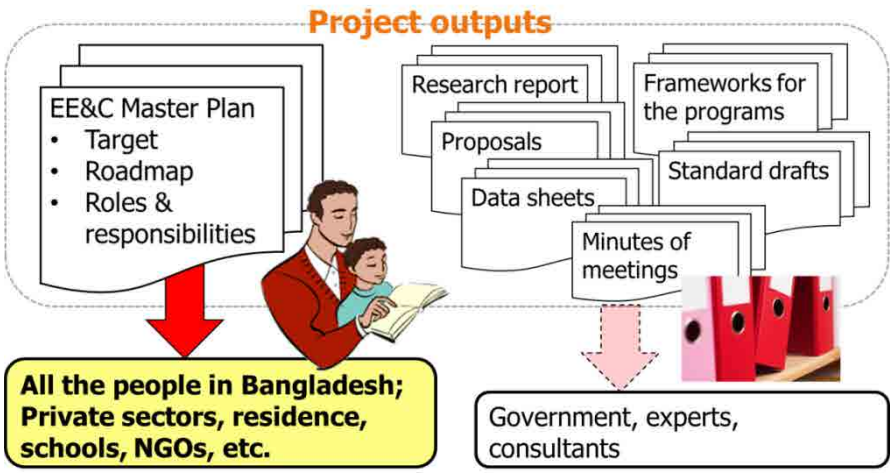


Figure 2.1-2 Objectives of EECMP

2.1.3 EECMP (Draft)

EECMP (Draft) was prepared by SREDA jointly with JICA Project Team. Contents of EECMP are the following (Refer to Annex (Separate Volume)):

Chapter 1: Introduction: background and necessity of EE&C

Chapter 2: Master Plan: objective, energy supply/demand situation, EE&C potential and target

Chapter 3: Action Plan: roles and responsibilities of participating parties, EE&C programs

Chapter 4: Economic Analysis of the EE&C Policies

Chapter 5: Capacity Development and EE&C Awareness Raising

2.1.4 Recommendation and Issues for Further Program Implementation

(1) Official publication of EECMP

To issue EECMP to the public, SREDA will have to take actions accordingly: 1) Stakeholder meetings will be continuously held by SREDA. 2) SREDA will amend EECMP according to the meetings or requirements. 3) SREDA will collect public comments from the people after reaching consensus in the Government and translating into Bengali. 4) The public comments will be utilized.

(2) Remaining EE&C plans

Plan on transportation sector, energy supply side and energy tariff system, which are not included in the Project, must be studied and these remaining issues should be integrated in new version of EECMP.

(3) EE&C target

Targeting on “primary energy consumption per GDP” is reasonable in the development stage. However, it may be better to shift this target to an absolute energy consumption reduction, when the country steps forward to stable economic growth in the future.

2.2 Energy Management Program

2.2.1 Objectives of the Program

Introduction of a suitable energy management is quite effective to promote EE&C for both industrial and commercial sectors. In Bangladesh, about 50% of primary energy is consumed by industrial sector. Thus, in order to accelerate EE&C in the industrial sector, the best way is to introduce energy management system (EMS). In this context, SREDA decided to establish the national program on energy management (Energy Management Program).

2.2.2 Components of Energy Management Program

Energy Management Program is the programs complex, which consists of the following components:

- Definition of Designated Large Energy Consumers (DCs) and mandatory energy management
- Certification of Energy Manager (EM), Certified Energy Auditor (CEA) and Accredited Energy Auditor (ACEA)
- Periodical reporting system for DCs
- Benchmarking on energy efficiency by industrial sub-sector and/or production process

2.2.3 Framework of Energy Management Program

Through Program Committee meetings, interview to related stakeholders, experts meetings and on-site surveys, basic design of the program components was drafted. "Framework of Energy Management Program" was prepared sorting the program components. The framework can be the base of regulation on the program. (Refer to Annex (Separate Volume))

2.2.4 Designated Large Energy Consumer (DC)[2]

JICA Project Team has introduced large energy consumer program in Japan, including the history of the program and an excellent outcome of EE&C in industrial sector. Besides Japan, similar programs are applied in India, Thailand, Turkey, Indonesia and Vietnam, as shown in Table 2.2-1.

Table 2.2-1 DC's Designations in Other Countries

Country	Numbers	Criteria of annual energy consumption	Energy manager	Annual report	Improvement plan	Energy audit
Japan	14,800	1,500 kloe	X	X	X	
Bangladesh	100	To be studied	X	X	X	X
Thailand	3,100	Contract demand: 1,000 kW	X	X	X	X
Vietnam	1,200	Factory: 1,000 toe Building: 500 toe	X	X	X	X
Indonesia	500	6,000 toe	X	X	X	
Turkey	4,000	Factory: 2,000 toe Building: 500TOE	X	X	X	
India	714	Steel, cement, fertilizer, paper, & power plant: 30,000 toe Textile: 3,000 toe	X	X		X

Note; X means under operation

Primary target of the 1st stage of Energy Management Program was proposed as follows:

- Target on the number of DCs: Around 100 large energy consumers in industrial sector

[2] The target consumers to be stipulated under the EE&C Rules (draft)

- Target on energy consumption share of 100 DCs: About 50% of the total industrial sector energy consumption

Research of sub-sector-wise annual electricity and gas consumption of large factories (about 100) and buildings have been implemented by a consultant (e.Gen Consultants Ltd.: an energy-sector local consultant in Bangladesh). The result of the research is summarized in Table 2.2-2. The energy consumption threshold criteria are suggested as shown in Table 2.2-3. DCs' energy consumption criteria are calculated with primary energy conversion factor.

Accordingly, proposed energy consumption criteria for DCs are as follows:

- Fertilizer, cement, steel-making & re-rolling, and petroleum-refinery: 10,000 toe/year and above
- Chemical, glass, paper & pulp, sanitary & ceramics, textile and garment: 6,000 toe/year and above
- Textile, garment and building: 3,000 toe/year and above

The total number of target DCs is about 110 to 120

- Energy consumption of industrial sector = 11,142,000 toe/y
- Share of DCs' energy consumption in industrial sector = 3421/11,142×100 = 31% (less than 50%)
- Numbers of DCs are 0.2% of the total establishments except micro factories. As assumed total numbers of the establishments are 60,000.

Table 2.2-2 Number of Industrial and Commercial Large Energy Consumers

No.	Sub-sector	Annual energy consumption (toe/year)				
		0 to 2,999	3,000 to 5,999	6,000 to 9,999	10,000 to 29,999	30,000 and above
1	Fertilizer					10
2	Cement		9	4	8	2
3	Steel-making & re-rolling				19	4
4	Sugar	10				
5	Brick	No data				
6	Chemical		8	4	5	
7	Cold storage	10				
8	Glass		3	2	3	
9	Paper & pulp		5	2	6	
10	Petro refinery				1	1
11	Jute	10				
12	Sanitary & ceramics		2	5	3	
13	Textile		6	4	3	2
14	Garment	7	0	5	2	
15	Building (office, hotel etc.)	46	10			
16	Transportation terminals		1			
Total		83	44	26	50	19

Table 2.2-3 Criteria, Number and Energy Consumption of DCs

Sub-sector	Threshold of energy consumption (toe/year)	Numbers of DCs	Annual energy consumption (toe/y)
Chemical fertilizer	10,000 and above	10	1,437,542
Cement	10,000 and above	14	295,091
Steel-making & re-rolling	10,000 and above	23	441,924
Chemical	6,000 and above	9	113,416
Glass	6,000 and above	5	60,841
Paper and pulp	6,000 and above	8	94,022
Petro chemical	6,000 and above	2	461,375
Sanitary & Ceramics,	6,000 and above	9	105,813
Textile	3,000 and above	15	200,584
Garment,	3,000 and above	7	64,154
Transportation terminals	3,000 and above	1	5,562
Building	3,000 and above	10	35,627
Total	-	113	3,315,951

Two selection methods of DCs are explained in the framework. One is the Authority's (SREDA's) nomination, based on energy suppliers' energy sales data. The other is energy consumer's voluntary declaration, based on their energy purchase data.

SREDA should start making contact with DC candidates and also industrial associations to give information about the program and get their consensus, in order to start the program smoothly.

2.2.5 Certifications of Energy Manager and Energy Auditor

(1) Several countries' certification methods

Several countries' certification methods were noticed. (Table 2.2-4, 2.2-5 and 2.2-6). SREDA has decided to establish similar certification system as in India.

Table 2.2-4 Certifications of Energy Manager and Energy Auditor in Japan and India

Japan	Training course and written test for certified energy managers are implemented by a governmental organization. Japan has no national certification system for energy auditors. Energy auditors are certified by a private organization.
India	Energy managers and energy auditors are selected through written test. The energy auditors can audit only small & medium size industries, while "accredited energy auditors" can audit the designated large consumers.

Table 2.2-5 Energy Manager Certifications in Other Countries

Country	Ministry for certification/Agency for implementation	Eligibility criteria	Written test	Lecture & Written test	Practical training & Written test
Japan	METI - ECCJ	None	1 day (1 time/year)	7 days (1 time/year)	
Thailand	MOE - DEDE	University graduates			7 days
Vietnam	MOIT	University graduates			10 days
Indonesia	MEMR	University graduates		5 days + 2-day test	
Turkey	MENR -DGRE	University graduates			10 days
India	MOP – BEE - NPC	University graduates	1 day (2 times/year)		
Sri Lanka	M0PE - SEA	University graduates & 1-year work experience	None	None	

Table 2.2-6 Energy Auditor Certifications in Other Countries

Country	License	Eligibility criteria	Written test	Lecture training & Written test	Practical training & Written test
Japan: EA for buildings	by ECCJ	Energy manager		2 days + Paper test + Audit report	
Japan: EA with profession	by ECCJ	Energy manager + Work experiences	1 day	Energy Audit report + Interview	
Bangladesh	MPEMR				
Thailand	None				
Vietnam	MOIT	University graduates		20 days + Audit training (Trial)	
Turkey	None				10 days
India	MOP - BEE	University graduates	1 day		
Sri Lanka	MoPE - SEA	University graduates & 10-year work experiences		Training course	

(2) Competency standard for the certification in Bangladesh

Competency standard for the certification in Bangladesh was drafted as shown in Table 2.2-7. SREDA intends to introduce the certification system step by step. The roadmap establishing the certification system is shown in EECMP.

Written tests include heat and electricity field, which are similar to India. The test will be held once or twice a year only in Dhaka, at the initial stage.

TICI (Training institute for chemical industries) of BCIC (Bangladesh Chemical Industries Corporation) is recommendable as a candidate for lecture/training venue.

Certification Committee, whose members consist of SREDA, academics and consultants who have energy audit expertise will be composed to support conducting certification.

Table 2.2-7 Competency Standards of CEA and ACEA Certifications

Items	Certified Energy Auditor (CEA)	Accredited Energy Auditor (ACEA)
Eligibility Criteria	EM Certificate or 3 years of work experience	CEA Certificate
Written test	4-subject paper including heat and electricity field	3-subject paper including heat and electricity field
Practical training and test (Hands-on test)	Applicable	Not applicable
Lecture training	5-day voluntary training	5-day voluntary training
Energy audit report	3 energy audit reports	5 energy audit reports
Oral interview	Applicable	Applicable

(3) Contents of written test and training in certification

Contents of written test, training course curriculum, contents of reference books, etc. were specified in the framework. The contents must be prepared by the Certification Committee.

The reference books are to be revised every 3 years, according to development of new EE technologies. Examples for calculation of energy saving effects in reference book for CEA are compiled from data of accumulated energy audit reports.

(4) Consideration of existing certification system in Bangladesh

An international energy auditor certification program supported by USAID and AEE (Association of Energy Engineers) has started in Bangladesh. As of October 2014, forty-three (43) energy auditors have been registered under this program. The candidates have to take three-day lecture/training, whose testing materials mainly focus on building and don't include measurement test. Besides SREDA's certification system focuses on industry and measurement skill. In addition to this, AEE energy manager certification program is scheduled to start in 2015.

SREDA will initiate training program for EM, CEA and ACEA in suitable location with trainers, having adequate knowledge on EM, CEA and ACEA training programs.

(5) Certification committee

Certification Committee will be formulated in EM, CEA and ACEA certification system. SREDA (certification authority) will outsource the works such as training, examination and scoring to Certification Committee. The committee member should consist of experts on energy and EE&C, who will be invited from the academy, consultants and the Government. The committee is also expected to give recommendation on the certification system to the Government.

2.2.6 Periodical Reporting System for DCs[3]

Format of periodical (annual) report was drafted and attached in the framework. Besides, application system through SREDA web-site was also developed as a part of "Energy consumption data collection mechanism" in the Project. In the reports, DCs are obliged to report their energy consumption intensity (i.e., primary energy consumption per production or sales amount: toe/ton or BDT) for the past five (5) consecutive years. Table 2.2-8 shows a sample of energy intensity transition. The form can be widely used by establishments in the both DCs and non- DCs.

Table 2.2-8 Energy Consumption Intensity in Past 5 Years (Example)

Fiscal year	2004-05	2005-06	2006-07	2007-08	2008-09	Change of intensity over 5 years
Energy consumption intensity (toe/ton) or kWh/ton or cum gas per ton	1.11	1.30	1.30	1.23	1.21	-
Ratio compared to the previous fiscal year	-	117%	100%	94.2%	98.8%	102%

2.2.7 Benchmarking

Benchmarking aims to show the best practice and distribution pattern of energy intensity (efficiency) by industrial sub-sector, and make every establishment to improve its energy efficiency.

JICA Project Team showed Japanese benchmarking criteria by production process and proposed "production process-wise benchmarking" with sample values. Tentative benchmark target was proposed in the framework.

The actual benchmark target should be defined by SREDA with the prior negotiation with the industrial sub-sectors (associations), which will be affected. The benchmark target should be up-dated based on the actual energy intensity data in Bangladesh and advanced case in foreign countries.

Table 2.2-9 shows benchmarking in Japan, in India (Perform Achieve and Trade (PAT) target value) and best practice value of Bangladeshi industries. The target values in India are specified to designated factories of PAT Program respectively. Bangladesh industries have large EE&C potential.

[3] The report, which is stipulated for DCs to submit, under the EE&C Rules (draft)

Table 2.2-9 Comparison of Benchmarking in Japan, India and Bangladesh

Sub-sector	Criteria: energy intensity (kgoe/ton)			
	Japan	India	Best practice data in Bangladesh	
Chemical fertilizer (Urea)	(690)	295 to 1487	1,700	Average values of BCIC + KFCO in 2012-2014
Steel-making & re-rolling	130 (Arc furnace)	226 to 1743	212 (Induction furnace)	Products: Steel bar
Re-rolling	50	-	64	Products: Bar steel
Cement kiln +mill	93	92 to 128	130	Material grinding + Rotary kiln + Grinding
Cement	15	13	16 (Vertical-Roller Mill)	23 (Ball mill)
Print paper	204	443 to 1482	210	-
Board paper	118	-		-
Soda chemical	82	249 to 928	300	Caustic soda (NaOH)

Source: Bangladesh data was provided by Prof. Ijaz, BUET

2.2.8 Internal Relationship of Program

Internal relationship of Energy Management Program is shown in Figure 2.2-1.

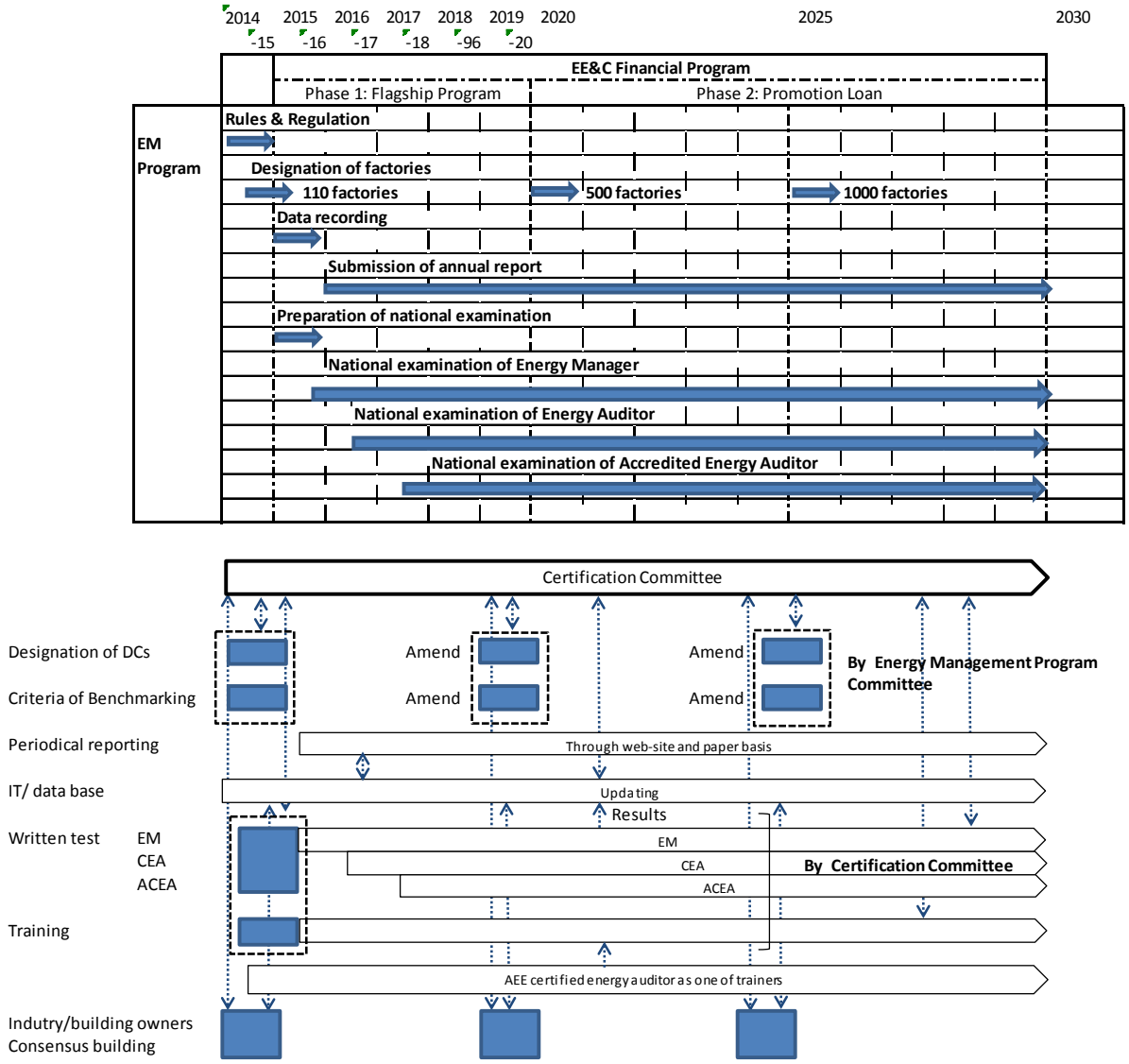


Figure 2.2-1 Internal Relationship in Energy Management Program

2.2.9 Primary Energy Conversion Factor for Grid Electricity

Primary energy conversion factor for grid electricity was proposed by JICA Project Team. After the discussions between SREDA and JICA Project Team, the primary energy conversion factor was defined as 2,867 kcal/kWh, instead of 860 kcal/kWh generally used, based on the thermal efficiency at end-user level in Bangladesh (or the grid generation efficiency of 30%[4]).

Calculation: 860 kcal/kWh / 0.30 = 2,867 kcal/kWh

This conversion factor should be up-dated referring to the grid generation efficiency periodically. (Refer to Table 2.7-5)

[4] Set at 1st EM Committee, based on the data provided by MOPEMR

2.2.10 Research and On-site Survey

(1) On-site survey

On-site surveys on eleven factories and two governmental buildings were conducted by JICA Project Team and e.Gen Consultants Ltd. Energy use condition, EE&C potential and energy management activities were observed and examined by one-day walk-through energy audits. The summary of the on-site survey result is shown in Table 2.2-10.

The main implication points from the on-site surveys are as follows:

1) Lack of Information for effective EE&C measures (Required for eligible energy auditing)
2) Lack of suitable maintenance for equipment (Required for efforts to maintain energy consuming equipment with appropriate conditions).
3) Lack of operation standards in governmental buildings such, as control of room temperature and lighting in lunch time
4) Cement-A, Steel making and re-rolling–B and Fertilizer-A are operated in good energy intensity because of installation of high efficient equipment (Required to disseminate high efficient equipment to other factories)

Table 2.2-10 Summary of On-site Survey Result

No.	Factory and building type	Energy intensity (kgoe/ton)		Energy use condition	EE&C measures and potential
		Audit data	Average in Japan		
1	Cold storage-A	7.5 (kW/t)	-	- Ammonia gas compressors are old	- Replacement of gas compressor saves around 61%
2	Textile - A	2,620	-	- Recovered waste heat of gas engines are used in spinning shop	- Compressed air pressure should be lowered. - Introduce LED lamps
3	Steel re-rolling - A	69	52	- No combustion control of re-heating furnace - No heat insulation on hot air pipe	- Combustion control saves around 6% - Heat insulation on hot air pipe
4	Textile & garment - B	No data	-	- Sewing machines - Fluorescent lamps are used in sewing shop	- Replace motor of sewing machines with servo-motor - Introduction of LED lamps
5	Textile & garment - C	490	-	- Compressed air pressure - Condensate recovery is not implemented - TFL	- Reduce compressed air pressure - Condensate recovery - Replace TFL with LED lamps
6	Cement - A	13	10	- A vertical roller mills (VRM) have been installed and operated.	- VRM is about 40% more efficient than a ball mill.

No.	Factory and building type	Energy intensity (kgoe/ton)		Energy use condition	EE&C measures and potential
		Audit data	Average in Japan		
7	Textile & garment - D	1,900	-	- Gas engine generators and steam boilers are operated. - TFL	- Introduction of gas turbine cogeneration system saves around30% - Replace TFLs with LED lamps
8	Steel making and re-rolling - B	50	52	- No combustion control of re-heating furnace - Wall temperature is high. - Preheating devices of ladles are not efficient. - Induction furnace	- Introduction of combustion control - Change castable refractories on reheating furnace to ceramic fiber. - Introduce regenerative burner for ladle heating/ saves around 50%
9	Cold storage - B	1,270 (kWh/t)	-	- Ammonia gas compressors are old.	- Replacement of gas compressor saves around 10%
10	Fertilizer - A	690	570	- Waste heat recovery system is implemented.	- Energy intensity is top rank in this sub-sector
11	Governmental building - A	372 (kWh/m^2)	139 (kWh/m^2)	- Monitoring and analyzing of power consumption by users has not been implemented. - All ACs have not been controlled. - Load of receiving transformers is as high as 90%: low efficiency	- Turn-off unnecessary lamp in lunch time. - Power monitoring to check unnecessary power. - Introduce ACs with COP 3.2 or over - Increase transformer capacity.
12	Office building - B	73 (kWh/m^2)	174 kWh/m^2)	- Monitoring and recording of power consumption of tenants by users has not been implemented. - All ACs have not been controlled. - Power consumption at midnight is 45kW, which is too large. - Window glass is covered with plastic film for heat insulation	- Recording of daily and monthly power consumption - Turn-off unnecessary lamp in lunchtime and midnight time
13	Textile & garment -E	1.18 (kgoe/m)	-	- Operation is conducted with many second hand machines. - Lightings of sewing shop are tubular fluorescent lamps. - Compressed air pressure is too high	- Introduction of high efficient weaving machines. - Introduction of high efficient fluorescent lamps or LED lamps - Examination and control of compressed air

Note: Multiple on-site surveys were carried out for textile, steel and cold-storage factories.

(2) Experienced person meetings

Experienced person meetings have been held three times. Information and data, related to the present energy management situation and energy saving potential, were provided by the participants. The energy audit data of steel re-rolling mills, textile and frozen seafood were reported by energy auditors. They have proposed and/or introduced economizer, heat insulation, VFD compressor, automatic biller casting system and so on. However detailed calculation data on energy saving amounts based on measurement has not been reported. Production conditions of industrial sub-sectors such as the size and numbers of factories have also been informed.

2.2.11 Recommendation and Issues for Further Program Implementation

(1) Issue of regulations on program

Overall roles and responsibilities are described in EECMP, Section 3.4.6, and time line (roadmap) is described in Section 3.4.9. The key issues are focused there and after. How to achieve the targets may be elaborately discussed, as actual means for achieving the targets are required to be known. Latest technology trends may also be proposed.

Since the program is mandatory, SREDA should promptly start preparation for issuing relevant regulations based on the framework. “Framework of Energy Management Program” should be finalized by Energy Management Program Committee and authorized by SREDA. The regulation should be issued by the end of 2015, in which commencement of the program should be fixed at the middle of 2016. SREDA should announce the program nationwide during regulations preparation.

(2) Stakeholder meetings on DCs’ program

SREDA should communicate with the candidates of DCs for their understanding of legal structure and obligations for DCs. Such meeting should be held through invitation of industrial associations, energy experts and other related candidate establishments. For that purpose, SREDA should formulate Energy Management Program Committee, inviting members from industrial sector and/or major candidates of DCs. Formulation of WGs by industrial subsector to discuss about specific matter, such as benchmarking, is an additional option. (By mid of 2015)

(3) Energy audit in DCs

Energy audits in DCs should be conducted every year as stipulated in EE&C Rules. It is recommended that energy audits should be conducted by some registered energy audit companies, which employ more than two accredited energy auditors and have measurement instruments necessary for energy audits.

(4) Award for benchmarking accomplishment

Award should be given to the establishments which achieved the benchmark target by the Minister of MPEMR.

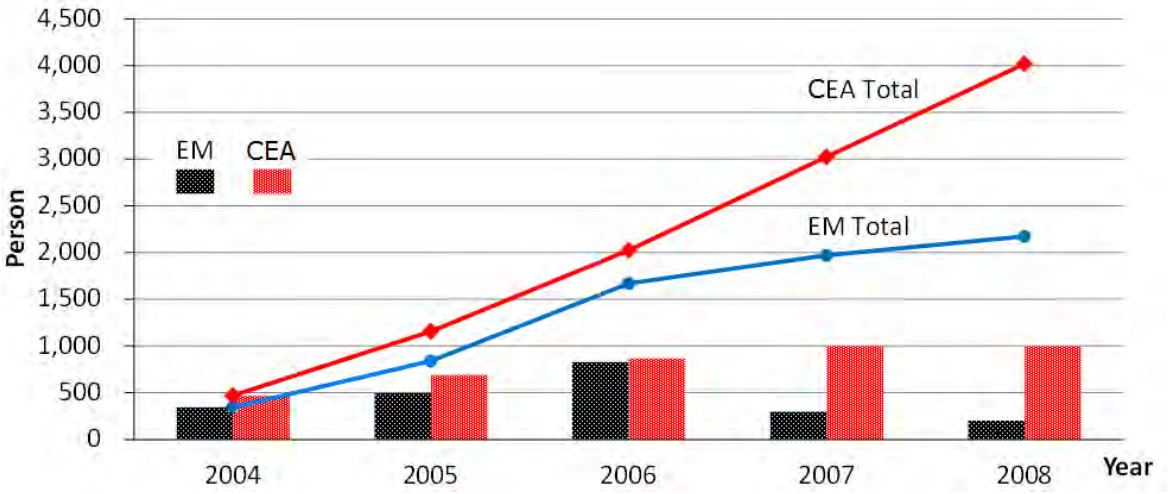
(5) Differentiation of certifications for energy manager and energy auditor

In India, number of newly EMs has been decreasing year after year, as shown in Figure 2.2-2. It is supposed that Indian EM program has not been working very well in recent years.

This is due to the contents of the examination for EMs and energy auditors being very similar to each other (3 of 4 subjects of the written test are in absolutely common), in spite of the fact that energy auditors can carry out energy audits, whereas EMs have no rights to carry out energy audits.

SREDA should avoid the similar situations mentioned above. Following matters are recommendable:

- Examination for EMs and CEAs should be made different for the degree of difficulty.
- CEAs should submit energy audit report and carry out lecture training and oral interview.
- EMs have rights to conduct the energy audit as in house employee.



Source: Compiled by JICA Project Team based on BEE website data

Figure 2.2-2 Number of Certificated Energy Managers and Energy Auditors in India

(6) Guidance of certification examination

Guidance for taking examination of EM, CEA and ACEA should be provided by SREDA. Advertising and guidance for the importance and meaning of taking an examination should be announced in Dhaka and Chittagong in order to promote participation for examinations.

2.2.12 SREDA's Immediate Action for Energy Management Program

SREDA should take immediate actions as shown in Table 2.2-11.

Table 2.2-11 SREDA's Immediate Action for Energy Management Program

	2015										2016								
	Mar.	Apr.	May	June	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1.Regulation on Energy Management Program																			
■ Appointment of Energy Management Program Committee member																			
■ Committee meeting: discussion and finalization of the Framework		▼	▼																
■ Drafting of regulation																			
■ Issue of the regulation					▼														
2.Designation of DCs																			
■ Pick-up of 100 candidates for DCs																			
■ Dissemination of program to DCs candidates																			
■ Nomination of DCs																			
■ Appointment of energy manager																			
■ Recording of energy data by factory																			
■ Receiving of annual energy report																			
■ Correcting and analysis of report data																			
■ Guidance and support of DCs																			
3.Certification of EM																			
■ Formulation of Certification Committee																			
■ Preparation of reference book, training, written test (by Certification Committee)																			
■ Advertisement to the applicants																			
■ Application of training/test																			
■ Training and test (by Certification Committee)											▼								
■ Issue of EM certificate and EM List													▼						
4.Certification of CEA																			
■ Advertisement to the applicants																			
■ Application of training/test																			
■ Preparation of reference book, training, written test (by Certification Committee)																			
■ Training and test (by Certification Committee)																▼			
■ Issue of CEA certificate and CEA List																		▼	
5.Certification of ACEA																			
■ Advertisement to the applicants																			
■ Application of training/test																			
■ Preparation of reference book, training, written test (by Certification Committee)																			
■ Training and test (by Certification Committee)																▼			
■ Issue of CEA certificate and CEA List																		▼	

	2015										2016								
	Mar.	Apr.	May	June	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
6.Periodical Energy Consumption Reporting System (PRS)																			
■ Development and trial operation (by SREDA and DCs)																			
■ Instruction to DCs (seminar ▼)										▼			▼			▼			
■ Operation by DCs																			

2.3 EE Labeling Program

2.3.1 Objectives of the Program

Introduction of standard and labeling (S/L) program on appliance/equipment is quite effective to promote EE&C in the residential sectors. In Bangladesh, about 30% of primary energy is consumed in residential sector. Thus, in order to accelerate EE&C for residential sector, SREDA decided to establish national EE Labeling Program.

2.3.2 Stakeholder Meetings and Major Issues on Program

EE Labeling Program Committee meetings, WGs and workshop were held in the Project. Table 2.3-1 shows the contents of discussions. The major outputs through these discussions and surveys are summarized below:

Table 2.3-1 Committees, WGs and Workshop

Name	Meeting	Discussion
Committee	1st meeting (18th May 2014)	■ Roles share among SREDA and BSTI ■ Verification system
	2nd meeting (1st Sep. 2014)	■ Framework of EE Labeling Program (Draft)
	3rd meeting (16th Nov. 2014)	■ Roadmap and budget planning
WG	Refrigerator WG (8th Sep. 2014)	■ Manufacturer's intention regarding joining to the labeling program (WALTON) ■ Procedure of the label certification
	AC WG (13th Nov. 2014)	■ Procedure of the label certification and verification system ■ Questionnaire on EE measurement methods and star rating criteria
	TV WG (13th Nov. 2014)	■ Procedure of the label certification and verification system ■ Questionnaire on EE measurement methods and star rating criteria
Workshop	24th Nov. 2014	Seven manufacturers and importers (WALTON, Hayes/Haier, SINGER, Energy Pac, BEIL-Transcom, ACT Energy & Power, and Electro Mart) participated in the workshop. General information on EE labeling and The Government's intention are shared among the participants. Major discussion points are: ■ Subjects on mainly refrigerator, AC and TV ■ General issues of labeling program ■ Accreditation by BAB (Bangladesh Accreditation Board) ■ Questionnaire on EE measurement methods and star rating criteria

As discussed in the meetings, major issues on EE Labeling Program are summarized as follows:

- Role-share among related organizations
- Assurance of EE label's reliability (establishment of verification system)
- Framework of EE Labeling Program
- Issue of BDSs on EE measurement method
- Capacity development of laboratories for applying mandatory program
- Management of stakeholder meetings

2.3.3 Role-share among Related Organizations

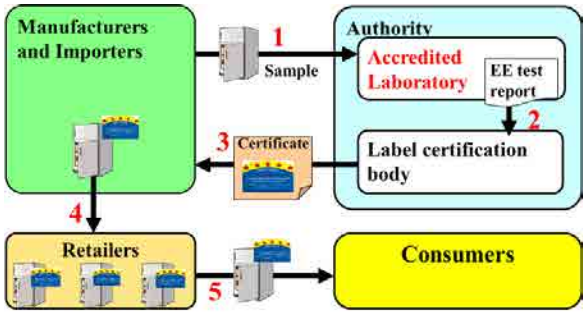
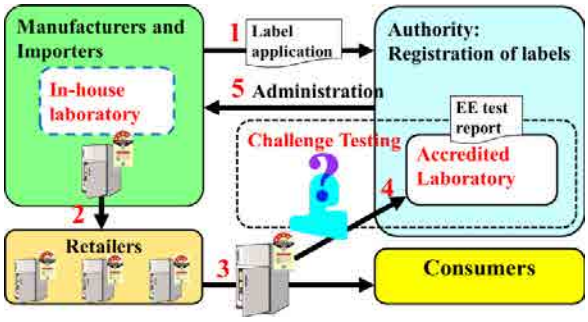
BSTI has initially been engaged as a leader in UNDP-BRESL (Barrier Removal for Energy Standards and Labeling) Project in Bangladesh. BSTI has issued BDSs on EE measurement methods, but couldn't issue regulation, and the initial EE Labeling Program didn't work well under the project. SREDA has been newly established with an objective to promote, coordinate and assist Renewable Energy and Energy Efficiency activities in the country. SREDA's most important role is to issue regulations and manage the program entirely. BSTI will concentrate standardization (issue of BDSs) and conduction of EE measurement tests. BAB (Bangladesh Accreditation Board) will join in the program for maintaining laboratories' test reliability by issuing accreditation. BSTI should get accreditations by BAB.

Key players/ stakeholders on the program are manufactures and importers. They are expected to join in the program voluntarily complying with the labeling rules. Also, they are expected to join in stakeholder meetings for developing and/or improving the program elements such as EE measurement method and star rating criteria, based in their technical expertise and information about market condition.

2.3.4 Assurance of EE Label's Reliability (Verification System)

Verification system including EE measurement procedures was selected from the two candidate verification types as shown in Table 2.3-2. Assuring EE label's reliability is the most important issue. Japan has been implementing EE Labeling Program with relatively soft verification system (Type 2), in which the manufacturers' voluntary compliance contributes for the reliability. In Bangladesh, strict verification system (Type 1) is adopted. Many South East Asian countries adopt such type of verification.

Table 2.3-2 Types of Verification System

Verification system – Type 1 (adopted)	Verification system – Type 2
	
Procedure 1. Manufacturers/importers get EE test on their products at accredited laboratories. 2. Label certification body evaluates the EE test report and issue label certificate on the product with star rating, and issue it to the manufacturer/importer 3. Manufacturers/importers affix the label on the products or their packages, and deliver to the markets. 4. Label certification body carries out EE check test for the products sold in the markets, picking up samples, in order to maintain credit of labels.	Procedure 1. Manufacturers/importers get EE test on their products and make EE label with star rating in accordance with the specified standards and criteria. 2. The labels are registered at the authority 3. Manufacturers/importers affix the label on the products or their packages, and deliver to the markets. 4. The authority carries out EE test for the products sold in the markets picking up sample, or being asked for "challenge test" by somebody who wants the test for verification. 5. Penalty will be imposed to the manufacturers/importers, if they affix illegal labels.
Example of countries: Singapore, Thailand, Malaysia, Vietnam, Indonesia	Example of countries: Japan, India, Australia/New Zealand, EU

2.3.5 Framework of EE Labeling Program

"Framework of EE Labeling Program" was initially drafted by JICA Project Team and discussed through several meetings of EE Labeling Program Committee. The frameworks can become the base of regulations; however they are on the way to be finalized. Table 2.3-3 shows contents of the Frameworks. Part 1 "General" contains general and common stipulation for the all appliances, which apply to EE Labeling Program. Part 2-8 deals with technical and specific matters which are regulated by each appliance type. Part 2 "CFL", Part 3 "Refrigerator", Part 4 "AC", Part 6 "Fan" and Part 7 "Ballast" were drafted utilizing existing Bangladesh Standards (BDSs) which have been obtained as output of BRESL Project. (Refer to Annex (Separate Volume))

Table 2.3-3 Framework of EE Labeling Program

Framework	Title	Content
Part 1	General	■ Definitions of terms ■ Organization rules that specify procedures for label certification, accreditation ,verification , standardization and other systems for the program ■ Incentive and disincentive ■ Complete procedure of the program
Part 2	CFL	■ Type and Scope of Products ■ Classification ■ Energy efficiency (EE) indicator ■ EE measurement method ■ Criteria of EE rating ■ Data verification, including laboratories' competence accreditation, data validation period, tolerance of data and test reporting ■ Label affixing rule ■ Product information
Part 3	Refrigerator	
Part 4	AC	
Part 5	TV	
Part 6	Fan	
Part 7	Ballast	
Part 8	Motor	

CFL will be gradually discontinued as it has got mercury and Bangladesh is a signatory of Minamata convention on mercury under UNEP who are committed to discontinue mercury use.

Many imported products are sold in Bangladeshi market. How to verify foreign manufacturers EE test data is the discussion point at EE Labeling Committees and WGs. The representative of WALTON insisted that foreign laboratories should receive BAB (Bangladesh Accreditation Board) accreditation.

2.3.6 Research and Study

(1) Local manufacturer's testing ability

WALTON has five sets of testing facilities (climate chambers), and has conducted tests according to BDS1850 (EE measurement method). However, these test facilities have not yet acquired BAB accreditation. WALTON can join EE Labeling Program, by applying for accreditation of BAB.

(2) 3rd party laboratories

Intertek Bangladesh, which was invited to participate on the 2nd labeling Program Committee, introduced its activity on labeling program in India acting as 3rd party laboratory. Intertek has no testing laboratory in Bangladesh, but there may be a possibility to join in the labeling program by utilizing its facility in India. 3rd party laboratories may be developed in time through consultation with BAB and BSTI.

(3) Market research

Home appliances market research and measurement for the residential electricity consumption

have been conducted. Final report on the research has been submitted at the end of November. Home appliance electricity consumption growth up to 2030, EE&C potential and economic analysis on EE Labeling Program was performed utilizing the research result. (Clause 2.7 and 2.8)

(4) Questionnaire on foreign countries' EE ratings

At the Workshop held on 24th Nov. 2014, JICA Project Team requested several manufacturers (WALTON, Hayes/Haier, SINGER, Energy Pac and other) to answer the questionnaire on star rating criteria for ACs in several countries (Australia/New Zealand, Singapore, India and Vietnam). These manufacturers were also asked to draft the rating criteria for TV, based on the method applied in Singapore.

2.3.7 Recommendation and Issues for Further Program Implementation

(1) EE labeling on industrial motor

Motors are popularly used as part of home appliances, but not sold and purchased individually. Moreover, energy efficiency of motors is already evaluated according to the four ratings of ISO/IEC. Provision of four-star-rating label, which is closely related to that of ISO/IEC, not applying Bangladesh five stars rating, is one of the alternative options to be considered. ISO/IEC was recommended in the Framework of Part 8 Motor.

(2) Mandatory program and EE testing capacity

SREDA intends to start mandatory program from FY 2016-17 in Phase 1 in order to facilitate the nationwide application of the program. In case the program becomes mandatory, laboratory's EE testing capacity becomes a critical problem. This is because The Government must provide full-fledged EE testing (measurement) services, which satisfy manufacturers and importers requests for label application. Therefore, the time line for the capacity building of BSTI's testing facilities and the timing of the shift from voluntary to mandatory implementation should be well coordinated between SREDA and BSTI. One of the options is to postpone commencement of the mandatory program.

(3) Problems in current BDS

BRESL Project produced eight harmonized BRESL standards for testing protocols and MEPS to be followed by six BRESL countries. As outputs of BRESL Project, some BDSs have been formulated by direct quotes from foreign standards. Table 2.3-4 shows the issues in the current BDS which need to be settled soon. SREDA should formulate technical WGs (Working Groups) by appliance inviting stakeholders and experts for settlement of the problems in corporate with BSTI. BSTI should issue revised BDSs.

Table 2.3-4 Problems in Current BDS

Appliance	BDS No.	Problem
AC	BDS-1852 (2012)	■ Modification from 10 stars to 5 stars rating (Clause 2.7) ■ Stipulation about MEPS (Clause 3.2) should be removed. MEPS should be issued by SREDA as a regulation. ■ EE measurement method and requirement (star rating) should be coordinated with BNBC [Revised] (New Version of Bangladesh National Building Code) and GBG (Green Building Guideline) ■ Modification of label design to the unified design (Section 5) ■ Calculation of AEER (Annual Energy Efficiency Ratio) following to AS/NZS is not suitable to the mainstream in the world.
	BDS-1853 (2012)	■ MEPS should be issued by SREDA as a regulation.
Refrigerator	BDS-1850 (2012)	■ Modification of label design to the unified design (Section 2-2)
Motor	BDS-EN 60034-30	■ Efficiency classification uses 4 grades in the BDS (Clause 5.3.2). Relation with 5 star rating must be made clear.
CFL	BDS-IEC 1761 (2006)	■ Modification of label design to the unified design (Chapter 8)
Fan	BDS-1860 (2012)	■ Stipulation about MEPS (Clause 7.1.2) should be utilized. However, MEPS should be issued by SREDA as a regulation. The MEPS was harmonized in 6 countries in BRESL project.
Ballast for FL	BDS IEC 60921 (2005)	■ Star rating criteria should be provided
	BDS IEC 60929 (2005)	

(4) International 3rd Party Laboratories

Some companies have testing facilities in the neighboring countries such as India, and are already participating in other labeling programs abroad. SREDA should consider the possibility of utilizing the facilities and experiences of these companies and other reputed international companies, mobilizing their participation in the labeling program. (See Table 2.3-5)

Table 2.3-5 International 3rd Party Laboratories

3rd party laboratory	Outline
Intertek	Offices in Dhaka AC test laboratory in India and China
TUV Rheinland	Office in Dhaka AC test laboratory in Singapore
Underwriter	No office in Bangladesh

(5) Issue of regulation on the program

Preparation for issuing regulation on the program should be carried out by SREDA. Core parts of the program, which are proposed in the Framework of Part 1 General, should be firstly put on the process for legislation. Technical and specific rules by appliances which are proposed in the

Frameworks of Part 2 - 8, should be studied and finalized under the stakeholder meetings. The rules should be issued as supplemental regulations one by one as they are finalized. Before issuing regulations, the BDSs, which are cited in the regulation, should have been already issued.

(6) Stakeholder meetings

EE Labeling Program will impact foreign manufacturers, because many foreign products are sold in the Bangladesh market. The program may cause a discussion of NTV (Non-Tariff Barrier). EE Labeling Program Committee and WGs by appliance should be held fairly and often not only involving the Government side members, but also inviting many stakeholders including foreign manufacturers. In the meetings, technical and specific matters by appliances, and cost bearing for EE measurement and label application should be discussed.

(7) On-site study in foreign countries

It is recommendable to visit to neighboring countries such as India, Sri Lanka, Malaysia, etc. where EE labeling program has been applied, to grasp present situation, issues and impact of the program. Not only SREDA, but also BSTI, local manufacturers and BAB are expected to join in the mission. In the foreign countries, interview to the authorities (the label certification body), survey in the appliance market and observation of laboratories testing equipment should be scheduled. The mission should be arranged and conducted by SREDA.

2.3.8 SREDA's Immediate Action for EE Labeling Program

The most important short term target is to issue regulation on the program by the end of October 2015. Table 2.3-6 shows action plan for this purpose and other. While proceeding legislation, SREDA should get stakeholders consent through enough information exchange. All frameworks should be finalized by EE Labeling Committee and WGs by appliance. The final version of frameworks should be authorized by SREDA for the base of regulations. BSTI should also authorize the frameworks for the base of BDSs.

Table 2.3-6 SREDA's Immediate Action for EE Labeling Program

	2015										2016					
	Mar.	Apr.	May	June	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June
1. Regulation on EE Labeling Program																
■ Appointment of EE Labeling Program Committee member	▒															
■ Committee meeting: discussion on Framework Part 1		▼	▼	▼												
■ Finalization of the Framework Part 1 (by Committe)					▼											
■ Drafting of regulation (ministerial order)						▒	▒									
■ Issue of the regulation								▼								

	2015										2016					
	Mar.	Apr.	May	June	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June
2. Labeling rules of CFL (technical provision)																
■ Appointment of WG member	■															
■ WG meeting: discussion of the Framework Part 2		▼	▼													
■ Finalization of the Framework Part 2 (by WG)				▼												
■ Review of the current BDS (by WG)		■	■													
■ Drafting of the regulation (ministerial order)					■	■										
■ Issue of the regulation								▼								
3. Labeling rules of refrigerator (technical provision)																
■ Make connection with major manufacturers	■															
■ Appointment of WG members	■															
■ WG meeting: discussion of the Framework Part 3		▼	▼													
■ Finalization of the Framework Part 3 (by WG)				▼												
■ Review of the current BDS (by WG)		■	■													
■ Drafting of the regulation					■	■										
■ Issue of the regulation								▼								
4. Labeling rules of AC (technical provision)																
■ Make connection with major manufacturers	■															
■ Appointment of WG members	■															
■ WG meeting: discussion of the Framework Part 4		▼	▼	▼												
■ Finalization of the Framework Part 4 (by WG)					▼											
■ Review of the current BDS (by WG)		■														
■ Questionnaire survey to the manufacturers		■	■													
■ Revision of BDS, importing other standard (by BSTI)			■	■	■											
■ Drafting of the regulation						■	■									
■ Issue of the regulation								▼								
5. Labeling rules of TV (technical provision)																
■ Make connection with major manufacturers	■															
■ Appointment of WG member	■															
■ WG meeting: discussion of the Framework Part 5		▼	▼	▼												
■ Finalization of the Framework Part 5 (by WG)					▼											
■ Study of forein labeling standard (by WG)		■														
■ Questionnaire survey to the manufacturers		■	■													
■ Drafting of new BDS on TV (by BSTI)				■	■											
■ Drafting of the regulation						■	■									
■ Issue of the regulation								▼								
6. Labeling rules of fan (technical provision)																
■ Appointment of WG member	■															
■ WG meeting: discussion of the Framework Part 6		▼	▼													
■ Finalization of the Framework Part 6 (by WG)			▼													
■ Review of the current BDS (by WG)		■	■													
■ Drafting of the regulation (ministerial order)				■	■											
■ Issue of the regulation								▼								
7. Labeling rules of ballast (technical provision)																
■ Appointment of WG member	■															
■ WG meeting: discussion of the Framework Part 7		▼	▼													
■ Finalization of the Framework Part 7 (by WG)			▼													
■ Review of the current BDS (by WG)		■	■													

	2015										2016					
	Mar.	Apr.	May	June	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June
■ Drafting of the regulation (ministerial order)				■	■											
■ Issue of the regulation								▼								
8. Labeling rules of induction motor (technical provision)																
■ Make connection with major manufacturers	■															
■ Discussion of necessity of EE label on moters	■															
■ Appointment of WG member	■															
■ WG meeting: discussion of the Framework Part 8			▼													
■ Finalization of the Framework Part 8 (by WG)				▼												
■ Review of the current BDS (by WG)			■	■												
■ Drafting of the regulation (ministerial order)					■	■										
■ Issue of the regulation								▼								
9. Development of EE measurement labolatory																
■ Discussion with BSTI about test facilities (equipment specification,)	■	■	■													
■ Getting BAB accreditation (by BSTI)						■	■	■	■	■			▼			
■ Discussion with 3rd party laboratories about their Intention of participation, accreditation, activity in other countries						■	■	■	■	■						
10. Information to the stakeholders																
■ Delivery of program leaflet							■	■	■	■						
■ Media campaign, seminars							■	■	■	■						
11. On-site study in neighboring countries																
■ Planning including neiboring countries acceptance								■	■							
■ Fomulation of mission team										■						
■ Dispatch of mission team (▼) and reporting											▼	■				

2.4 EE Building Program

2.4.1 Objectives of EE Building Program

The energy consumption is rapidly increasing in building sector of Bangladesh. Therefore, it is needed to implement an effective counter measures to mitigate this issue in this sector. Besides, New Version of Bangladesh National Building Code (hereinafter referred as "BNBC [Revised]") is going to be published by Ministry of Housing and Public Works (MOHPW), taking into consideration energy consumption in building as well. Since BNBC [Revised] is the core program for promoting EE buildings, it is focused hereinafter.

On the other hand, for not only energy efficiency and conservation but also reduction of overall environmental impact and betterment of indoor air environment in buildings, MOHPW is developing Green Building Guideline (GBG). Since green building program is important as one of international movement, GBG is also discussed hereinafter.

2.4.2 EE Building Program WG and Discussion Issues

EE Building Program Working Group Meetings were held during the Project. Table 2.4-1 shows the contents of discussion

Table 2.4-1 Discussion Points in WG Meetings

Meeting	Discussion
1st meeting (19th and 21st May, 2014)	■ Implementation structure between SREDA and MOHPW ■ Current situations of BNBC, development progress of BNBC [Revised] and GBG ■ EE&C requirement issues in BNBC [Revised] ■ Introductions of Japanese systems and programs for EE buildings
2nd meeting (2nd and 8th September, 2014)	■ Roles and Responsibilities under BNBC [Revised] ■ Check and monitoring system for BNBC [Revised] ■ Problems in BNBC [Revised] criteria
3rd meeting (17th November, 2014)	■ BNBC [Revised] implementation ■ GBG development and implementation ■ Other related programs for EE buildings ■ Check and monitor of BNBC [Revised] and GBG ■ Roadmap and budget

Implementation structure for EE Building Program between MOHPW and SREDA, which has been previously confirmed, are as follows;

a) MOHPW takes the role and responsibility as an implementing body of BNBC [Revised].
b) SREDA provides supports and advices for promoting implementation of buildings EE&C measures.

MOHPW and SREDA should cooperatively promote EE&C in buildings. As a good example would be Japanese joint implementation structure in which Ministry of Economy, Trade and Industry (METI) and Ministry of Land, Infrastructure, Transport and Tourism (MLIT) collaborate and promote EE&C in buildings.

Study and recommendations on the major issues mentioned above are summarized below:

2.4.3 BNBC [Revised] and GBG

The outlines and the current situations of BNBC [Revised] and GBG are as follows.

a) BNBC is a mandatory program, which provides regulation and/or the minimum requirements of building type, size, structure strength, indoor condition, construction material, etc. Energy efficiency (EE) requirements for buildings are added in BNBC [Revised].
b) GBG is the voluntary program that provides recommendations not only on energy and water use efficiency, but also on reduction of overall environmental impact caused by building construction,

usage and demolition. GBG will be completed by 2025 and will enter into the implementation phase after that.

(1) BNBC [Revised]

1) EE&C requirement issues in BNBC [Revised]

a) On the first implementation stage, EE&C requirement issues in BNBC [Revised] are confirmed to be proper and compared favorably with those in Sri Lanka and India.
Comparison of EE&C requirement issues in each country is shown in Table 2.4-2.

Table 2.4-2 Comparison of EE&C Requirement Issues in Each Country

	Bangladesh (New Version of Bangladesh National Building Code (BNBC [Revised]))	India (Energy Conservation building Code (User Guide))	Sri Lanka (Code of Practice for Energy Efficiency Buildings)	Japan (Energy Conservation Act & Regulations)
Building Envelope	Window to wall ratio Shading Roof insulation and Green roofing system	Mandatory Requirements Fenestration Opaque construction Building envelopment sealing Prescriptive Requirements Roofs Cool roofs Opaque walls Vertical fenestration Skylights Building Envelope Trade-off Option	Mandatory Requirements U-values Envelops sealing Air leakage National building regulations Prescriptive Requirements External wall with/without fenestration Roofs Windows	Prescriptive Requirements Insulation of walls, roofs and floors, Windows' condition (Specification, Blind), Shading, Building configuration, Shade areas or sunny areas, Air-conditioning spaces or no-air-conditioning spaces
HVAC / Ventilation	HVAC systems Operable window (Natural ventilation) Celling fans Wall fans	Mandatory Requirements Natural ventilation Minimum equipment Control Piping and Ductwork System balancing Condensers Prescriptive Requirements Economizers Variable flow and Hydronic system	Mandatory Requirements Load calculations System and equipment sizing Fan system design criteria Pumping system design criteria Separate air distribution system Temperature controls Off-hour controls Piping insulation Air handling system ducts A/C equipment Testing, adjusting, balancing and commissioning Water treatment Maintenance	Prescriptive Requirements HVAC system (Type of heat source equipment, Variable speed control of fan and/or pump, operation number control of fans and pumps, heat exchange, All flesh air cooling) Ventilation (High efficient drive, variable speed control (Invertor), Temperature, CO2 and/or CO control)
Hot Water Supply	Solar hot water system	Mandatory Requirements Solar water heating Equipment efficiency Supplementary water heating system Piping insulation Heat traps Swimming pools	Mandatory Requirements Water heating equipment efficiency Service water heating piping insulation Service water heating system control Prescriptive Requirements Temperature limits Heat traps Supplementary service water heating systems	Prescriptive Requirements Solar hot water system Heat loss of pipe lines
Lighting	Daylight Lighting power density Occupancy sensors Supplementary lighting system	Mandatory Requirements Lighting control Exit signs Exterior building grounds lightings Prescriptive Requirements Interior lighting power Building area method installed interior lighting power Exterior lighting power	Mandatory Requirements Lighting control Maximum allowable power for illumination systems Building exterior lighting power Prescriptive Requirements General and task lighting considerations Selection of appropriate components	Prescriptive Requirements Planning (Room configuration, Task and ambient lighting, Interior fixtures) Lighting (Type of lighting fixture type and lamp) Lighting control (Occupancy sensor, Time schedule, Dimmer control, Lighting intensity correction in early time, Blind control)
Electric Power/ Distribution	Efficient pumps and fans are included in HVAC / Ventilation	Mandatory Requirements Transformers Energy-efficient motors Power factor correction Check-metering and monitoring Power distribution systems	Mandatory Requirements Electrical distribution system Transformers Electric motors Prescriptive Requirements Metering	Prescriptive Requirements Efficient pumps and fans are included in HVAC / Ventilation
Elevator	Efficient elevators and Escalators			Prescriptive Requirements Efficient elevator (Variable speed control)
Others	Rain water harvesting system Efficient fittings in toilets Unpaved area Site drainage and run-off coefficient Irrigation plan Renewable energy Reuse of gray water			Prescriptive Requirements Solar Generation Co-generation
Remarks		Performance-based alternative		Performance-based alternative

b) On the other hand, there are inconsistencies among the criteria of BNBC [Revised], GBG and EE Labeling Programs (draft) in Bangladesh, since the criteria of developed countries on several requirements are directly quoted in the criteria of BNBC [Revised], but are not suitable for Bangladesh, considering the present market conditions.

2) Application of BNBC [Revised]

A phased implementation approach for BNBC [Revised] has already been planned by MOHPW. Table 2.4-3 suggests how the areas can be changed to expend the coverage of the code. This contributes to properly and effectively promote building EE&C in Bangladesh. BNBC [Revised] will be improved time to time.

Table 2.4-3 BNBC [Revised] Coverage of Gloss Floor Area in m^2 of Building Types

Categories	2015	2017	2019	2022
Office	≥ 5,000	≥ 5,000	≥ 3,000	All
Rental / Mercantile	≥ 10,000	≥ 5,000	≥ 3,000	All
Residential	≥ 10,000	≥ 5,000	≥ 3,000	All
Hospital	≥ 10,000	≥ 10,000	≥ 3,000	All
School	≥ 10,000	≥ 10,000	≥ 3,000	All
Hotel	≥ 5,000	≥ 5,000	≥ 3,000	All

Note: Year is calendar year from January to December.

3) Roles and responsibilities

All stakeholders should understand and implement their roles and responsibilities as follows;

a) The Government should formulate legal framework, promote BNBC [Revised] and spread the program nationwide. MOHPW is the leading executing body for BNBC [Revised] implementation and promotion of its EE&C components. SREDA provides supports and advices for promoting implementation of buildings EE&C measures.

b) Local governments are ones who should actually be at the front line of the implementation of BNBC [Revised]. They should implement BNBC [Revised] under MOHPW's awareness raising and capacity development in association with SREDA.

c) Building owners, building users, designers and constructors and other parties should comply with BNBC [Revised]

Understanding of all stakeholders' roles and responsibilities are needed to promote BNBC [Revised] implementation. Awareness raising and capacity development for local governments and other stakeholders are needed to overcome the present situation, as law and regulation are not perfectly sustaining the program. All stakeholders' roles and responsibilities are shown in Table 2.4-4

Table 2.4-4 Roles and Responsibilities of Stakeholders

Concerned Organization and stakeholder		Design	Constructio	Operation	Demolition	Roles and responsibilities
The Government	MPEMR/ SREDA	*	*	*	*	1) Comprehensive promotion of EE&C ・ Formulation of EE&C requirement, criteria and evaluation method, in coordination with MOHPW and HBRI 2) Initiatives on implementation of EE&C ・ Monitoring of program implementation reported by MOHPW and Housing and Building Research Institute (HBRI) ・ Review of the program with MOHPW and HBRI ・ Promotion of the program with MOHPW and HBRI 3) Information provision for MOHPW
	MOHPW /HBRI	*	*	*	*	1) Comprehensive promotion of EE&C on buildings ・ Formulation of EE&C requirement, criteria and evaluation method coordinating with SREDA ・ Review of the program with SREDA 2) Initiative on implementation of EE&C on buildings 3) Information provision for local governments, building owners & users, designers and constructors ・ Promotion of the program to building owners & users, designers and constructors ・ Instruction of the program to local governments and governmental agencies ・ Monitoring of the program implementation, and report to SREDA
Local Government		*	*	*	*	1) Promotion of EE&C on buildings in accordance with the local characteristics 2) Initiatives on implementation of EE&C on buildings ・ Examine the program suitability, considering local conditions ・ Promotion of the program to building owners & users, designers and constructors ・ Monitoring of the program implementation, and report to MOHPW and HBRI 3) Information provision for building owners & users, designers and constructors
Building Owner		*	*	*	*	1) Concrete implementation of EE&C ・ Compliance to the program regulation 2) Lifestyle modification for EE&C 3) Consider the lifecycle cost
Designer		*				1) Concrete implementation of EE&C ・ Compliance to the program regulation ・ Explanation to building owners ・ Documentation for application and approval of the local government 2) Lifestyle modification for EE&C 3) Consider the lifecycle cost
Constructor			*			1) Concrete implementation of EE&C ・ Compliance to the program regulation ・ Explanation to building owners ・ Documentation for application and approval of the

Concerned Organization and stakeholder	Design	Constructio	Operation	Demolition	Roles and responsibilities
					local government 2) Lifestyle modification for EE&C 3) Consider the lifecycle cost
				*	1) Concrete implementation of EE&C 2) Consider 3R (reduce, recycle and reuse)
Building User			*		1) Concrete implementation of EE&C ・ Compliance to the regulation on the program ・ Voluntary efforts on EE&C ・ Cooperation with other stakeholders 2) Lifestyle modification for EE&C 3) Consider the lifecycle cost

4) Check and monitoring system to ensure buildings EE&C performance

The current building permit system, in which buildings' EE&C performance is checked and approved at design and construction stages is not effective to ensure actual EE&C performance at buildings operation stage, because building design and/or specification of equipment are sometimes changed from the drawings previously approved. Therefore, check and monitoring system after buildings completion and during buildings operation is needed.

In Japan, large scale building owner must submit notification and periodical report describing building EE&C measures and performance to the government. It is recommendable to introduce similar system in Bangladesh. Check and monitoring systems under BNBC [Revised] are proposed as shown in Table 2.4-5. Form of notification and periodical report are attached in Annex (Separate Volume).

Table 2.4-5 Check and Monitoring System under BNBC [Revised]

Stage	Check and monitoring system	
Design	Building Permit (existing)	Local governmental agency checks if the plan and design are made in accordance with the building codes and the relevant regulations. If the buildings are not planned and designed properly, the governmental organizations recommend and instruct their redesign. If the buildings are not redesigned, the local governmental agency does not permit buildings construction.
	Notification of EE&C measures	Building owners submit Notification on EE&C measures to the local governmental agency prior to the construction. If the EE&C measures are insufficient, the local governmental agency recommends or instructs the owners to improve measures. In case of disobedience to the instruction, disclosure of establishment name and/or other penalty are imposed.
Construction	Building Permit (existing)	Local governmental agency inspect if the buildings are constructed in accordance with the original plan and design. If the buildings are not constructed in accordance with the original plan

Stage	Check and monitoring system	
		and design, the local governmental agency recommends and instructs how to modify them. If the buildings are not modified, the local governmental agency does not permit the buildings use.
Operation	Periodical Report of EE&C Measures	Building owners submit Periodical Report to the local governmental agency. Operation and maintenance conditions concerning the items described in the Notification shall be reported.

(2) GBG

Requirements in GBG are not only for use of energy and water but also for waste management, indoor air quality, materials and other environmental issues. GBG will be used as a guideline for the design and construction of upper-grade EE&C and low environment impact buildings. GBG's main targets in the first stage will be new and big development projects of offices, shopping malls, residences, hospitals, schools and hotels.

(3) Check and review

MOHPW and SREDA should regularly check and review the progress of BNBC [Revised] implementation and GBG development. In case that any situation change or any problems arise, they should make reviews on the schedule and conduct proper counter-measures.

In addition, for the quantitative analysis when doing check and review properly, statistical database is needed and maintained. MOHPW in association with SREDA should build statistical database for existing and under construction buildings, which include not only number of floors and floor area by building type but also energy consumption and equipment list.

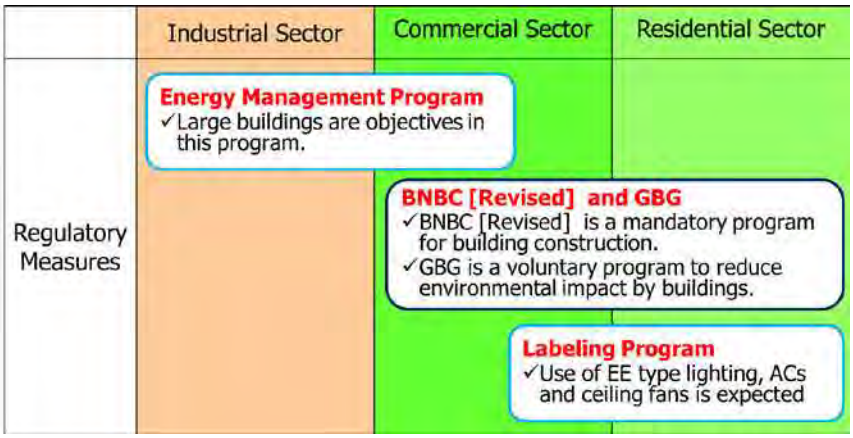
2.4.4 Relation with Other EE Programs

Energy Management Program and EE Labeling Program (Clause 2.2 and 2.3) are the programs related to BNBC [Revised] and GBG.

a) Energy Management Program covers large energy consumers. Large building owners are managed by this program in parallel with BNBC [Revised].
b) EE Labeling Program is applied on electrical appliances. Lighting, ACs, and ceiling fans are managed by this program in parallel with BNBC [Revised].

Relation with these programs can be shown in Table 2.4-6.

Table 2.4-6 Relation with Other EE Programs



2.4.5 Research and Study

In order to grasp present situation of building EE&C implementation, two on-site surveys for government buildings have been carried out. (Summary of on-site survey result refer for Section 2.2.10)

The main EE&C improvement points, which come from the surveys, are lighting, ACs and heat insulation of windows. As described in Section 2.4.3 (1), the following measures are confirmed to be effective for building EE&C implementation;

a) Introduction of EE type ACs under the BNBC [Revised] implementation
b) Enhancement of heat insulation performance of window under the BNBC [Revised] implementation
c) Implementation of lights-out at lunch time and night through awareness raising
d) Proper temperature setting of ACs through awareness raising

There are not many examples of properly conducted energy audits in Bangladesh. More energy audits should be implemented to prepare database for building EE&C, collecting and analyzing data through the energy audits should be furthermore implemented.

2.4.6 Recommendation of Further Program Development

(1) Development of EE&C building manual for BNBC [Revised]

EE&C building manual is needed to be developed and introduced in order to encourage proper and effective implementation of EE&C measures in BNBC [Revised].

The manual includes detailed explanations and concrete construction methods for EE&C measures in BNBC [Revised]. The manual includes popular measures applicable to all buildings and a variety of recommended measures for individual building types.

The manual is expected to be used as a guideline for local governments, building owners and users,

designers, and constructors.

MOHPW, with SREDA's support if needed, should develop and publish the EE&C building manual in the initial BNBC [Revised] implementation stage of 2015 and 2016. Reflecting data and information which are acquired through the activities of awareness raising and capacity development, MOHPW should complete the manual by using expert consultants.

(2) Development of Green Building Assessment System for GBG

Green building assessment system should be developed in association with the GBG development for effective implementation and promotion of GBG. The Japanese system which is called CASBEE (Comprehensive Assessment System for Built Environment Efficiency) is one of good examples. Such assessment system should not be directly imported from developed counties, but the system should be well arranged to suite to Bangladeshi climate, society, culture, manner and laws & regulations. MOHPW, with SREDA's support if needed, should develop and publish the system in time with GBG issue (See Table 2.4-7).

In the future, green building assessment system for GBG will be adopted as an evaluation method for certification of "Green building" and/or "Net zero energy building". Incentive mechanisms for constructing green buildings should be also developed and provided.

Table 2.4-7 Development Schedule of GBG and Green Building Assessment System

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
GBG (MOHPW) EE&C Clauses in GBG (SREDA/MOHPW)		Development									Voluntary Implementation					
Green Building Assessment System (MOHPW)									Development			Implementation				

2.4.7 Immediate Action for EE Building Program

Development of EE&C building manual is the most important and urgent issue. MOHPW should set up a working team in the ministry and start developing the manual. SREDA should support the MOPHW's activities to develop the manual on the economic and technical aspects. In this context related meetings will be held between MOHPW and SREDA, depends. The concrete development schedule is shown in Table 2.4-8.

Table 2.4-8 Development Schedule of EE&C Building Manual (Mainly by MOHPW)

	2015										2016											
	Mar.	Apr.	May	June	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Development of EE building manual																						
■ Set-up Working Team																						
■ Collection of data and information																						
■ Drafting the manual (partially supprted by SREDA)																						
■ Finalizing the manual (ditto)																						
■ Authorizing the manual (ditto)																						
■ Issue of the manual																						

2.5 EE&C Finance Program

2.5.1 Objectives and Components of Program

In order to promote EE&C effectively, financial incentive mechanisms are necessary to introduce in Bangladesh, as well as regulatory measures. During the project, JICA Project Team studied through discussions with stakeholders various ways to propose effective finance mechanism to proliferate EE&C policies.

2.5.2 Stakeholder Meetings and Major Issues on Program

Three meetings of Finance Program and Economic Analysis Committee and several meetings with relevant stakeholders were held in the Project to discuss what would be the most effective and feasible measure to implement EE&C policies with the support of financial schemes. The research outputs including the proposed loan schemes have been made from discussions and consultations with the following organizations during the Project (See Table 2.5-1).

Table 2.5-1 List of Interviewees during the Project

Category	Organization	Department	Committees			Interviews			
			May	Sept	Nov	Feb	May	Sept	Nov
Ministries & Government Organizations	SREDA		X	X	X	X	X	X	X
	MPEMR	Power Division	X	X	X	X	X	X	X
		Energy & Mineral Resources Division	X		X				
	Ministry of Finance	Bank and Financial Institutions Division (BFID)						X	
		Economic Relations Division (ERD)		X		X		X	
		Finance Division (FD)						X	

Category	Organization	Department	Committees			Interviews			
			May	Sept	Nov	Feb	May	Sept	Nov
Banks and NBFIs	Bangladesh Bank (BB)	Research Department		X	X				
		SME Department				X	X		X
		Green Banking & CSR Department							X
	Planning Commission		X						
	National Board of Revenue (NBR)	Tax Policy		X	X			X	
		Customs						X	
	IDCOL	Deputy CEO							X
		Investment Advisory				X	X	X	X
		Renewable Energy	X	X		X			
	IDLC Finance						X		
	Mutual Trust Bank (MTB)						X		
	United Commercial Bank (UCB)						X		
	United Capital Limited (UCL)								X
International Donors	GIZ Office Dhaka	Sustainable Energy Development (SED)				X	X	X	X
	UNDP Bangladesh	Sustainable Development, etc.						X	
	USAID Bangladesh	Economic Growth Office						X	
	World Bank Office Dhaka	South Asia Sustainable Development						X	
Electric Appliance Distributors	Solar En Foundation								X
	Rahimafrooz Renewable Energy Ltd.								X

Note: The bracket with X mark shows the month in which an interview had taken place.

The major issues of EE&C Finance Program are as follows:

- Financial incentives for EE&C promotion
- EE&C finance mechanism for Bangladesh with JICA ODA loans
- EE&C support activities by international donor agencies

2.5.3 Financial Incentives for EE&C Promotion

(1) Types of financial incentives

Financial incentives, in definition, are monetary rewards provided for performance above targeted objectives; and they can provide economic benefits for implementation of EE&C projects though people's behavioral change. For instance, investment subsidies, low-interest rate loans and preferential tax measures are considered as the most effective financial measures to promote EE&C.

In contract to energy subsidies, which is rampant in Bangladesh, financial incentives in general have good effects on raising the people's awareness on EE&C.

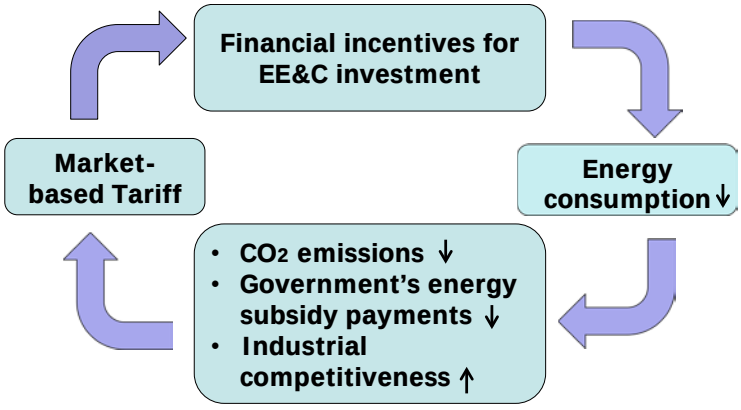


Figure 2.5-1 Virtuous Circle of Financial Incentives

As shown in Figure 2.5-1, financial incentives such as investment subsidies for EE&C facilities, projects and technologies and low-interest loans for EE&C investments and purchase of EE equipment provide effective incentives for the people and companies to cut down their energy consumption. This will increase their industrial competitiveness, lessen the Government's fiscal burden for subsidy payment and reduce CO_2 emissions.

And this virtuous circle allows The Government to eventually adopt a market-based pricing system, for the energy supplier.

Table 2.5-2 shows the pros and cons of the respective financial incentives.

Table 2.5-2 Types of Financial Incentives for EE&C Promotion

	Examples	Pros	Cons
Investment subsidies	- Investment subsidy - Rebate program - Interest subsidy for loans (buy-down grants) - Bilateral Offset Credit Mechanism (BOCM)	- Available for anyone - Economic stimulus effects are expected	- High transaction costs
Preferential taxation	- Tax exemption - Tax reduction - Accelerated depreciation	- Available for anyone - Low transaction costs	- Difficult to measure policy impacts
Low-interest loans	- Government support loans (e.g. SME loans supported by Bangladesh Bank, BB Refinance Line for Renewable Energy) - ODA loans (e.g. JICA loans)	- Less financial burden for the Government - Easy to implement for Participating Financial Institutions PFIs - Long term financial support for end-user	- Beneficiaries are limited to eligible

*BOCM = An agreement between GoB and GoJ, based on which GoJ supports GoB for reducing CO_2 emissions by providing grants to install low-carbon emission equipment/ projects. The grants will cover 50% of total cost of each project.

In a broad sense, preferential tax and subsidy measures are implemented by The Government, whereas low interest loans are provided by the financial institutions. Since loans are not gratuitous, and must be repaid thoroughly, beneficiaries are limited to those companies that meet financial and technical eligibility criteria. This aspect of low interest loans is actually both disadvantage and advantage. Beneficiaries are limited in a sense that they are screened by eligibility criteria, but because of that, low interest loans can promote the intended policy more efficiently.

In contrast to this, the beneficiaries of both preferential tax and subsidy measures are not restricted by financial eligibility criteria. Any company and any individual can receive the support for their purchase of EE equipment and EE investments.

With regard to disadvantages, the economic impacts of tax measures such as accelerated depreciation and tax reductions on EE&C are hard to measure, since they both are simply an accounting procedure to reduce taxable income. As for the disadvantage of subsidy measures, implementing EE&C promotion measures require high administrative and transaction costs, which cannot necessarily be quantified.

All considered, low interest loan measure is relatively the most effective and efficient financial measure for executing EE&C promotion. It is effective because financial institutions provide long-term funds based on certainty of repayment, which requires intensive and thorough credit appraisal process. And it is efficient because financial institutions support companies' voluntary efforts in improving their energy efficiency, which will increase their industrial competitiveness.

(2) EE&C financial incentives in other countries

Promotion of energy savings and demand side management had started as early as 1975 in Japan, and followed suit by many Asian countries in early 2000s. (Appendix 1 "Examples of EE&C Financial Incentives in Asian Countries for the details".)

1) Subsidies

Subsidy programs are implemented in many countries to promote nationwide dissemination of EE&C and to stimulate positive economic impact. Subsidies are utilized for investment subsidies (including various discount treatments), supporting energy audit fee, in-kind benefits (e.g. free distribution of CFL light bulbs), etc. For example, Japan and South Korea conducted rebate programs for individuals (and establishments in Japan) in which economic benefits (such as "Eco-Points" which can be traded with certain goods) were provided for people who had taken actions for EE&C activities (such as purchasing EE products, etc.). In Singapore, NEA (National Environment Agency), a public organization to improve and sustain clean and green environment, implemented EASe (Energy Efficiency Improvement Assistance Scheme) investment allowance program. This program provided financial supports to companies which wished to take energy audits. EASe also covered costs for implementing energy measures recommended by ESCOs based on energy audits. South Korea also had a similar program to support energy audit costs for

large energy consuming companies. Whichever type of subsidies to implement, it is important for the implementing agency/agencies to secure certain amount of funds.

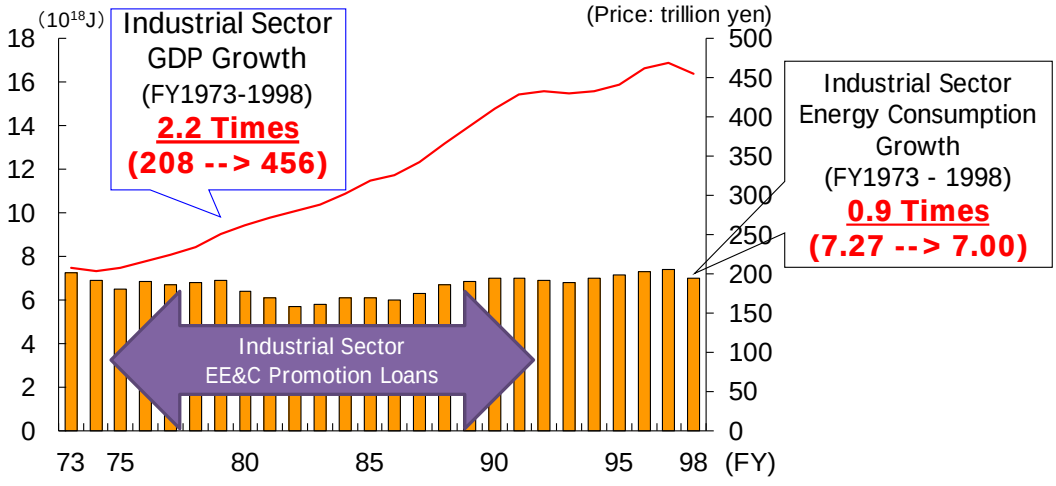
Table 2.5-3 Types of Subsidies

Type	Country
Investment subsidies (including various discount treatments)	China, Singapore
Rebate program	Japan (Eco-Point), South Korea (Carbon Cash bag)
Grants for energy audit costs	South Korea, Singapore
In-kind benefits (free-of-charge)	Thailand (free distribution of CFLs)

2) Low-interest loan program

Many countries currently provide low interest loan programs, but Japan is one of the pioneers of EE&C promotion utilizing low interest loans.

In case of Japan, where low interest loans for industrial sector EE&C promotion started as early as 1975, its economic benefits was remarkable. During the 30 years between mid-1970s and mid-1990s, the Development Bank of Japan, a policy-based financial institution, provided a total of JPY 657 billion for industrial sector EE&C promotion and successfully mobilized more than the same amount of loans through joint financing with private sector financial institutions. As a result of joint private and public sector EE&C efforts, the industrial sector GDP in 1998 more than doubled compared with mid-1970s, without increasing the industrial sector's total energy consumption during the period.



Source: Agency for Natural Resources and Energy[5]

Figure 2.5-2 Transition of Final Energy Consumption in Japan (1973 - 1998)

[5] http://www.enecho.meti.go.jp/about/whitepaper/2013html/2-1-1.html

In Thailand, Department of Alternative Energy and Energy Development (DEDE) provided a soft loan program, Energy Efficiency Revolving Fund (EERF). The 10-year program implementation brought 1,170.66 GWh electricity savings per year, and the total energy savings amounted to 5.4 billion Baht per year for the total energy costs reduction. (See Table 2.5-4)

Table 2.5-4 EERF Project-Status Fact Sheet

Implementation period	2003 – 2011
Number of Projects	294
Total Investment	15,959.05 million baht
Loan from Revolving Fund	7,231.94 million baht
Loan from Commercial Bank	8,727.10 million baht
Electricity Savings	1,170.66 million kWh / year
Oil Savings	234.35 million litter / year
Total Energy Savings	5,423.48 million baht / year
Reduction Oil Imports	320.38 ktoe / year
GHG Emission Reduction	0.98 million ton CO_2 eq.

Source: Status Fact Sheet provided by Sinsukprasert, Prasert, DEDE [2011]

3) Tax incentives

Tax incentives are for companies and individuals to promote replacement with new energy saving equipment. For example, Japan and China introduced tax exemption and reduction program for EE cars and new energy cars (hybrid cars, EVs), by which many people rushed to the car dealers to replace their car with more energy efficient or energy-saving ones. For companies, Singapore implemented an accelerated depreciation program which can save income taxes in the first year of replacement or addition of EE equipment. In case of South Korea, 10% of relevant investment amount will be deducted. Japan had also accelerated depreciation program designed for SMEs during the year 2011-2014. In this program, SMEs could enjoy special depreciation of 30% of purchase value.

(3) Best choice of financial incentives for promoting EE&C in Bangladesh

Drawing an implication from the past experience, JICA Project Team suggests that long-term low-interest financing, among all financial incentives, is more sustainable and effective for The Government to promote EE&C in the country, especially under tight budget constraints.

1) EE&C promotion loan scheme by JICA ODA loans

JICA has been providing concessional loans and technical assistances to various countries since 2007. EE&C promotional loan program for micro, medium, and small enterprises (MSMEs) in India is one of the successful cases. Under this loan program, participating financial institutions (PFIs) and leasing companies provide loans/ leasing for their customers who are planning to install EE equipment with more than 10% EE&C improvement potentials. This program was

implemented first in 2008 and re-disbursed twice in 2011 and 2014, upon the strong request of the Government of India. To date, the needs for EE&C investments among MSMEs remain high. The third phase currently under implementation will continue to support EE&C dissemination among MSMEs until 2019. Figure 2.5-3 shows the detailed scheme of this program.

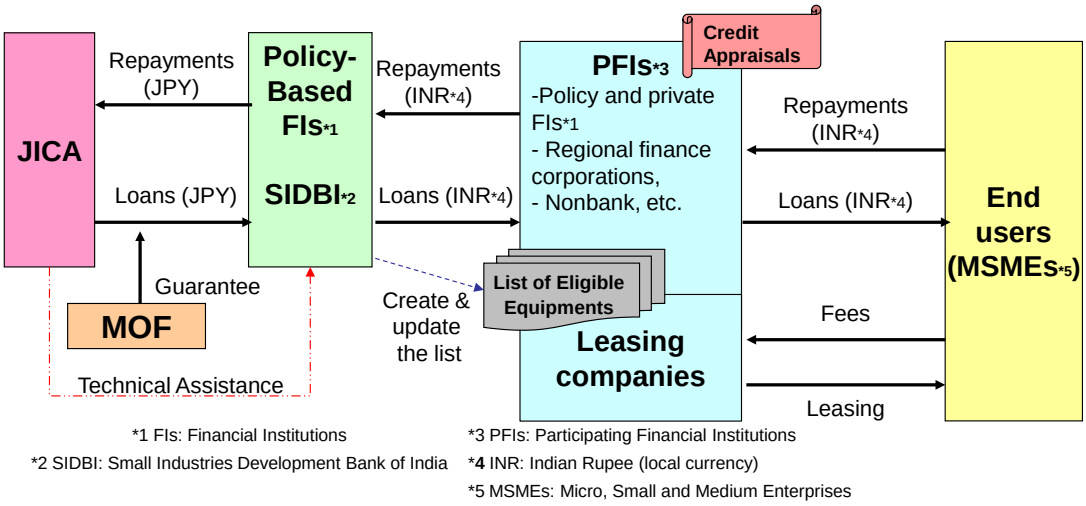


Figure 2.5-3 JICA EE&C Promotion Loan Scheme for MSMEs (India)

As a result of 1st phase (2008 – 2011), average energy savings per project came out to be 35.67%, which is higher than the national goal stated on 11th 5-year plan in India. (See Table 2.5-5)

Table 2.5-5 Energy Consumption Reduction from the Project

Average energy saving rate	35.67%
Annual reduction on electric energy consumption	477.71 GWh
Annual reduction on thermal energy consumption	446,474 Gcal
National goals by 2017 (from 11th 5-year plan)	20%
Target energy saving rate at appraisal	More than 10%

Source: JICA Ex-post Evaluation Report, 2012[6]

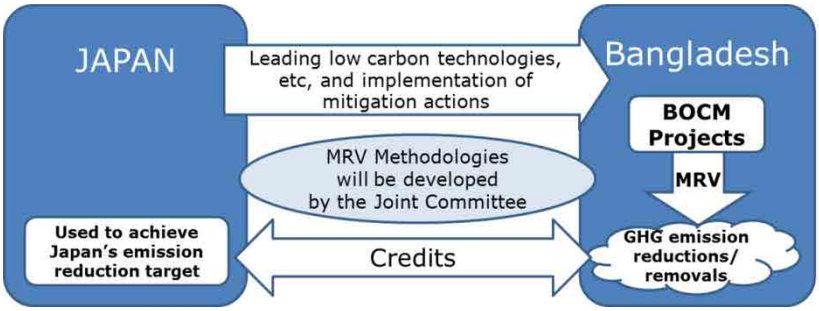
2) BOCM (Bilateral Offset Credit Mechanism) / JCM (Joint Crediting Mechanism)

Government of Japan (GoJ) also provides several supporting tools to help developing countries for promoting environmental-friendly activities such as EE&C, GHS emission reductions, etc. Bilateral Offset Credit Mechanism (BOCM) or Joint Crediting Mechanism (JCM) grant program is one of them. BOCM can also be utilized, in addition to EE&C loan program, as the source of funds for EE&C pilot projects.

GoJ started BOCM/JCM since 2013. BOCM/JCM is a cooperative agreement between GoJ and host country to reduce CO_2 emission. When the agreement was signed, GoJ will provide grants

[6] http://www2.jica.go.jp/en/evaluation/pdf/2012_ID-P200_4.pdf

for projects which are to replace/install EE type equipment, which will also reduce CO_2 emission. The grants will cover 50% of total project costs. As of 2014, GoJ signed the contracts with 10 countries: Bangladesh, Indonesia, Vietnam, Mongolia, Lao PDR, Kenya, Ethiopia, Maldives, Costa Rica, and Palau.



Source: BOCM Bangladesh-Japan https://www.jcm.go.jp/bd-jp/about

Figure 2.5-4 BOCM Scheme between Bangladesh and Japan

2.5.4 EE&C Finance Program for Bangladesh with JICA ODA Loans

(1) Overview

As a part of the Project, financial incentives were discussed to promote major EE&C policies and programs (i.e. energy management, EE labeling and EE building) in Bangladesh. And according to the following reasons, low interest loan utilizing concessional ODA funds was considered as most effective among the three financial incentives, such as subsidies, tax incentives and loans, in order to stimulate private sector EE&C investments in the country:

- Less financial burden for The Government: Fund will be returned with interest from participating financial institutions (PFIs).
- Easy to implement for PFIs: No need to create a new loan process for PFIs. (Adopt same credit appraisals as normal ones, use eligible lists/ criteria for technical appraisals created by SREDA)
- Long-term financial support for end users: Encourage industries to work with energy efficient machineries with improved production quality and quantity (increasing industrial competitiveness)

As a result of the discussions with SREDA and other stakeholders about the feasible and effective financial schemes, JICA Project Team has designed an EE&C Promotion Loan Program which utilizes JICA ODA Loan. The details of the loan program will be elaborated in the following sections.

(2) Main purpose of EE&C promotion loan program

The main goal of EE&C Promotion Loan Program is to promote the adoption and dissemination of the three EE&C policies and programs by stimulating EE&C investments for EE equipment/ appliances and green buildings/EE buildings. However, under the current market situation, where the Government highly subsidizes energy and power sector to lower the costs of fuel and

electricity for the household and industries, there is lack of urgency among the public and industries to save energy, and therefore less momentum to install, execute and proliferate EE&C policies and programs. Furthermore, private-sector investors, financial institutions (scheduled banks and non-bank financial institutions) and companies are not yet aware of the importance of investing in EE equipment and EE&C technologies.

With this recognition, financial incentives are necessary to facilitate the deployment, execution, and proliferation of EE&C policies and programs. At the same time, the creation of viable and bankable EE&C markets is indispensable to convince such investors.

Therefore, EE&C Promotion Loan Program will be designed in two phases: the first phase for implementing flagship EE&C projects to prove their economic viability, and the second phase for the nationwide dissemination of EE&C investments.

(3) Candidate implementing agencies

For the implementation of this program, there are three candidates: SREDA, Bangladesh Bank (BB), and Industrial Development Company Limited (IDCOL). All of them are governmental organizations which can receive JICA loans via the Ministry of Finance in Bangladesh (MOF). While both BB and IDCOL have abundant experiences to handle donor funds including JICA ODA loans, SREDA is a newly established organization which has no experience in handling ODA loans. Nevertheless, compared with other candidates, SREDA can be the prime candidate for overseeing the program considering the following factors (See Table 2.5-6).

- SREDA is the nodal institution for identification, promotion, facilitation and overall coordination of all national renewable energy and EE&C policies and programs in Bangladesh.
- SREDA Act indicates that SREDA can have their own fund, namely, SREDA Fund, procuring funds from public and private sources for the promotion of renewable energy and EE&C activities.
- SREDA can lend money at the most preferential rates to end-users by directly providing loans to project owners, without financial intermediaries. This aspect is especially important in the first phase (flagship stage) of the program, in which significantly competitive interest rates should be provided to end-users to stimulate their investments on EE&C projects.
- SREDA has two advantages over IDCOL in terms of end user interest rate: (i) SREDA is a non-profit organization whereas IDCOL is a profit seeking non-bank financial institution; and thus the former can provide lower interest rate to end users; and (ii) SREDA, as a newly established governmental institution with important mandate to promote EE, can request MOF to provide it with very concessional lending terms and conditions.

Detail of organization profiles and charts of SREDA and IDCOL are shown in Appendix 2 “SREDA and IDCOL Profiles”.

Table 2.5-6 Comparison of Candidate Implementing Agencies

		Viability of candidate implementing agencies		
		SREDA	BB	IDCOL
Types of organization (public/ private)		Governmental organization (EE&C regulatory body)	Governmental organization (Central bank)	Governmental organization (NBFI)
Experiences in handling ODA loans		None (New organization)	Abundant (JICA SME Two-step Loan etc.)	Abundant (SHS Program etc.)
Phase 1 (Flagship stage) objectives	1. Create new markets for EE investments 2. Showcase of high-potential EE&C projects	High viability: SREDA can recommend or expedite to provide loans directly to the project owners with the lowest interest rates (at half the market prices) compared with other two.	Low viability: - BB can only provide loans via participating financial institutions (PFIs) which implies that end-user lending interest rates will be higher after adding PFI interest margins - BB cannot instruct PFIs to provide loans for specific projects	Medium viability: IDCOL can directly provide loans to their end users. However, its end user interest rates will be higher than those of SREDA since IDCOL, as a financial institution, has to earn interest margins.
Phase 2 (Dissemination stage) objectives	Promoting nationwide adoption and implementation of EE&C policies	Medium viability: - Beneficiaries can be expanded nationwide through on-lending via PFIs (PFIs will provide loans to their customers through their branch networks) - On-lending through PFIs may be a new challenge	High viability: - Beneficiaries can be expanded nationwide through on-lending via PFIs (PFIs will provide loans to their customers through their branch networks)	Low viability: - Their branch network is not wide enough (13 branches) - As a PFI itself, on-lending through other PFIs may be a new challenge

Considering both disadvantages and advantages of these three candidates, there are two plans to implement the program: One is the plan if SREDA is an implementing agency and the other is the selection of IDCOL.

(4) Plan A: SREDA as an implementing agency

1) Phase 1: Flagship stage

In phase 1, SREDA picks up projects, which will have high energy-saving potential such as investments on EE equipment and machineries by industrial companies, installment sales of EE type appliances to the households and constriction of EE buildings and Green Buildings (See Figure 2.5-5). The lending interest rate for Phase 1 will be aimed at half the market rate. This

phase is to show end users the positive economic impact of EE&C investments. Target end users are (i) large energy consuming companies, in order to promote Energy Management Program; (ii) distributors and wholesalers of electric appliances, for the promotion of EE Labeling Program; and (iii) building owners and developers as a promotion of EE Building Program.

With regard to the promotion of EE type appliances, the manufacturers of EE appliances will also be included as the beneficiaries of the concessional loans. Due to high transaction costs, direct loans to individual households cannot be handled. Therefore, the scheme intends to provide refinancing loans at concessional rates to those distributors and wholesalers who are willing to promote the sales of EE type appliances to end users on installment at favorable terms.

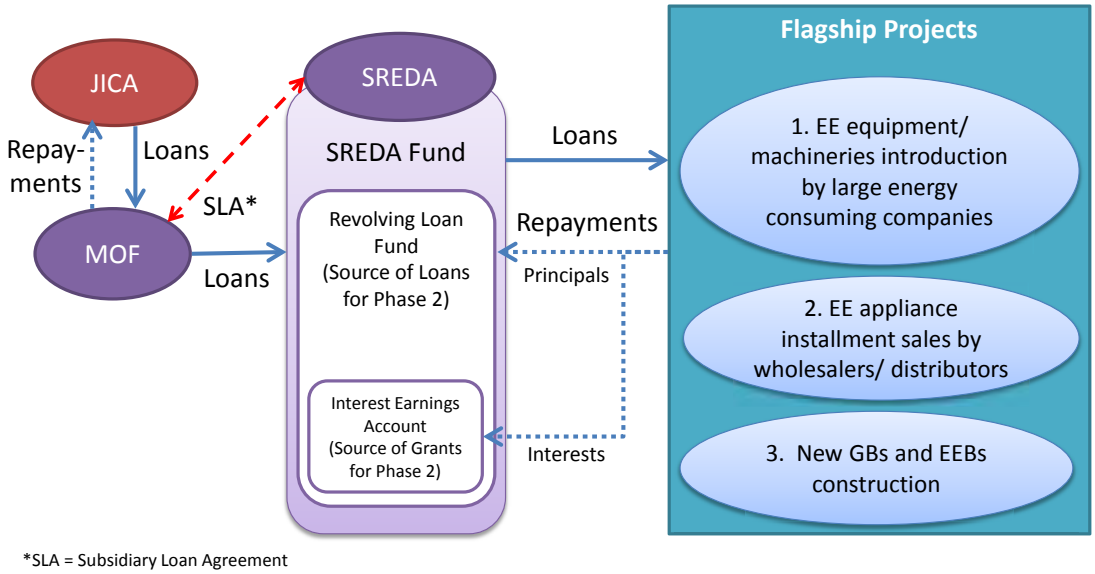


Figure 2.5-5 EE&C Loan Program Scheme (Phase 1)

2) Phase 2: Dissemination stage

In Phase 2, loans will be provided via participating financial institutions (PFIs) to each of their customers by utilizing their branch networks (See Figure 2.5-6). The technical criteria to select eligible projects will be defined and provided to PFIs by SREDA[7]; PFIs will be responsible for conducting financial appraisals after screening projects based on the criteria/ list. The criteria/ list will be revised and updated twice a year by an independent technical standard committee.

[7] The eligible equipment list (technical criteria) for the phase 2 will be created during the phase 1. The first draft will be created with the support of an outsourced expert who is expected to be appointed and dispatched by JICA.

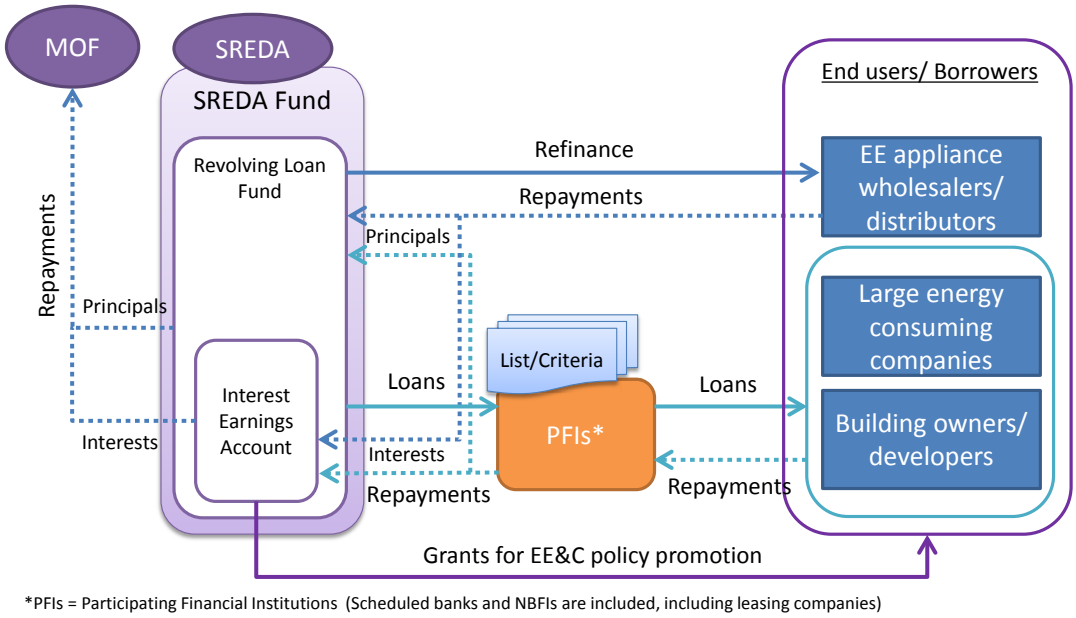
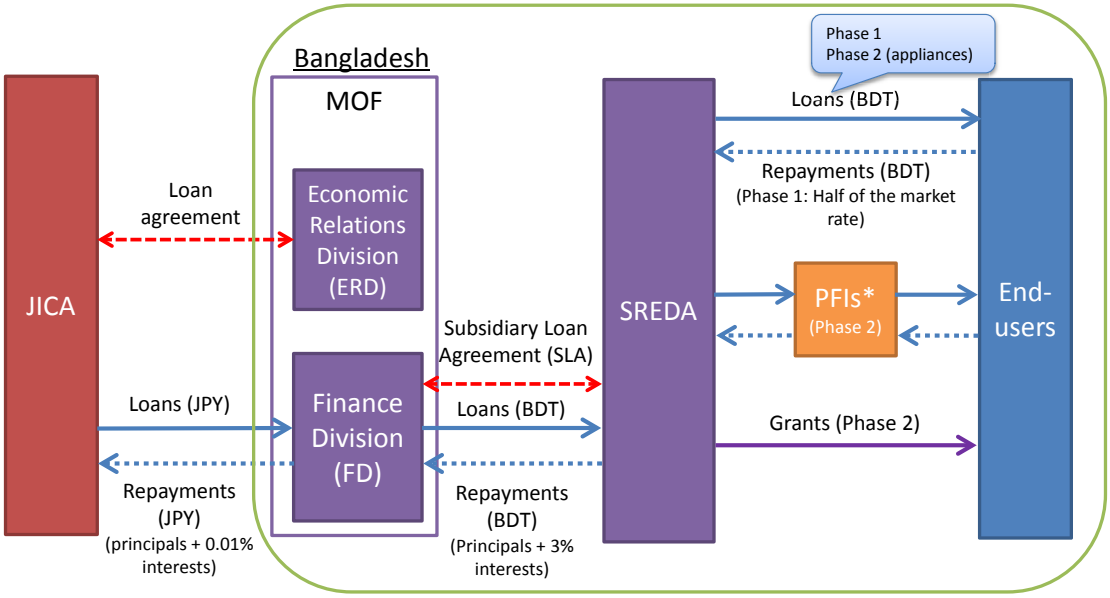


Figure 2.5-6 EE&C Loan Program Scheme (Phase 2)

The sources of funds to be reinvested in Phase 2 will be accumulated during the grace period, in which SREDA will be exempted from repaying principals to MOF. According to the provisions clarified under the SLA to be signed between MOF and SREDA, SREDA will start repaying principals to MOF after the expiration of the preset grace period, which is assumed to be 10 years in consistency with the lending conditions to be agreed between JICA and MOF. Within this grace period, SREDA can accumulate interest margins through reinvesting the revolving loan funds (i.e. interest earnings and principal payments collected from end-users).

In this scheme, throughout Phases 1 and 2, a capable financial institution will be appointed as the SREDA Fund management institution for the management of loans and grants under the EE&C Policy Promotion Loan Program (Sub section "SREDA Fund Management Institution" for the details). In addition, SFMI will be in charge of providing refinancing loans to partner organizations (POs) which sell EE labeled (thus highly energy efficient) home appliances to the households by installments.

In Phase 2, the grants will also be used for EE&C policy promotional activities: (a) sales promotion for EE equipment/ appliances with EE labels by distributors, (b) EE / appliances testing equipment by manufacturers and suppliers, (c) establishment of green buildings and EE buildings standard and criteria, (d) compilation and maintenance of EE equipment list, (e) energy audits, (f) capacity development of energy managers and energy auditors, etc. The source of grants will be net interest margins generated during the Phases 1 and 2.



*PFIs = Participating Financial Institutions (Scheduled banks and NBFIs are included, including leasing companies)

Figure 2.5-7 Overall Process of Fund Flow

3) SREDA Fund Management Institution (SFMI)

For the actual fund management in Phase 1, SREDA has to appoint one of the scheduled banks or non-bank financial institutions (NBFIs) as a SREDA Fund Management Institution (SFMI), since SREDA is not a financial institution licensed by BB. Delegating SREDA FUND management to a professional financial institution will also enable SREDA to concentrate on its important roles as the sole regulatory authority in charge of EE&C and RE promotion in Bangladesh. In this program, SFMI is supposed to support SREDA for selecting flagship projects, credit appraisals in Phase 1 (and partly in Phase 2), monitoring through site visits, loan portfolio management, etc. SFMI is supposed to receive all inclusive annual fund management fees from SREDA at fixed rate (e.g. 0.5%) of the total amount of outstanding flagship loans during Phase 1 and fixed rate (e.g. 0.5%) of the amount of each loan disbursement for Phase 2. At present, IDCOL is the most probable candidate to handle SREDA Fund (See Figure 2.5-8). (Refer to Appendix 3 "SREDA Fund Management Institution (Terms and Reference Draft))

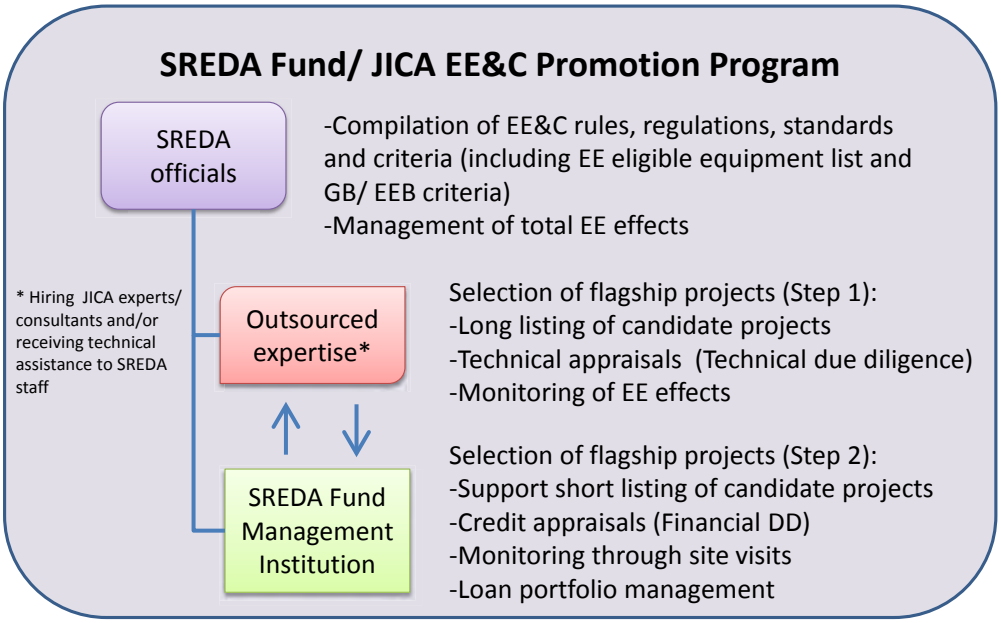


Figure 2.5-8 SREDA Fund Management Institution (SFMI) in SREDA Fund

(5) Plan B: IDCOL/BB as implementing agencies

There is an alternative loan scheme, which is similar to what JICA has been conducting in Bangladesh. In this loan scheme, instead of using SREDA Fund as an intermediary financial institution, BB and IDCOL will be appointed as the implementing agencies which manage funds and on-lend to participating financial institutions (PFIs). This is considered feasible in a sense that both BB and IDCOL are already engaged in other JICA loan schemes. (See Figure 2.5-9)

However, to become the implementing agency of this program the following abilities are also required:

(i) ability to execute flagship projects selected by SREDA for the first stage of the program;
(ii) ability to ensure the end user interest rate low enough to stimulate investments at the second stage of the program; and
(iii) ability to acquire or share with SREDA all data concerning EE effects of the projects funded under the program

1) Flagship project

In the first stage of the program, it is very important to provide concessional loans to flagship projects which highly qualify for showcasing the-state-of-the-art EE&C technologies and their economic benefits to the private sector investors and the households. For this purpose, SREDA intends to select adequate projects with the support of outsourced expertise (i.e. energy experts including those to be dispatched by JICA). Any agency which becomes the implementing agency for the program will be required to finance these selected flagship projects, once they meet technical and financial appraisals.

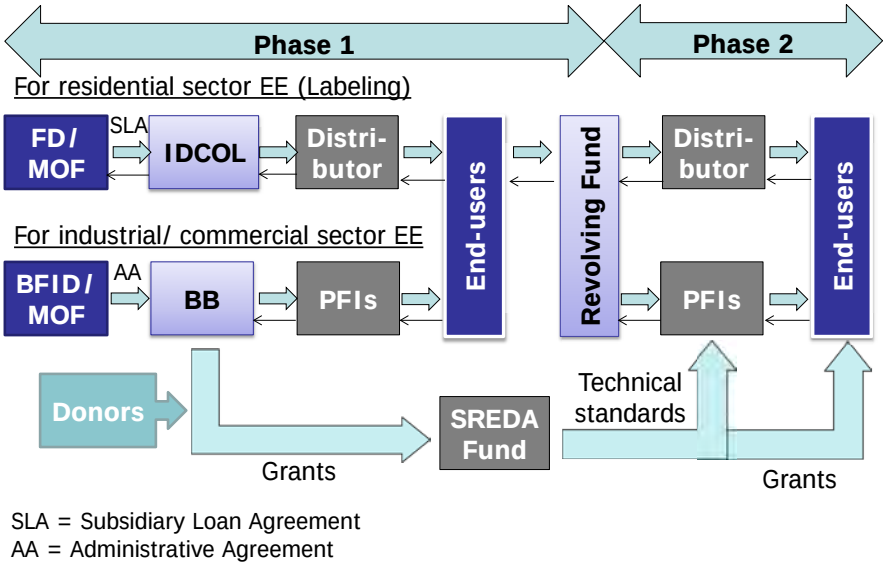
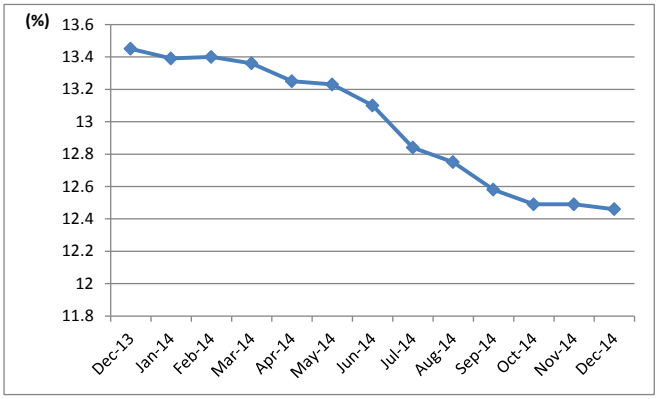


Figure 2.5-9 Two-step Loan Scheme through IDCOL and BB

2) Low end-user interest rate

As mentioned earlier in Table 2.5-6, the lending terms and conditions by BB and IDCOL for end-users will be higher than those of SREDA and therefore less effective in stimulating EE&C investments. Considering the fact that PFIs would need to ensure 5% interest margin to cover the risks involved in promoting EE&C loans as well as the recent downward trend in interest rates on financial market (as indicated in Figure 2.5-10), the end user interest rates assumed in EE&C Promotion Loan Program (which is below 9% currently provided by BB) will not be easily attainable.

Scheduled Banks' Weighted Average Interest Rate on Lending (December2013 – December 2014)



Average Interest Rates (December 2013 – December 2014)

(unit: %)

Month	Deposits	Lending	Spread
Dec 2013	8.39	13.45	5.06
Jan 2014	8.40	13.39	4.99
Feb 2014	8.34	13.40	5.06
Mar 2014	8.21	13.36	5.15
Apr 2014	8.11	13.25	5.14
May 2014	8.01	13.23	5.22
June 2014	7.79	13.10	5.31
July 2014	7.71	12.84	5.13
Aug 2014	7.63	12.75	5.12
Sept 2014	7.48	12.58	5.10
Oct 2014	7.40	12.49	5.09
Nov 2014	7.32	12.49	5.17
Dec 2014	7.25	12.46	5.21

Source: Bangladesh Bank

Figure 2.5-10 Monthly Average Interest Rates (December 2013 - December 2014)

3) EE&C data collection by SREDA

SREDA, in case deprived of the authority to provide loans to end users, would find itself in a difficult situation where it could not easily gather information from banks and/or end-users on EE&C investments and their energy efficiency (EE) effects. Any agency which becomes the implementing agency for the program shall cooperate with SREDA by sharing all necessary data on EE&C projects for calculating their EE effects.

With the three issues in mind, JICA Project Team had discussions with BB and IDCOL, and came to a conclusion that BB does not fit as the implementing agency for the program, but IDCOL can be a good candidate with some conditions. (Table 2.5-7 for the comparison of BB and IDCOL)

Table 2.5-7 Comparison of IDCOL and BB

Organization	Flagship project	End user interest rate	Sharing EE data with SREDA
IDCOL	Acceptable, upon financial appraisals by IDCOL	The same level as SREDA can be provided by adding grants as interest subsidies (buy-down grants)	Acceptable (since IDCOL already shares EE/RE project data with SREDA), although legally not binding. Standardized reporting format shall be defined under the Project Agreement between JICA and IDCOL for the program.
BB	Not acceptable	Not possible to provide below 10% (5% discount rate+5% margin by PFIs)	Not acceptable, since BB has no legal responsibility to report to SREDA (although BB may compile EE data collected from PFIs)

Source: Compiled by JICA Project Team based on interviews with BB and IDCOL in November 2014

(6) SREDA as a Project Controlling Authority

1) IDCOL as an implementation agency

As shown in Figure 2.5-11, IDCOL is willing to finance the EE&C projects on the Flagship Project List to be provided by SREDA, with the condition that all projects will pass financial appraisals by IDCOL. IDCOL, with 3% fund procurement rate from MOF, can currently provide the end user rate as low as 6-9%, depending on the financial credibility of the project/borrower. In addition, it can also provide lower interest rates, the levels similar to those of SREDA, by blending grants to end user interest rates (as interest subsidies). Similar arrangement has already been done for the SHS Program.

At the second stage of the program, for the wider dissemination of EE&C investments, IDCOL may have to carry out-loans through PFIs. This may not be easy considering the fact that IDCOL itself is one of them, and has no yet successful on-lending experience.

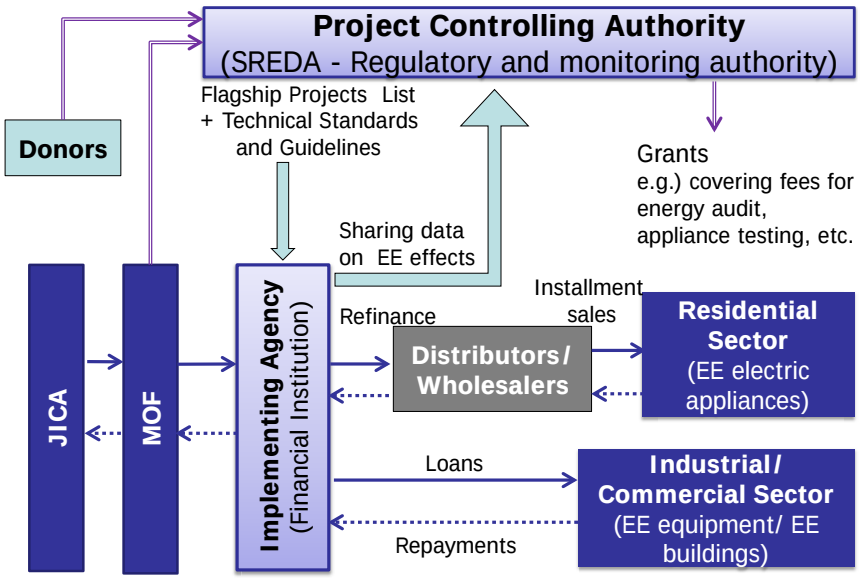


Figure 2.5-11 IDCOL as Implementing Agency (an Alternative to SREDA)

Under the current financial market situation, where interest rates are constantly slipping downwards, it is advisable to execute only the first stage of the program, irrespective of whether SREDA or IDCOL becomes the implementing agency. For the on-lending through PFIs to become effective as financial incentives, we have to wait until the market starts to pick up again.

2) SREDA as a Project Controlling Authority

Another idea is that SREDA takes the role of Project Controlling Authority to collect EE&C effects. SREDA establishes Program Management Committee to handle overall program: develop flagship projects, coordinate with organizations which are involved in the project, on-lend to PFIs etc. At the same time IDCOL becomes Project Financing Authority to manage program fund. In this case, SREDA needs grants for following purposes:

- Provide measurement equipment for EE appliances which are to be used in the testing labs for EE appliances (providing by additional project from JICA loan)
- Capacity development for technical staff in SREDA ("Supporting Staff" cost extracted from JICA loans before disbursing to IDCOL)

2.5.5 EE&C Support Activities by International Donor Agencies

JICA Project Team has interviewed 4 international donors, namely, GIZ, UNDP, USAID, and World Bank (WB), which are actively supporting demand side management for promoting EE&C. They are trying to reduce energy consumption by providing EE type equipment and conducting capacity development for energy regulatory body to strengthen their operation. ADB, which could not be met during the missions, provided relevant information, demonstrating that also actively implements EE&C promotional activities. Table 2.5-8 shows the summary of EE&C support activities by major

donor agencies. (Refer to Appendix 4 "EE&C Promotional Activities by International Donor Agencies" for the details)

Table 2.5-8 EE&C Support Areas by Donor Agencies

Donors	Project name (year)	Types of support			Support target		
		Grant	TA	Loan	Regulatory support (establishment of organization, rules, standards, etc.)	Companies (State-owned and/or private companies, entrepreneurs)	Individuals (Households)
ADB	Bangladesh Industrial Energy Efficiency Finance Program (BIEEFP) (2011 – 2013)		X	X		X (Capacity development for on-lending loan schemes, conducting energy audits)	
GIZ	Sustainable Energy for Development (SED) Program (2008 – 2020)		X		X (SREDA– Organizational capacity development)		
	Renewable Energy and Energy Efficiency Programme (2007 – 2011)	X	X			X (IDCOL – Supporting SHS Program)	
UNDP	Improving Kiln Efficiency in Brick Making Industry (2005 - March 2015)	X				X (Replacing to Hybrid Hoffman Kiln/ HHK)	
	BRESL (Barrier Removal to the Cost Effective Development and Implementation of Energy Standards and Labeling) (2010 - June 2015)		X		X (Labeling project for EE&C electric appliances)		
USAID	CCEB (Catalyzing Clean Energy in Bangladesh) (Task3: Industrial Energy Efficiency Analysis and Adoption) (2013 – 2017)	X	X		X (BERC– Organizational capacity development)	X (Provides energy audits and training program for energy auditors)	
WB	ELIB (Efficient Lightning Initiative of Bangladesh) (2010)	X					X (Free distribution for replacement of CFL bulbs)

Note: X is Target

(1) Asian Development Bank (ADB)

The promotion of EE&C is a key objective under ADB's Strategy 2020. From 2011 until 2013, ADB provided the Bangladesh Industrial Energy Efficiency Finance Program (BIEEFP), a loan

and a technical assistance program. In the loan program, ADB disbursed to IIDFC and other participating financial institutions (PFIs) to on-lend to eligible industrial energy efficiency projects for 6 high EE&C potential sectors: (i) textiles (including garments and leather), (ii) iron and steel, (iii) cement clinker, (iv) ceramics and glass, (v) chemicals (including fertilizer and pulp and paper), and (vi) agro-industries (including food processing, sugar and jute industries).

For technical assistance, ADB consultant team (Tetra Tech) mentioned on the Final Report that a lack of financial and human resources is impeding the realization of national energy goals. To create bankable EE&C reports and recommendations that can form the basis of business model acceptable to financial institutions, ADB consultants conducted energy audit for 120 plants in the 6 representative sectors (about 20 plants in each sector). Also, in order to increase the knowledge on EE&C financing within IIDFC and raise the awareness of other banks and NBFIs, ADB consultant team conducted three capacity building workshops during the Project.

(2) German International Development Corporation (GIZ)

GIZ provides mainly technical assistance to Bangladesh. They have been focusing on the following priority areas, in Bangladesh, since 2014. EE&C is one of them.

- Renewable energies and EE&C
- Good governance, rule of law and human rights
- Adaptation to climate change in urban areas

Currently GIZ has been advising SREDA for organizational operations and conducting staff trainings for SREDA newcomers at the same time. Also, GIZ provided an energy manager training to engineers at Titas Gas Transmission & Distribution Corporation.

(3) United Nations Development Program (UNDP)

UNDP provides technical assistance (TA) and grant programs. Currently UNDP has been conducting two major EE&C projects in Bangladesh: (i) Improving Kiln Efficiency in Brick Making Industry Program and (ii) BRESL (Barrier Removal to the Cost Effective Development and Implementation of Energy Standards and Labeling) Project.

Improving Kiln Efficiency in Brick Making Industry Program is targeted for the heavy energy intensive sector, brick-making. The target operating sites (15) are selected by Bangladesh Brick Making Owners Association. UNDP has replaced old and inefficient kilns to energy efficient ones at 7 operating sites out of 15 and will continue to replace at rest of 8 sites by the end of 2015. This move will be accelerated and expanded when the new brick rule Brick Making and Brickfield Establishment (Control) Act 2013[8] is activated scheduled in November 2014.

In BRESL Project, EE standards defined and specified on 6 electric appliances types (room ACs,

[8] This new law prohibits conventional methods as hazardous brick-making technologies, and promotes energy-efficient and relatively cleaner technologies like Hybrid Hoffman Kiln (HHK) and Vertical Shaft Brick Kiln (VSBK) etc.

refrigerators, electric fans, electric motors, ballasts for fluorescent tubes, and CFLs). UNDP is considering expanding target countries and appliances to new phase (Phase 2).

(4) United States Agency for International Development (USAID)

USAID has been providing development assistance to Bangladesh since 1971. USAID supports Bangladesh Energy Regulatory Commission (BERC) in setting energy tariffs, developing accounting systems, customer awareness, etc. for EE&C and renewable energy use. For EE&C activities, USAID works in the industrial sector, mainly textile, jute, steel re-rolling, and frozen food, for sustainable energy efficiency, and supports Bangladesh to develop effective demand side management.

Catalyzing Clean Energy in Bangladesh (CCEB) program is designed to support the energy sector development for energy security, economic growth and climate change mitigation. In this program, in Task 3, USAID provided energy auditing training programs for engineers and Certified Energy Auditor (CEA) examination through the Association of Energy Engineers (AEE).

Also, USAID provides a grant for SMEs called Industrial Energy Efficiency Incentive Fund. This program supports EE&C equipment, covering up to 30% of total investment. The target sectors are textile, jute, steel re-rolling, and frozen food.

(5) World Bank

Efficient Lighting Initiative of Bangladesh (ELIB) set in motion the replacement of incandescent lamps with energy efficient compact fluorescent lamps (CFLs) in 27 residential districts in Bangladesh. In phase 1, 10.5 million CFLs replacement were made in urban area (January 2010 – December 2010).

During phase 1, on June 19, 2010, almost 5 million energy-efficient CFLs were installed in one day and were marked as the World Record. This resulted on domestic CFL manufacturing sector to grow from 6 to 30 manufacturers. People are motivated to choose CFLs and purchase from suppliers/ distributors.

Phase 2 planned to replace more than 7 million CFLs in rural area, but the project is ceased. World Bank and the Government note that the CFL distribution is well adopted and expanded so that they are considering utilizing LED instead of CFL. As the total cost of LED is much higher than CFL, it will take some time to further discuss on how to implement the program.

2.5.6 SREDA's Immediate Action for EE&C Finance Program

SREDA should take immediate actions as shown in Table 2.5-9.

Table 2.5-9 SREDA's Immediate Action for EE&C Finance Program

	2015										2016											
	Mar.	Apr.	May	June	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Low Interest Loan Program																						
■ Select a financial scheme among three options (Plans A, B and C)																						
■ Appoint members of Techcnial Standards Committee																						
■ Create a long list of Flagship Projects																						
■ Create a short list of Flagship Projects																						
■ Prepare technical appraisal standards by the Technical Standard Committee (for introductory phase)																						
■ Select Implementing Agency																						
■ Create operating manuals for implementing agency																						
■ Sign Loan Agreement with GoB and GOJ																						
■ Sign Program Agreement with JICA and Implementing Agency																						
■ Loan disbursements (JICA → GoB)																						
■ Monitoring EE&C projects																						
■ Update Flagship Projects List by Technical Standard Committee																						

Below items will be implemented in 2017 or later

- Hold seminars for banks and NBFIs to apply for Participating Financial Institutions (PFIs) for dissemination phase
- Create EE equipment list / technical standards by Technical Standard Committee
- Select PFIs
- Create operational manual for PFIs
- Provide EE equipment list/ technical standards to PFIs

2.6 Global Warming Considerations

2.6.1 Overview

Nowadays, the preparation of any energy plan must consider Climate Change (CC) impacts. Even when dealing with Energy Efficiency (EE), CC policies must be properly analyzed.

Bangladesh GHGs emission represents less than 1% of global emissions and its per capita emission is around 0.9t-CO_2, much lower than global average of 6t-CO_2 (2005 data) and 30 times lower than per capita emission in US. In short, Bangladesh contribution to CC is not significant.

On the other hand, it is well accepted that per capita energy consumption in the least developed countries are too low and in the future, shall increase along the improvement of reasonable living

standard.

Based on the facts above, the natural proposal is that energy supply as a country priority should be pursued based on the lowest potential cost. Nevertheless, this straightforward conclusion may not be the best approach.

Global concern about CC is widespread and many recommendations about it have being incorporated in foreign external aid regulation in general and, in particular, in the availability of international money addressed to CC mitigation. Since Bangladesh infrastructure development must rely in external financing to speed up its installation, the country strategic approach cannot ignore CC implications.

In conclusion, in order to attract external grants and financing, it is our understanding that CC must be considered for all energy activities in the country.

Internal discussion with some of the Bangladesh officers involved in the preparation of the EE&C Master Plan allow the conclusion that the above proposed approach may be a consensus. Consequently, all actions established shall be designed to minimize CC impacts, even if the initial economic evaluation demonstrates some higher cost when compared with more traditional options. This does not mean that the country agrees in paying higher costs to help other countries to minimize global warming. What is understood under such decision is that a more careful financing evaluation shall be prepared, considering the possibility of external grants and soft loans. Since many EE&C technologies are available and their full cost, when considering the value of energy saved (that is a full cycle economic analysis), are lower or just a little more expensive than conventional technology, there is a good chance that external money can fully offset any extra expenses assumed by the country. Thus, one of the Master Plan guideline is always give priority to social and environmental sound technologies and look for external financing. Projects priority list shall be prepared considering this approach and only implemented when its full cycle cost for the local population is lower than the traditional technology.

2.6.2 Working Committee Implementation

Up to now, the CC issue has not been discussed in depth. The establishment of a committee to officially define the Bangladesh policy and procedures to incorporate the issue to the Master Plan is being considered. The committee can be useful to discuss several aspects commented in the overview and to define transparent and clear operational procedures on how to properly evaluate EE&C projects costs. The project should imply lower cost to the country population than the BAU technologies when considering external soft loans and grants. It is highly recommendable that general regulation and procedures be defined for the financial evaluation of any EE&C project that relies partially or fully in external money.

For the definitions of such regulation and procedures the committee shall request the cooperation of experts working in EE&C Finance Program and Economic Analysis Committee, described in Clause 2.5.

2.7 Energy Data, EE&C Scenarios and IT Infrastructure

2.7.1 Energy Consumption Data

(1) Data source

A lot of reports focusing on energy supply and demand data are issued by many institutes including academies, associations and governmental organizations. .However they are usually collected independent and these data have not been integrated and cross-checked.. Therefore, defining the original data source is very important to establish and maintain accuracy and reliability of the energy data used for EE&C programs. Table 2.7-1 shows the source of main data, used in the Project. Table 2.7-2 shows further referential data sources used.

Table 2.7-1 Major Data Sources for EE&C Programs

Category	Data source
1. GDP	World Bank
2. Calorific values and GHG emissions	UNFCCC Second National Communications, Oct. 2012
3. National energy consumption	
3.1 Macro balance	IEA country statistics 2012 is the latest in 2014
3.2 Gas by sector	Petrobangla MIS, including for captive power
Gas by end-user	Gas Distribution Authorities 1.Gas Transmission & Distribution Company Limited 2. Bakhrabad Gas System Limited 3. Karnafully Gas Distribution Company Limited 4. Jalalabad Gas Transmission & Distribution Company Limited 5.Paschimanchal Gas company Limited
Gas trend	Petrobangla MIS
3.3 Oil by sector	BPC
Oil by end-user	BPC
3.4 Coal total	IEA Bangladesh country statistics. There exists an illegal import
Domestic production	Barapukuria Coal Mining Company Ltd.
Import	MOC
4. Grid power	
4.1 Power sales by sector	BPDB, Directorate of System Planning Accumulation of power companies, incl. IPP
Power sales by end-user	Electricity Distribution Companies: 1.BPDB 2.Dhaka Power Distribution Company 3. Dhaka Electric Supply Company 4. Rural Electric Board 5.West Zone Power Distribution
4.2 Fuel consumption	ditto
4.3 Monthly generation	PGCB
4.4 Load curve, energy curve	National Load Dispatch Center
4.5 GHG emission	DOE

Table 2.7-2 Other Data Sources for EE&C Programs

Category	Data source
5. Residence	Floor data from "Green Building Code Project Report (UNDP 2012, the project has finished)"
6. Building (Commercial)	Floor data from "Green Building Code Project Report (UNDP 2012)" Building types are categorized by the energy supply companies
7. Industrial Sub-sectors	
7.1 Steel	BRMA's information on production and employee.
7.2 Fertilizer	BCIC's information on production and employee.
7.3 Cement	IDLC's information on production and employee.
7.4 Textile	BTMA's information on production (MI kg) and employee.
7.5 Garment	BGMEA's information on production (dozen) and employee.
7.6 Ceramic	Association's information on production (tons and tiles/sqm) and employee.
7.7 Brick	Association's information on production (piece) and employee. Green Brick Project (UNDP), annual data available
7.8 Sugar mill	BSFIC's information on production and employee.
7.9 Pulp/paper	Association's information on production and employee. TPD
7.10 Food and cold storage	BCSA's information on production and employee.
7.11 Chemical	BCIC's information on production and employee.
7.12 Jute mill	BJMA's information on production and employee.

Abbreviations, webpages

1. BERC: Bangladesh Energy Regulatory Commission
   http://www.berc.org.bd/
2. BCIC: Bangladesh Chemical Industries Corporation
   www.bcic.gov.bd
3. BRMA: Bangladesh Re-Rolling Mills Association
   http://www.brma-bd.com/members-profile.html
4. BCSA: Bangladesh Cold Storage Association
   http://www.fis.com/fis/companies/details.asp?l=e&filterby=companies&letter=b&page=1&company_id=99569&country_id=bd
5. BTMA: Bangladesh Textile Mills Association
   www.btmadhaka.com
6. BSFIC: Bangladesh Sugar & Food Industries Corporation
   http://www.bsfic.gov.bd/index.php/mills-factories-under-bsfic.html
7. BGMEA: Bangladesh Garment Manufacturers & Exporters Association
   www.bgmea.com.bd
8. BJMA: Bangladesh Jute Mills Association
   http://www.bjmc.gov.bd

Web links:
Pulp & Paper- www.banglajol.info/bd/index.php/JCE/article/download/10181/753
Cement Industry- www.idlc.com/sector.../1332569363Research%20Report%20on%20Cem...
Petroleum Refinery - http://www.bpc.gov.bd/

(2) Present energy consumption by sector

Present annual energy consumption by sector and fuel type is shown in Table 2.7-3.

Table 2.7-3 Present Annual Energy Consumption by Sector and Fuel Type

	Industry	Transport	Residence	Commercial	Agriculture	Total
Grid electricity (GWh)	12,292	0	18,264	3,556	1,713	35,825
Gas (MMCM)	9,612	1,136	2,875	252	23	13,898
Oil (MMT)	189	2,288	343	20	985	3,825
Coal (1,000toe)	666	0	0	0	0	666

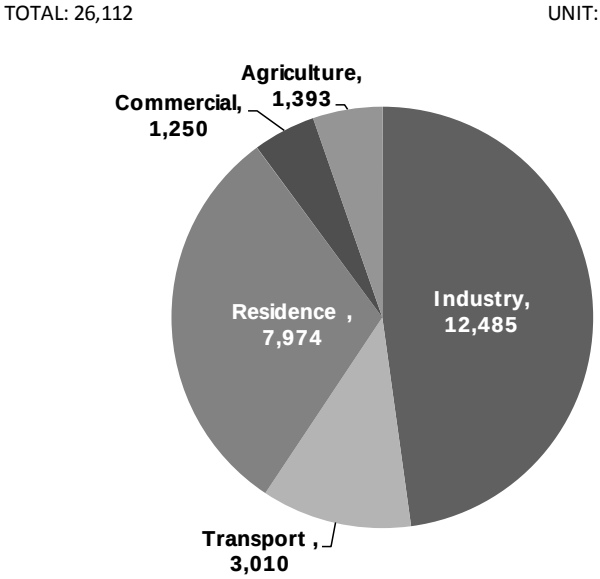
Source: Electricity: 2013-14, Source: Power Cell, Power Division, Ministry of Power, Energy and Mineral Resources
Gas: 2013-14, Source: MIS of Patrobangla July2014
Oil: 2012-13, Source: BPC
Coal: IEA 2012 data

Present annual energy consumption by sector (primary energy basis) is shown in Table 2.7-4 and Figure 2.7-1. It is observed that the most energy consuming sector is industry (about 50%) and the second energy consuming sector is residence (about 30%).

Table 2.7-4 Present Annual Energy Consumption by Sector and Fuel Type (Primary Energy Basis: Excluding Biomass)

(ktoe)

	Industry	Transport	Residence	Commercial	Agriculture	Total
Electricity	3,524	0	5,236	1,020	491	10,271
Gas	8,126	960	2,431	213	19	11,749
Oil	169	2,049	307	18	882	3,426
Coal	666	0	0	0	0	666
Total	12,485	3,010	7,974	1,250	1,393	26,112



Note: Conversion factor: Electricity (GWh)-ktoe;0.2867 (1kWh=2,867kcal; efficiency 30%),
Gas (MMCM)-ktoe; 0.8414, Oil (MMT)-ktoe; 0.8956, cal-Joule; 4.184

Figure 2.7-1 Present Energy Consumption by Sector (Primary Energy Basis, Excluding Biomass)

(3) Conversion factor

SREDA should provide conversion factor in order to measure primary energy consumption of the energy consumers. The conversion factor as shown in Table 2.7-5 should be reviewed time to time or as and when required. Review in every 3 years is recommendable. Same table was included in EECMP and "Framework of Energy Management Program".

Table 2.7-5 Primary Energy Conversion Factor (Draft)

Type of energy source		Unit	Conversion factor		Heat value		Specific gravity (ton/kL, m^3)
			Numeric	Unit	Quantity	Heat value	
Fuel and Heat	Petrol/ octane	kL	8,295	toe/kL	10,900	Mcal/ton	0.761
	Naphtha	kL	7,521	toe/kL	10,900	Mcal/ton	0.69
	Kerosene	kL	8,248	toe/kL	10,500	Mcal/ton	0.7855
	Diesel oil	kL	0.8956	toe/kL	8,956	Mcal/kL	
	Furnace oil	kL	0.9546	toe/kL	9,546	Mcal/kL	
	Liquefied petroleum gas (LPG)	ton	1.06	toe/ton	10,600	Mcal/ton	
	Natural gas	1,000 m^3	0.8454	toe /1000m^3	8,454	Mcal /1000m^3	
	Coal (Domestic)	ton	0.61	toe/ton	6,100	Mcal/ton	
	Steam	GJ					
	Hot water	GJ					1.0
	Cold water	GJ					1.0
Electricity	Grid electricity (Primary energy conversion)	MWh	0.287	toe/MWh	2,867	Mcal/MWh	Note*1
	Electricity (Secondary energy base)	MWh			860	Mcal/MWh	

Note*1; Heat value of various fuels can be converted by Table 2.7-5. Grid electricity heat value is based on end-users' thermal efficiency: 36% (at plant) minus 6% (transmission and distribution loss) = 30%

2.7.2 Energy Consumption Forecast up to 2030 (Baseline Scenario)

(1) Prerequisite conditions for calculation

Prerequisite conditions for calculation of the forecast up to 2030 are summarized in Table 2.7-6. The expected growth rate by sub-sector is derived from the data in UNFCC Second National Communications, October 2012. Prerequisite Conditions for CO_2 emission by energy type is summarized in Table 2.7-7. Present CO_2 emission from grid electricity is 0.67kg-CO_2/kWh and expected CO_2 emission in 2030 is 0.79kg-CO_2/kWh. This emission rate increase will be caused by the change of generation mix, due to the increase in thermal combustion.

Table 2.7-6 Prerequisite Conditions for Forecast (Growth Rate by Sub-sector)

Electricity

		Category	Growth Rate(%)
1		Idustrial	
	1	Chemical	5.0
	2	Chemical Firtilizer	1.0
	3	Cement	7.5
	4	Steel-making & re-rolling	7.5
	5	Brick	5.0
	6	Glass	10.0
	7	Frozen food & cold storage	5.0
	8	Petroleum refinary	10.0
	9	Sugar	0.0
	10	Pulp & Paper	4.0
	11	Jute mills	10.0
	12	Textile	6.0
	13	Garment	10.0
	14	Sanitary and tiles industry	10.0
	15	Captive Power	4.9
2		Residence	1.75
3		Commercial	10.0
4		Agricultural	3.0

Gas

		Category	Growth Rate(%)
1		Industrial	
	1	Chemical	5.0
	2	Chemical Firtilizer	1.0
	3	Cement	7.5
	4	Steel-making & re-rolling	7.5
	5	Brick	5.0
	6	Glass	10.0
	7	Frozen food & cold storage	5.0
	8	Petroleum refinary	10.0
	9	Sugar	0.0
	10	Pulp & Paper	4.0
	11	Jute mills	10.0
	12	Textile	6.0
	13	Garment	10.0
	14	Sanitary and tiles industry	10.0
	15	Others	10.0
2		Residence	6.2
3		Commercial	10.0
4		Agricultural	3.0

Source: UNFCCC Second National Communications, October 2012

Table 2.7-7 Prerequisite Conditions for Forecast (CO_2 Emission by Energy Type)

Energy type	CO_2 emission factor	Source
Electricity	0.67kg-CO_2/kWh (2013-14)	DOE Bangladesh
	0.79 kg-CO_2/kWh (2030)	Based on the generation mix estimated in PSMP 2010, coal thermal ratio will increase
Hydro	0	
Oil	3,200t-CO_2/kt	Compiled by JICA Project Team based on the data from UNFCCC Second National Communications, October 2012
Coal	2,500t-CO_2/kt	
Gas	2,000t-CO_2/MMCM	
Nuclear	0	
Import	0	

(2) Result of calculation

Estimated baseline of primary energy consumption by sector up to 2030 (toe) is shown in Figure 2.7-2. In 2030, national primary energy consumption in industrial, residential, commercial and agricultural sectors will be 2.9 times larger than that in 2013, over 70mil toe/year. The shares of primary energy consumption in industry and residential sectors are estimated to be 62% and 26% in 2030 respectively.

Additionally, the forecast of primary energy consumption per GDP (toe/GDP) is shown in Table 2.7-8. Compared with 2013, the national primary energy consumption per GDP (toe/GDP) will

increase 4.3 % in 2030.

Estimated baseline consumption by sector up to 2030 (GWh) of grid electricity is shown in Figure 2.7-3. In 2030, grid electricity consumption in industrial, residential, commercial and agricultural sectors will be 3.6 times larger than that in 2013, around 128,000GWh/year. Besides, the shares of grid electricity consumption in industry and residential sectors are estimated to be 45% and 40% in 2030, respectively.

Estimated baseline of CO_2 emission by sector up to 2030 (t-CO_2) is shown in Figure 2.7-4.

The share of CO_2 emission from grid electricity is estimated to reach 54% in 2030. (In 2013 it was 40%).

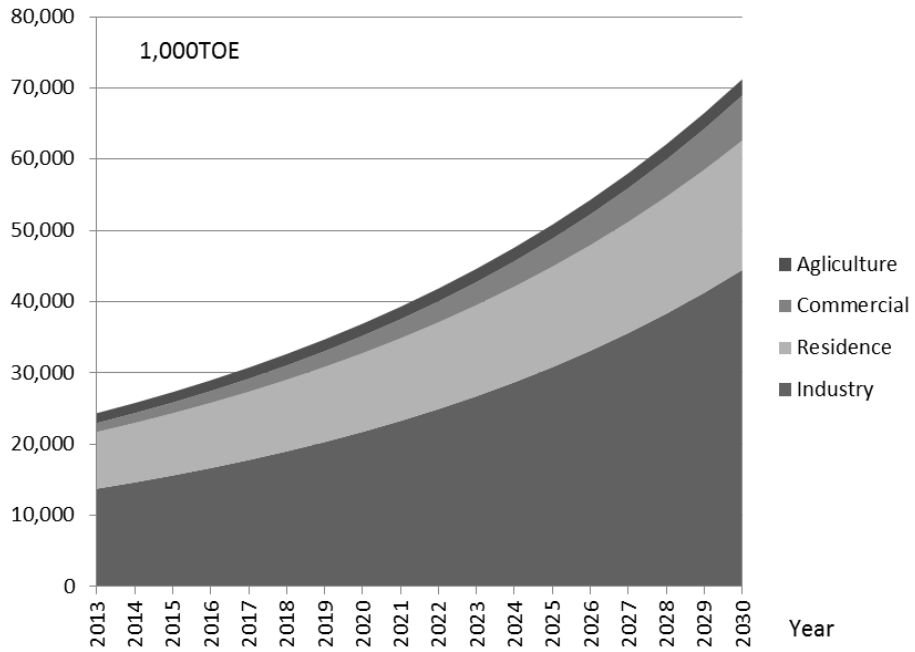


Figure 2.7-2 Baseline Forecast of Primary Energy Consumption by Sector

Table 2.7-8 Baseline Forecast of Primary Energy Consumption per GDP (toe/million BDT) Excluding Transportation

Fiscal year	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
PEC/GDP	2.37	2.22	2.22	2.21	2.19	2.17	2.16	2.14	2.13
Fiscal year	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31
PEC/GDP	2.14	2.16	2.17	2.18	2.20	2.22	2.24	2.27	2.29

Source: Energy consumption from MPEMR and Gas distribution authorities BPC etc.

Note: GDP growth rate is estimated as 7.0%/year until 2021 and from 2022 to 2030 as 6.0%/year

Gas consumption data collected from distribution authorities (sum-up of end-users) is about 8 % exceeding that from Petrobangla data (macro)r

PEC means Primary Energy Consumption

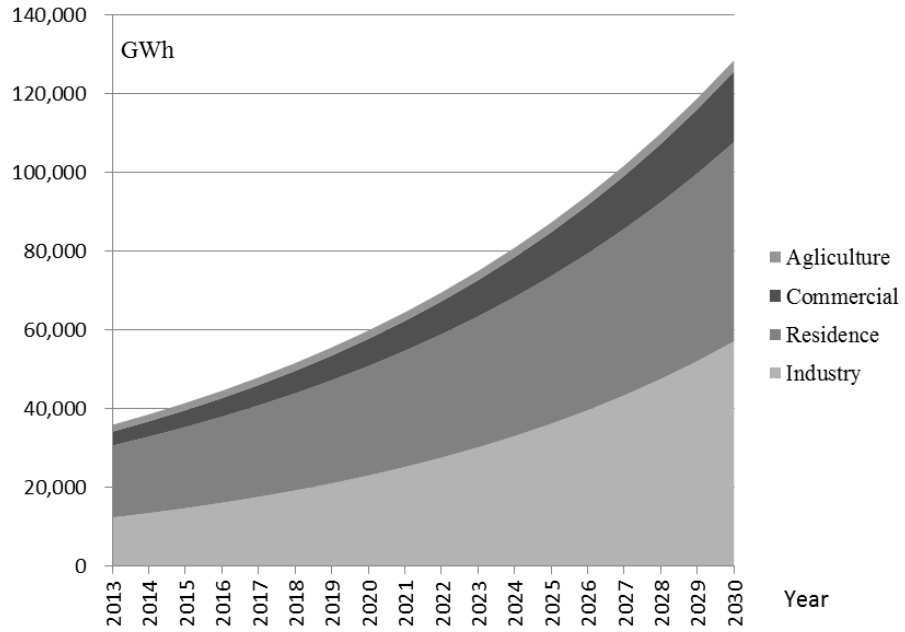


Figure 2.7-3 Baseline Forecast of Grid Electricity Consumption by Sector

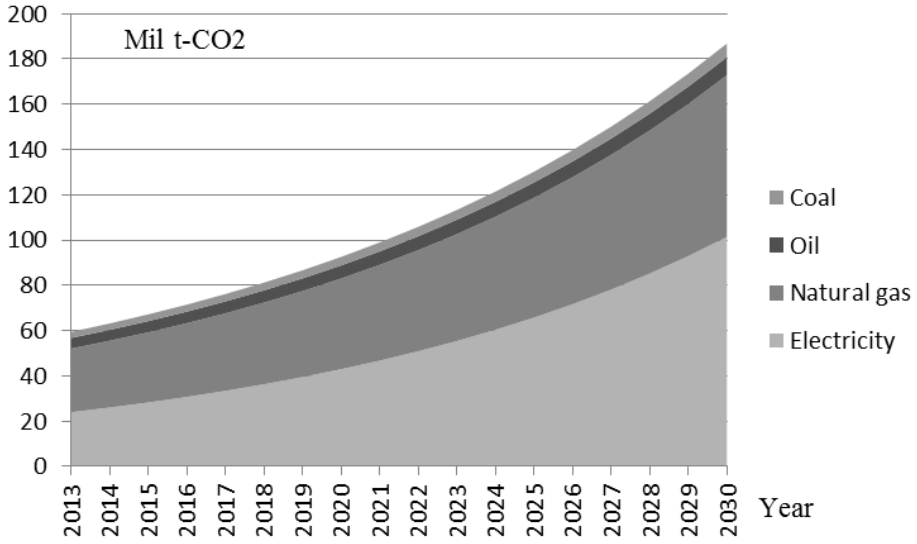
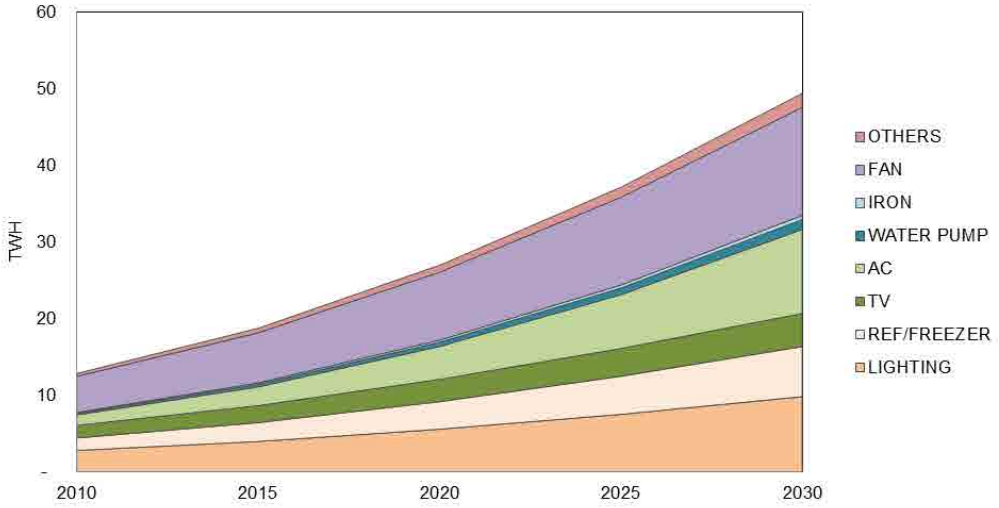


Figure 2.7-4 Baseline Forecast of CO_2 Emission by Fuel

(3) Forecast of home appliance electricity consumption growth up to 2030

Home appliances market research and measurement for the residential electricity consumption were carried out. Forecast of electricity consumption by appliance in residential sector up to 2030 is shown in Figure 2.7-5. This figure was illustrated based on the present home appliances sales amount (JICA Project survey), expected GDP growth rate (around 6%), increase of electrification ratio (from 84% to 92% in urban area, 43% to 65% in rural area) and present electricity consumption by appliance (JICA Project survey). Electricity consumption in 2030 is estimated to be around three times larger than that of present consumption.



Source: NewVision Solutions Ltd. (Survey on electricity consumption and usage of home appliances in 2014)

Figure 2.7-5 Growth of Home Appliance Electricity Consumption

2.7.3 EE&C Potential

(1) Overview

Efficient products are increasing in the home appliance market; however their share is quite limited at present. If all existing home appliances in residences were replaced by the highest efficiency products, huge amount of energy reduction can be achieved. This amount is defined as "EE&C Potential". The observation is similar for the industrial sector. Replacement by the latest EE type production equipment and implementation of perfect energy management will bring large scale of energy saving. Grasping EE&C potential is necessary for recognizing how much energy the country has been wasting and how reasonable and suitable EE&C target is.

EE&C potential includes an economically feasible potential and also an economically infeasible/ theoretical potential, which cannot be paid back by energy cost reduction.

(2) EE&C potential of industrial sector

As results of energy audits and factory surveys, JICA Project Team grasped present energy consumption by industrial sub-sector and assumed EE&C potential by the sub-sector as shown in Figure 2.7-6 and Table 2.7-9. Garment, textile and fertilizer are the most energy consuming sub-sectors.

Chemical fertilizer industry, textile & garment industry and steel-making & re-rolling industry have large EE&C potential and needs energy management activities, such as DCs program, energy audit, and daily maintenance. Those are driving forces of EE&C in the industrial sector. EE&C potential is estimated at around 21%, excluding infeasible EE potential which is hard to be paid back by energy cost reduction. Besides, EE&C target for gas consumption is assumed 23 % and that for electricity is assumed to be 18%.

Table 2.7-9 EE&C Rate by Industrial Sub-sector

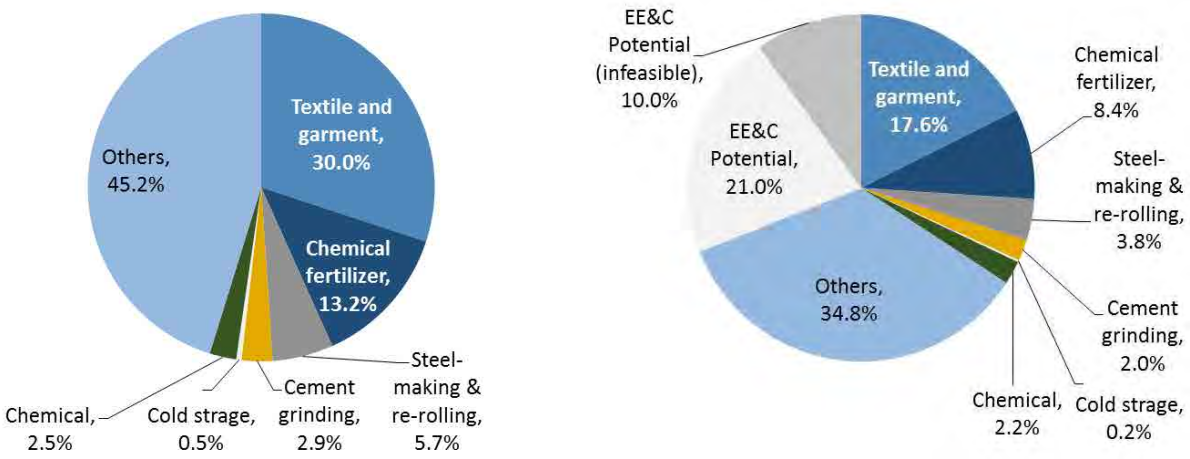
No	Sub-sector and item	Energy consumption (1000 toe/year)	EE&C potential rate (%)	EE&C potential (1000 toe/year)	Note
1	Chemical fertilizer	1,646.3		431	
1.1	Replacement of 2 old plants with 3rd generation technology plants	(348)	60%	(209)	
1.2	Waste heat recovery technology and rehabilitation in 4 plants	(740)	30%	(222)	
2	Steel-making & re-rolling	707		156	
2.1	Reheating furnace: Re-generative burner	(250)	30%	(120)	Note 1
2.2	Reheating furnace: Combustion control unit		10%		
2.3	Reheating furnace: waste heat recovery		10%		
2.4	Reheating furnace: heat insulation with ceramic fiber		15%		
2.5	Replacement of induction furnaces with arc furnaces	(120)	30%	(36)	
3	Cement grinding	358			
3.1	Vertical roller mill	(250)	30%	(75)	
4	Textile and garment	3,740		1,159	
4.1	Spinning machine	(825)	7%	58	
4.2	Air Jet Loom (Weaving machine)	(300)	21%	63	
4.3	Sawing machine	(430)	25%	108	
4.4	Lighting: HF TFL and LED lamp	(100)	20%	20	
4.5	Gas engine waste heat recovery	(1,342)	25%	336	Note 2
4.6	Gas turbine cogeneration	(2,926)	40%	(1,170)	
4.7	Steam boiler waste heat recovery	(1,584)	10%	(158)	
4.8	Steam boiler combustion control		5%	(79)	
4.9	Once-through steam boiler (2t/h)		30%	(475)	
4.10	High efficient stenters	(500)	20%	(100)	
5	Cold storage	60		31	
5.1	Gas compressor renewal	(50)	62%	(31)	
6	Chemical	310		5	
6.1	Caustic soda electrolyte process	(18)	30%	(5)	
7	Others	4,823	10%	482	
8	Energy management in all sub-sectors				Note 3
8.1	Enforcement of energy management: DCs, EM, Energy audit	11,643	11%	1281	
9	Non specified	803			
Total		12,447	31% (including infeasible potential (10%))	3,620	Note 4

Note 1: 120 = 250×(1-0.3)×(1-0.1)×(1-0.1)×(1-0.15)

Note 2: Item 4.5 and 4.9 are applied to prevent duplication

Note 3: 11,643 toe are total amount of sales of natural gas and grid electricity

Note 4: 12,447 toe are total energy consumption in industrial sector by IEA statistics data



A: Present Energy Consumption B: EE Case Energy Consumption

Source: Compiled by JICA Project Team based on the data from gas and electricity distribution companies

Figure 2.7-6 EE&C Potential of Industrial Sector

There is no integrated database on energy consumption by industrial sub-sector or company. It is quite hard to get these data in Bangladesh. Therefore JICA Project Team illustrated the figure based on the data sources as listed in Table 2.7-10:

Table 2.7-10 Data Sources for Energy Consumption by Industrial Sub-sector

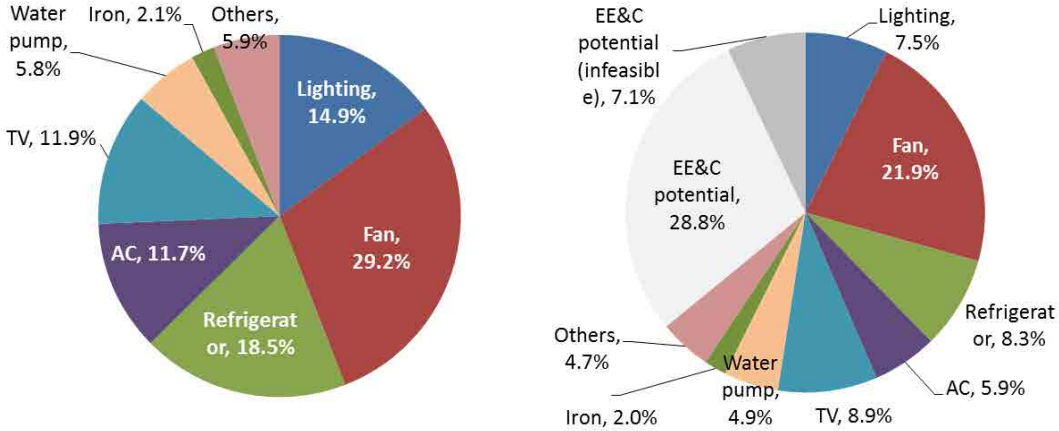
Energy	Data source
Electricity	Electricity Distribution Companies: - BPDB - Dhaka Power Distribution Company - Dhaka Electric Supply Company - Bangladesh Rural Electric Board - West Zone Power Distribution
Gas	Gas Distribution Authorities - Gas Transmission & Distribution Company Limited - Bakhrabad Gas System Limited - Karnafully Gas Distribution Company Limited - Jalalabad Gas Transmission & Distribution Company Limited - Paschimanchal Gas company Limited
Oil	BPC

(3) EE&C potential of residential sector (home appliances)

Table 2.7-11 shows a rough estimation of energy consumption reduction rates (EE rate) by appliance, gained by introducing the current EE technologies. Figure 2.7-7 shows the present electricity consumption by home appliance (A) and EE case electricity consumption (B), applying the EE rates given in Table 2.7-11. EE&C potential is estimated as 28.8%, excluding infeasible EE&C potential which is hard to be paid back by energy cost reduction (assumed 20% of the total potential).

Table 2.7-11 EE Rate of Home Appliances

Appliance	EE technology	EE rate
Lighting	LED, high frequency FL	-50%
Refrigerator/freezer	Variable speed compressor, high performance heat insulation	-55%
TV	LCD with LED back light	-25%
AC	High COP with large heat exchanging coil and variable speed compressor	-50%
Water pump	High efficiency motor	-15%
Iron	Thermostat	-5%
Fan	High efficiency motor	-25%
Other		-20%



A: Present Electricity Consumption B: EE Case Electricity Consumption

Source; JICA Project for EECMP

Figure 2.7-7 EE&C Potential of Electric Home Appliances

(4) EE&C potential of commercial sector (buildings)

For this sector electricity is mainly consumed in buildings. Around 50% of the total energy is consumed in air conditioning and from 10% to 30% is consumed in lighting. Expected potentials for these 2 categories are as follows:

- Air conditioning: 50% by applying high efficient ACs with inverter technology
- Lighting: 50% by applying high efficient lighting system, such as LED lamp, T5 florescent lamp with electronic ballast or utilizing solar light

It is expected that a simple replacement of ACs and lighting systems with high energy efficiency ones can save about 50% of total electricity consumptions in the commercial sector. However it is not easy to introduce EE&C measures for all the buildings. Thus as a realistic value, EE&C potential for buildings was estimated about 10%.

(5) EE&C potential of agricultural sector

Electricity, including captive power, is the main mode of energy in agricultural sector. And the largest energy is used for irrigation pumps. EE&C potential for existing pumps is expected as around 20%.

2.7.4 EE&C Target and Future Forecast up to 2030

There are several indicators to evaluate the improvement of future national energy efficiency, such as a) the actual reduction amount of energy consumption, b) reduction ratio (value) for future BAU value, c) energy consumption per capita and d) energy consumption per Gross Domestic Product (GDP), etc. However there is less data for structuring a) and b) values in Bangladesh. Evaluation in terms of energy reduction amount is not easy since the national baseline has to be fixed for the future. Energy consumption per capita is not suitable for developing countries like Bangladesh. Energy consumption per GDP can consider both energy efficiency and increases in national economy. In this EECMP, therefore we apply "primary energy consumption per GDP" as an indicator to evaluate future national energy efficiency.

While identifying a huge EE&C potential, we should take practical approach to gradually realize it in a phased manner, since EE&C implementation requires a huge amount of money and time. With the formulation of suitable regulatory measures and incentive mechanisms in accordance with nationwide actions for energy conservation, "primary energy consumption per GDP" can be reduced below 2013 level, EE&C target and roadmap are set as Table 2.7-12. The targets for 2021 and 2030 are set at 15% and 20% reduction compared with 2013 value, with due consideration of the EE&C potential and current energy consumption status: low electrification ratio, industries' insufficient environmental protection measures, improvement in work conditions and modernization of life styles, etc. The final goal of EE&C policies is to realize a self-reliant cycle in which people proactively and voluntarily save energy, rather than through compulsory EE&C activities. We aim to accomplish the target for realizing the self-reliant EE&C society by 2030.

Table 2.7-12 EE&C Implementation Roadmap (2015-30)

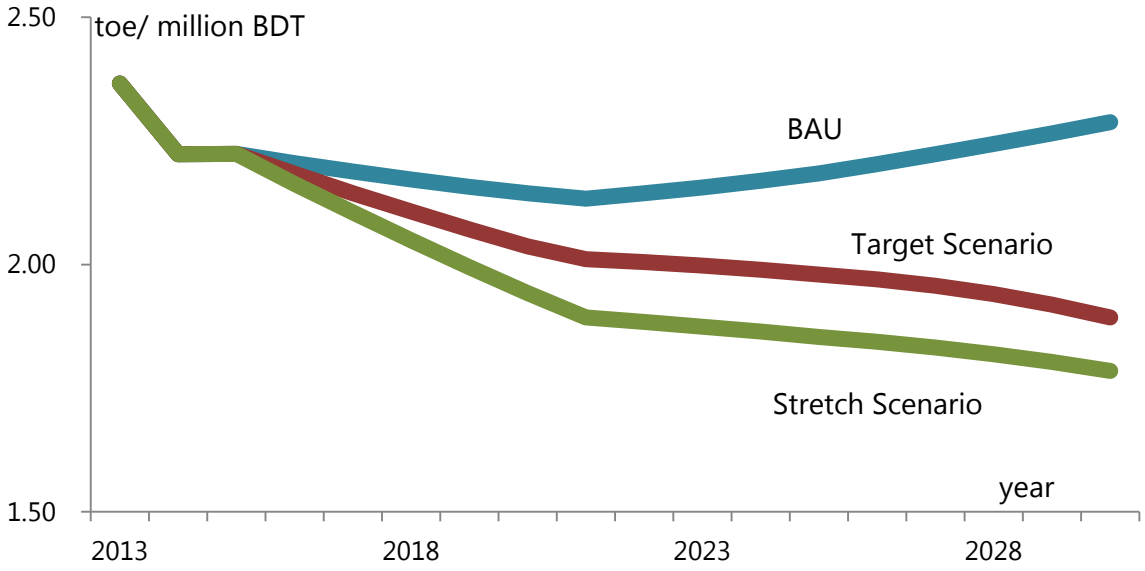
It is expected that the primary energy consumption per GDP will slightly decrease until 2021 and then gradually increase up to 2030. And in order to achieve the above mentioned target in 2021 and 2030, the following scenarios are to be recognized.

Table 2.7-13 shows the outline of investigated EE&C Scenarios

Figure 2.7-8 shows the forecast of estimated values of primary energy consumption per GDP (toe/million BDT) for both scenarios. EE&C realization rate for the economically feasible EE&C potential and expected EE&C amount by sector is summarized in Table2.7-14.

Table 2.7-13 Outline of Investigated EE&C Scenarios (2015-30)

Scenario	Conditions
Target Scenario	In 2016, EE&C regulations will be enforced by the Government, and EE&C measures will be implemented gradually. In 2021 and 2030, primary energy intensity (toe/GDP) will be 15％and 20％ less than that in 2013-14 basis, respectively. (EE&C realization rate for the EE&C potential is 20-30% and 60-80% in 2021and 2030, respectively.
Stretch Scenario	In 2016, EE&C measures will be implemented gradually. EE&C realization rate for the EE&C potential is 50% and 100% in 2021 and 2030, respectively.



Source: Compiled by JICA Project Team, based on the present energy consumption data and forecast of future growth rate by sub-sector derived from UNFCCC Second National Communications, Oct. 2012, GDP growth rate is assumed at 7.0%

Figure 2.7-8 Future Scenarios of Primary Energy Consumption in 2030 (BAU Case, Excluding Transportation and Biomass)

Table 2.7-14 Efforts Needed to Achieve EE&C Target

Target Scenario

Sector	Realization rate for EE&C potential			
	2021		2030	
	%	EE&C amount (ktoe)	%	EE&C amount (ktoe)
Industrial	30	1,474	80	7,497
Residential	20	670	80	4,197
Commercial	20	54	80	380
Agriculture	20	75	80	296
Total		2,273		12,370

Stretch Scenario

Sector	Realization rate for EE&C potential			
	2021		2030	
	%	EE&C amount (ktoe)	%	EE&C amount (ktoe)
Industrial	50	2,453	100	9,372
Residential	50	1,676	100	5,247
Commercial	50	134	100	633
Agriculture	50	188	100	493
Total		4,451		15,745

Grid electricity and gas consumption forecast scenarios is shown in Figure 2.7-9 and 2.7-10, respectively. In case of gas supply deficit for captive power generation around 2020 and forward, grid electricity consumption may increase by consumers' shift from captive to grid electricity. And in case of gas supply deficit around 2020 and forward, gas consumption may decrease.

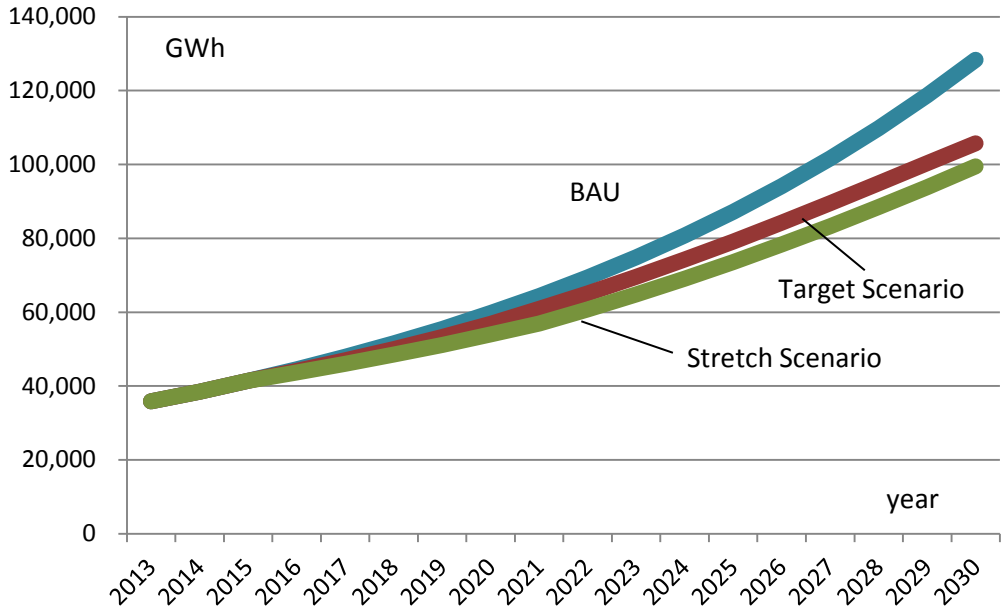


Figure 2.7-9 Grid Electricity Consumption Forecast by Scenario

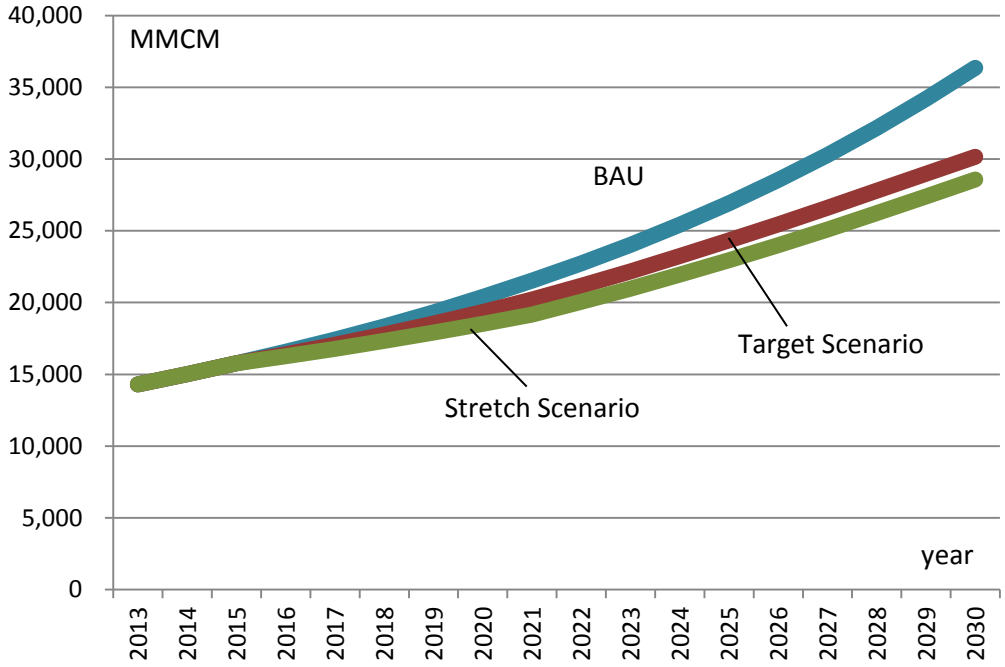


Figure 2.7-10 Gas Consumption Forecast by Scenario

2.7.5 Forecast of Electricity Load Curve and EE&C Impacts

(1) Present load curve of grid electricity

Figure 2.7-11 shows the estimated daily load curve on 31 May 2014 of the grid electricity. Lighting, TV and other appliances in residential sector may cause the evening peak.

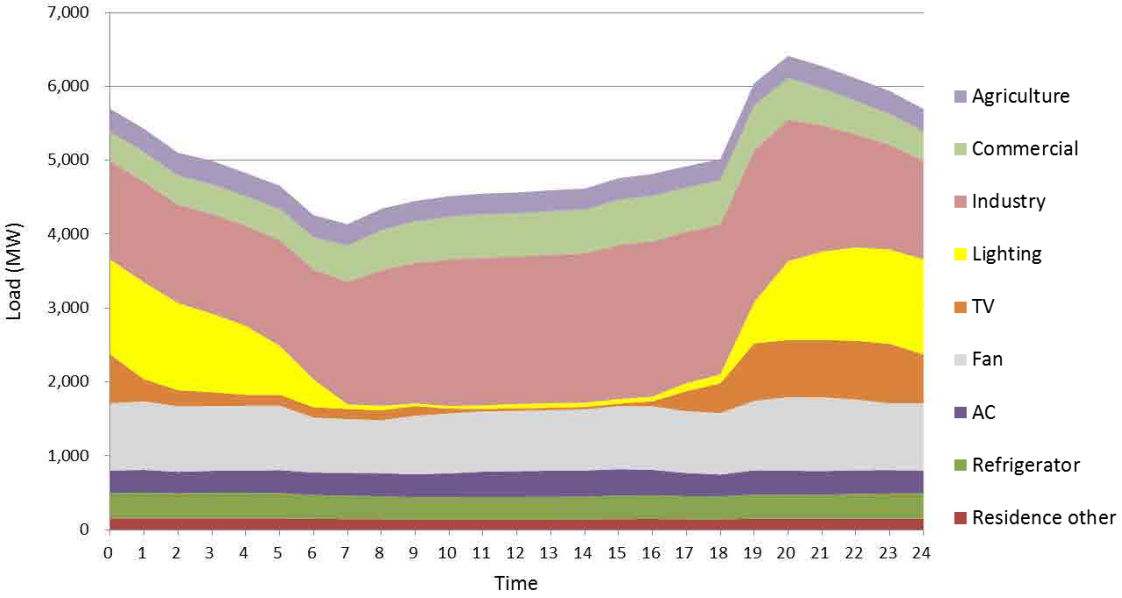


Figure 2.7-11 Estimated Breakdown of Grid Electricity Daily Load Curve (31 May 2014)

(2) Forecast of load curve in BAU case

Figure 2.7-12 shows load curve forecast in 2015, 2020, 2025 and 2030 as BAU case. The peak load in 2030 is estimated around three times as high as that in 2014, about 20,000MW.

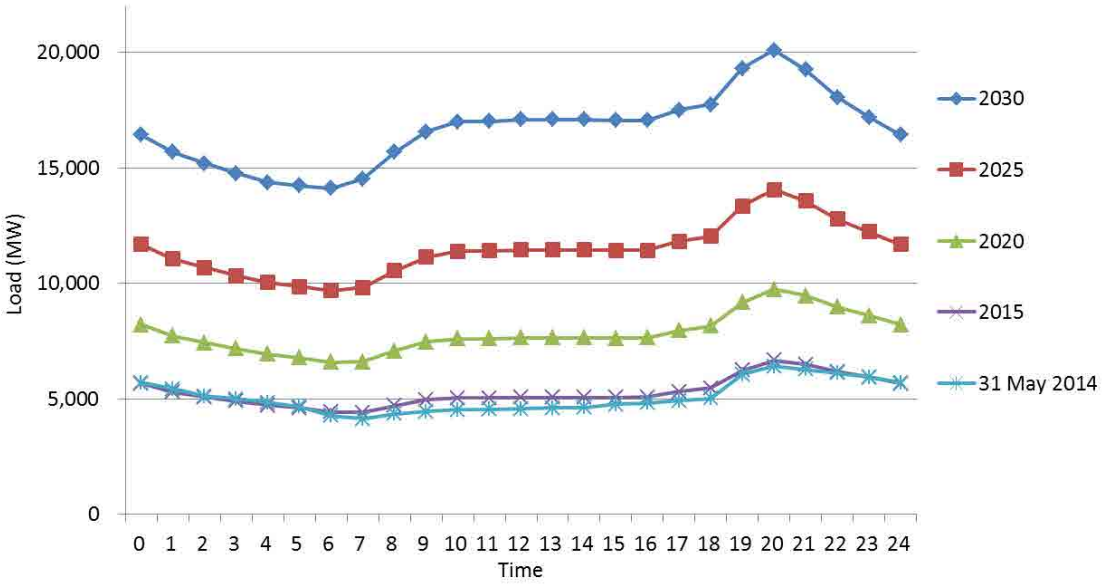


Figure 2.7-12 Load Curve Forecast (BAU Case)

Figure 2.7-13 shows the estimated breakdown of daily load curve in 2030.

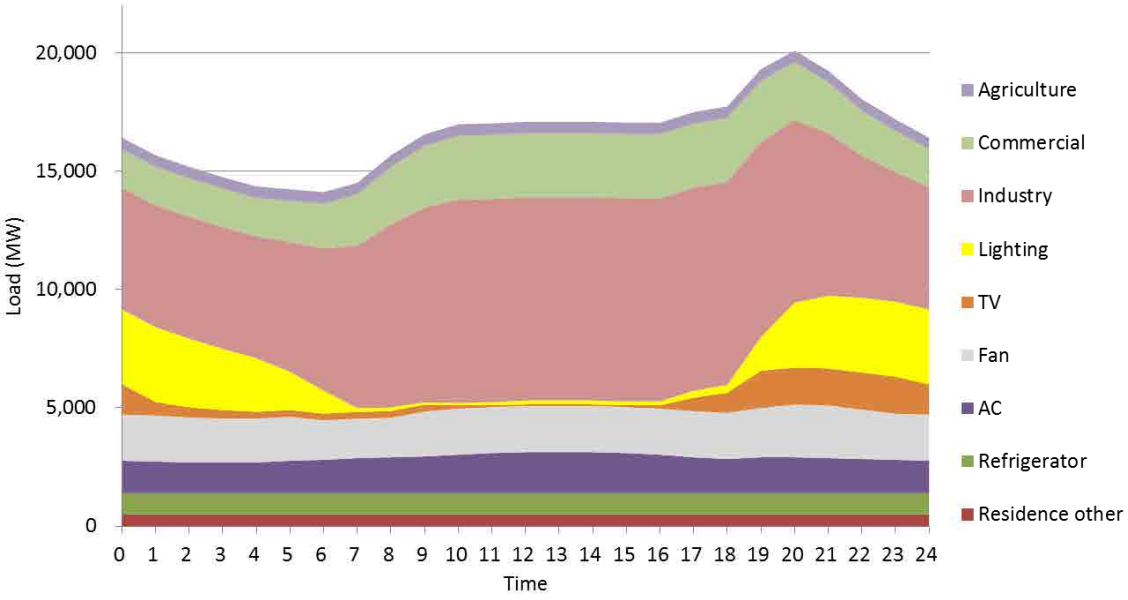


Figure 2.7-13 Daily Load Curve Forecast in 2030 (BAU Case)

(3) Forecast of load curve in EE&C scenario

Figure 2.7-14 shows the load curves forecast in 2015, 2020, 2025 and 2030 in EE&C scenario. The peak load in 2030 is estimated to be around twice as high as that in 2014, around 15,000MW. Expected reduction ratio for evening peak time is 25% through EE&C measures.

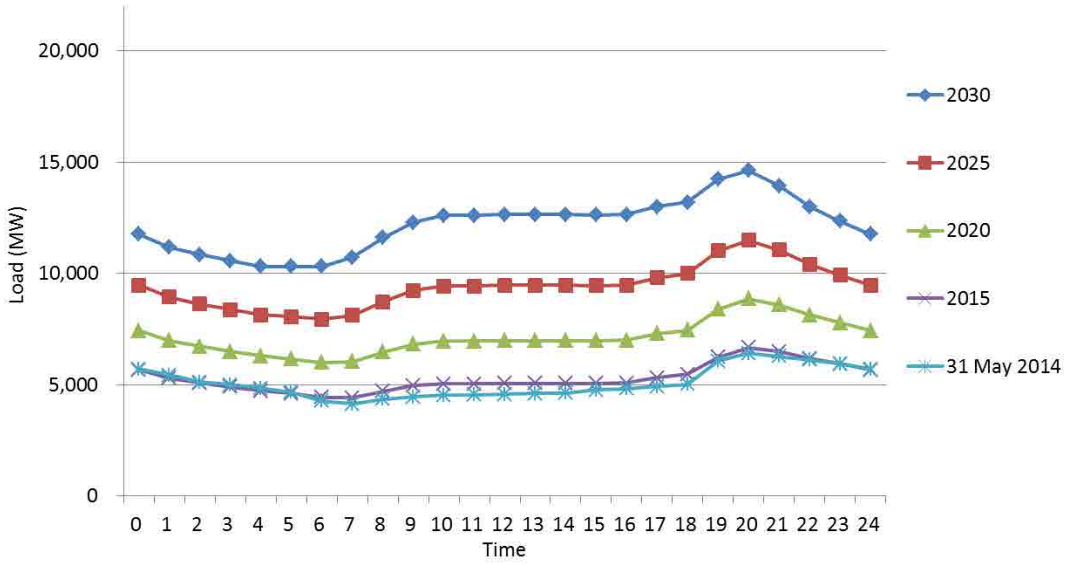


Figure 2.7-14 Load Curve Forecast (EE&C Case)

Figure 2.7-15 shows the estimated breakdown of daily load curve in 2030 in EE&C scenario. EE improvement of lighting, TV and other appliances in residences can contribute for the reduction of the evening peak load.

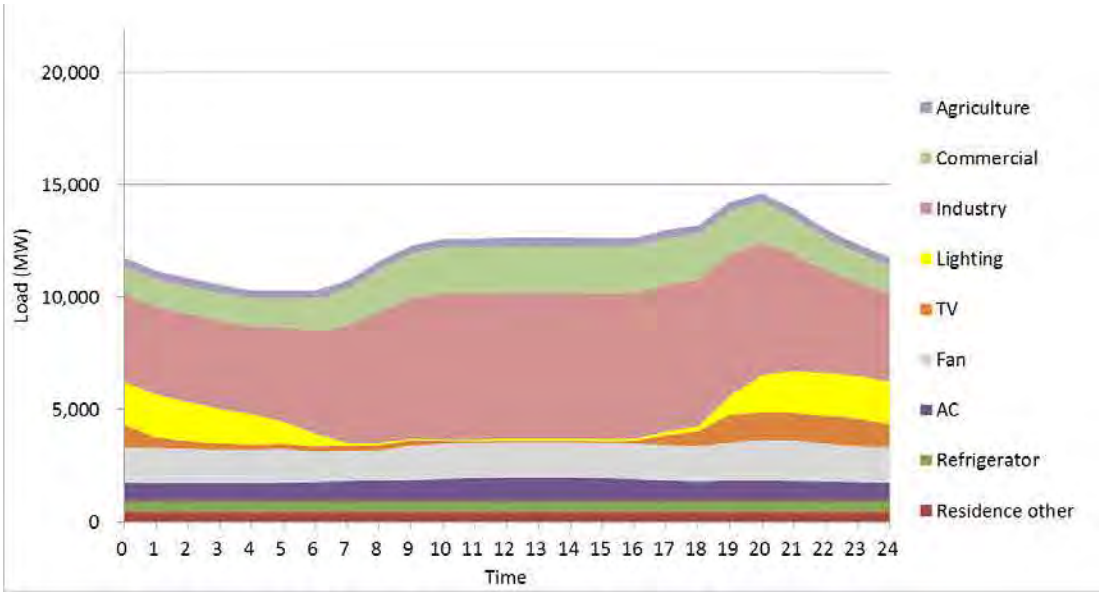


Figure 2.7-15 Load Curve Forecast in 2030 (EE&C Case)

The load curve and its break down by sector and appliance shown above are not compiled from actual measurement data, but based on the data of annual electricity consumption by sector (statistics) and sample measurement of home appliances at residences (total 100 houses, under JICA Project). Conducting a more detailed load analysis, based on the actual measurement, is recommended to clarify the above mentioned estimation.

2.7.6 IT Infrastructure

(1) Development of SREDA website

SREDA was established under Power Division of MPEMR. Normally, its website is provided as a part of Power Division website. However, the role of SREDA is jurisdiction over the efficient use of all energy, and SREDA is responsible for wide ranged fields, such as renewable energy, EE&C and any other services prescribed by rules and regulations issue from time to time. Then, SREDA decided to develop its own website. The address of SREDA website is

http://www.sreda.gov.bd

SREDA website covers the entire business fields as defined in Act no. 48 of 2012 "An Act to provide for the establishment of the Sustainable and Renewable Energy Development Authority to ensure energy security". Under JICA Project, the website main frame (general website contents) was developed.

Figure 2-7-16 shows an example of homepage of SREDA website. Any person can visit most pages in this website. One of framed boxes indicates the portal of Periodical Reporting System described in the next section. Clicking the framed EE&C Data Entry box, user name and password are required to login the pages.

Figure 2-7-16 Homepage of SREDA Website and Portal of Periodical Reporting System

(2) Outline of periodical energy consumption data collection system

To have a true figure of energy consumption, there are two channels of data collection, one from the demand side and the other from the supply side. Since governmental organizations and major energy suppliers are operating in the latter channel, it is comparatively easy to get supply side energy data. On the other hand, it is not easy to collect demand side energy consumption data from large number of energy consumers of small and medium size. However, in order to understand the structure of energy consumption and to promote national energy management properly, energy consumption data from the demand side is indispensable.

Large energy consuming companies are defined as Designated Large Energy Consumers (DCs). And DCs will be regulated to submit an annual energy consumption report to SREDA. These data will be the basis of demand side energy consumption data. In this Project the reporting form was drafted. And a prototype of web page for “the Periodical energy consumption data collecting mechanism” was developed. The target DCs will report their data via internet or by mail. SREDA analyzes the data to understand the energy consumption trends by sector or sub-sector, and the results are disclosed on the website of SREDA. Figure 2-7-17 shows the scheme of energy consumption data collection from the DCs.

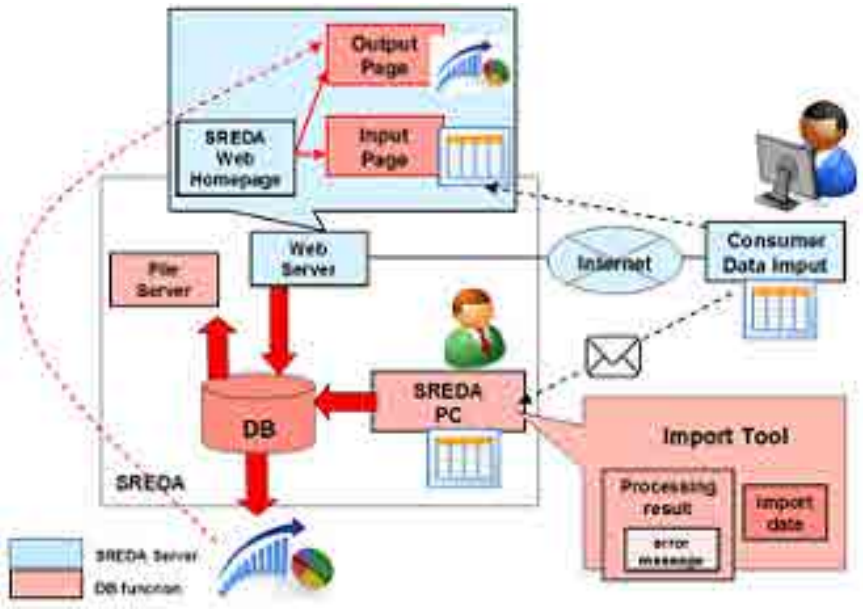


Figure 2-7-17 Data Flow of Energy Data in the Periodical Reporting System

(3) Data reported by DCs

Data which are reported by DCs are as follows:

- Company profile
- Annual consumption of all kinds of electricity, fuel and heat
- Major energy consumption equipment and their capacity and change of function
- Production volume (industrial sector) and floor area (building sector)
- Energy intensity and their change in the past five years, and comments on their change

(4) Statistical work of reported data

- Annual consumption and annual consumption trends of past ten years in each sector and/or sub-sector
- Energy intensity and energy intensity trends of past ten years in each sector and/or sub-sector
- Energy type of individual companies and each sector and/or sub-sector
- Benchmarking of energy intensity on past ten years in each sector and/or sub-sector

Above-mentioned results and summary of energy consumption data of each establishment are indicated in the item of "Reports" of the SREDA website. Figure 2-7-18 shows the pull-down menu of "Reports" and an example of Energy Intensity Trend. Blue bars show production amount and the line shows trend of energy intensity. These results can be browsed with PCs, tablets and smart phones.

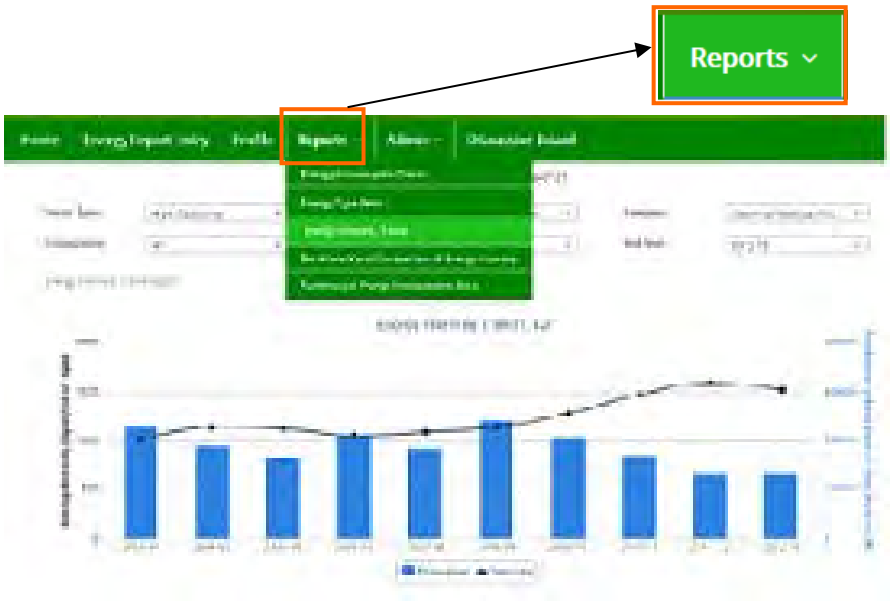


Figure 2-7-18 Example of Statistically Treated Report of Energy Intensity Trend Shown in SREDA Website

(5) Disclosure and publicity restriction

Because the energy consumption data of each company is confidential, only SREDA staffs in charge and the reporting company itself can access the reported data and analyzed results. Restriction to visitors is managed by login ID and password, and the status of visitors that is granted by SREDA office. Also, for SREDA personnel that can be in contact with these data, strict confidentiality is imposed.

2.7.7 SREDA's Immediate Action for Energy Data Collection and IT Infrastructure

SREDA should take immediate actions on energy data collection and IT infrastructure as shown in Table 2.7-15.

Table 2.7-15 SREDA's Immediate Action for Energy Data Collection

	2015										2016								
	Mar.	Apr.	May	June	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
Energy data collection																			
■ Definition of energy data sources																			
■ Establishing connection to the data sources (Agreement on confidentiality, etc.)																			
■ Request and acquisition of energy data																			
■ Analysis of energy consumption by sector																			
■ Analysis of energy consumption by industrial sub-sector																			
■ Upload of energy data on SREDA's website																▼			

2.8 Economic and Financial Analysis

2.8.1 Overview

Economic viability and benefits of EE&C measures are already well introduced and tested[9]. Nevertheless, when it comes to a nation-wide implementation of EE&C measures, it is not as easy and smooth as power supply side measures, such as the introduction of power plants utilizing renewable energy sources (i.e., wind, solar, geothermal and water). This is largely due to generally small investment size of each EE&C measure, which implies relatively high transaction costs, as well as to the general sense of insecurity towards the familiar concept of Negawatt[10] or cash flow from energy savings, which financiers (investors or lenders) do not know how to collateralize.[11]

In order to solve these problems and promote the nationwide EE&C implementation, economic viability and benefits of EE&C measures must be quantified in monetary terms and shared with all interested parties.

First of all, from the viewpoint of effective and efficient implementation, economic viability of each EE&C measure has to be verified by clarifying and comparing its costs and benefits (Cost-Benefit Analysis). In addition to energy consumption reduction, which is the primary and direct benefit of EE&C measure, secondary and indirect benefit shall, in some cases, be taken into consideration in order to justify the costs involved.

Secondly, from the viewpoint of effective allocation of limited resources, The Government has to compare candidate EE&C measures and projects according to their cost effectiveness (Cost Effectiveness Analysis). After all, The Government has the responsibility to prioritize the allocation of limited resources to economically viable projects and to avoid implementation of those projects, which seem to waste time and resources.

Meetings of EE&C Finance Program and Economic Analysis Committee were held three times, once each in May, August and November. Discussions were mainly focused on financial incentives mechanism and less on economic evaluations, which deeply rely on data collection activities by other committees. Nevertheless, it was significant in a sense that representatives from major interested parties had attended and shared the common view on the importance of economic evaluation in order to promote EE&C policy measures in Bangladesh.

In the following sections, economic viability of the four targets of EE&C policy measures, namely, Energy Management Program (Section 2.8.3), EE labeling Program (Section 2.8.4), EE Building Program (Section 2.8.5), and EE&C Finance Program (Section 2.8.6) were analyzed; and their implementation will be prioritized according to their cost effectiveness (Sections 2.8.7 and 2.8.8).

[9] There are several reports published from International Energy Agency (IEA) on economic benefits of energy efficiency improvements and policies to promote them. http://www.iea.org/topics/energyefficiency/

[10] Definition of Negawatt: a reduced amount of energy (measured in Watts) which is generated as a result of energy efficiency and conservation (EE&C) activities, and recognized as a source of new energy

[11] OECD/IEA (2012), by Ms. Lisa Ryan, Ms. Nora Selmet, Mr. André Aasrud, “Plugging the Energy Efficiency Gap with Climate Finance”

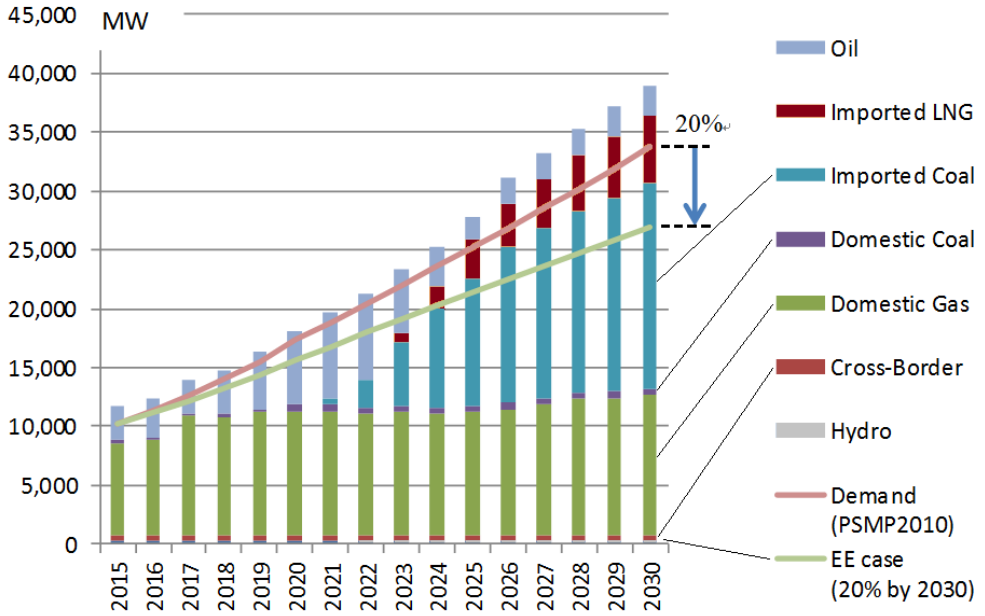
According to the results of the Cost-Benefit Analyses of Energy Management Program, EE Labeling Program and EE Buildings Program, all three programs proved to be economically viable for the Government to implement: their average annual net economic benefits during the period between 2015 and 2030 will be approx. BDT 100 billion, BDT 14 billion and BDT 15 billion, respectively. This does not mean, however, that the total economic benefits of the three programs add up to approx. BDT 130 billion/year, since the main target of both EE Labeling and EE Buildings Program is the residential sector and there are overlaps in terms of saved energy from electric appliances attached to newly constructed houses.

It is also proved that all the three EE&C Programs can be implemented at a net benefit according to the results of the Cost Effectiveness Analyses: EE Buildings Program proved to be the most cost effective, followed by EE Labeling Program and Energy Management Program. Given that all programs can be implemented at a net benefit, the Government may also consider energy reduction volume as well as cost effectiveness for prioritization of the programs: The order of implementation would be EE Labeling Program, Energy Management Program and EE Building Program.

Note that, due to data limitations, each policy measure will be independently quantified according to its data availability. Since all EE&C policy measures to be implemented under this Master Plan are new and are being introduced for the first time in Bangladesh, there is no time sequential data available from the past. Thus, target vs. non-target comparisons will be conducted. In principle, publicly disclosed statistics and data will be utilized for the evaluation. In some cases where adequate data is not available, however, raw data will also be collected through questionnaire surveys.

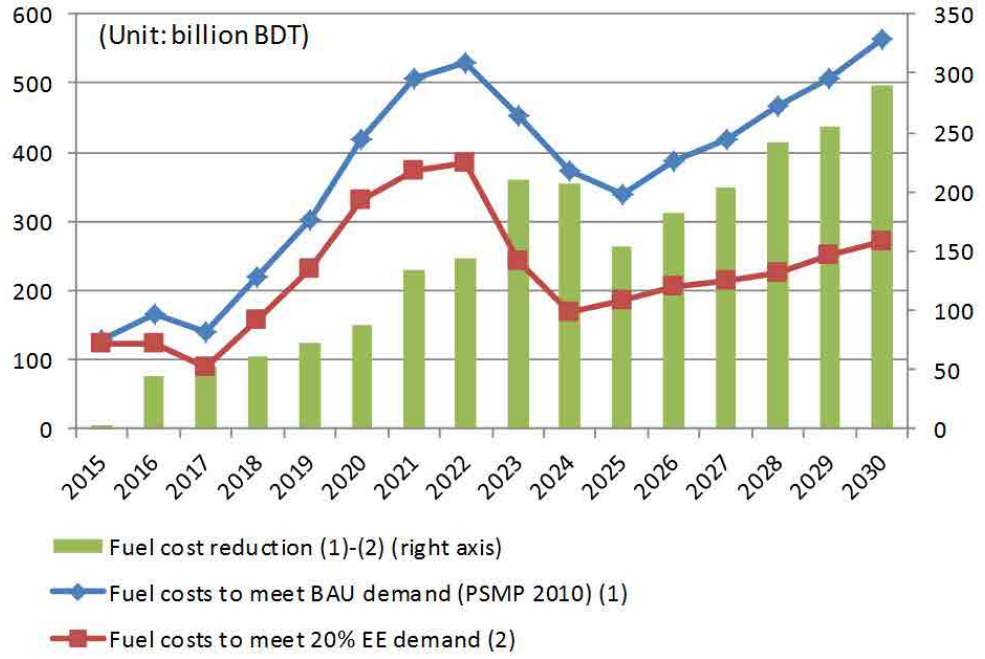
2.8.2 Economic Impact of EE&C Programs as a Whole

Before analyzing the economic viability of each EE&C program, we would like to show the magnitude of economic impact that can be achieved by implementing EE&C programs to gradually reduce power demand by 20% between 2015 and 2030. As shown in Figure 2.8-1 and 2.8-2, energy-saving activities promoted under EE&C programs will directly affect power supply through reduced power demand. As a result of power demand reductions, additional power supply capacity development will be reduced by 2.9%/year from 27,147MW to 19,147 (8,000MW reduction) between 2015 and 2030, even under the current O&M conditions. As a result, the amount of imports of expensive fuels for power generation will decrease remarkably; the savings would amount to 2.3 trillion taka (or an annual average of 135 billion taka) between 2015 and 2030 in terms of reduced fuel costs, which is equivalent of 6% of national budget and 1% of GDP (2013).



Source: Power Supply/Demand Database compiled by Mr. Kazushige YASHIRO, JICA Expert (May 2014)

Figure 2.8-1 Impact on Power Demand and Supply



Note 1: Fuel costs calculated based on PSMP 2010, with the condition that present O&M situation is maintained for all power plants

Note 2: Power supply (installed basis) has been adjusted from PSMP 2010 reflecting the delays in infrastructure development plans.

Source: Power Supply/Demand Database compiled by Mr. Kazushige YASHIRO, JICA Expert (May 2014)

Figure 2.8-2 EE&C Impact on Power Generation Fuel Costs

2.8.3 Economic Viability of Energy Management Program

Following the enactment of the Regulations under the Energy Efficiency Rule, it is expected that designated large energy consumers (DCs) will be identified and each DC will be obliged to appoint energy manager among its workers. Proposed energy consumption criteria for selecting DCs are 10, 000 toe for fertilizer, cement, steel-making, re-rolling, and petro-refinery, 6,000 toe for chemical, glass, paper & pulp, sanitary & ceramics and 3,000 toe for textile and garment. It is estimated that, through the EE investments and energy management by DCs, about 21% of the total energy consumption in the industrial sector can be reduced compared with the BAU (business as usual/no EE measure) case.

(1) Energy consumption trend (BAU case) and EE prospects

It is estimated that the economy of Bangladesh will grow by an annual average of 6.2% between 2015 and 2030, and industrial sub-sectors will enlarge their energy consumptions accordingly. Figure 2.8-3 shows the trends of energy consumption increases without adopting EE measures (BAU case) and with EE measures (EE case). Without EE measures, total energy consumption will more than triple to reach over 44,000 toe by 2030.

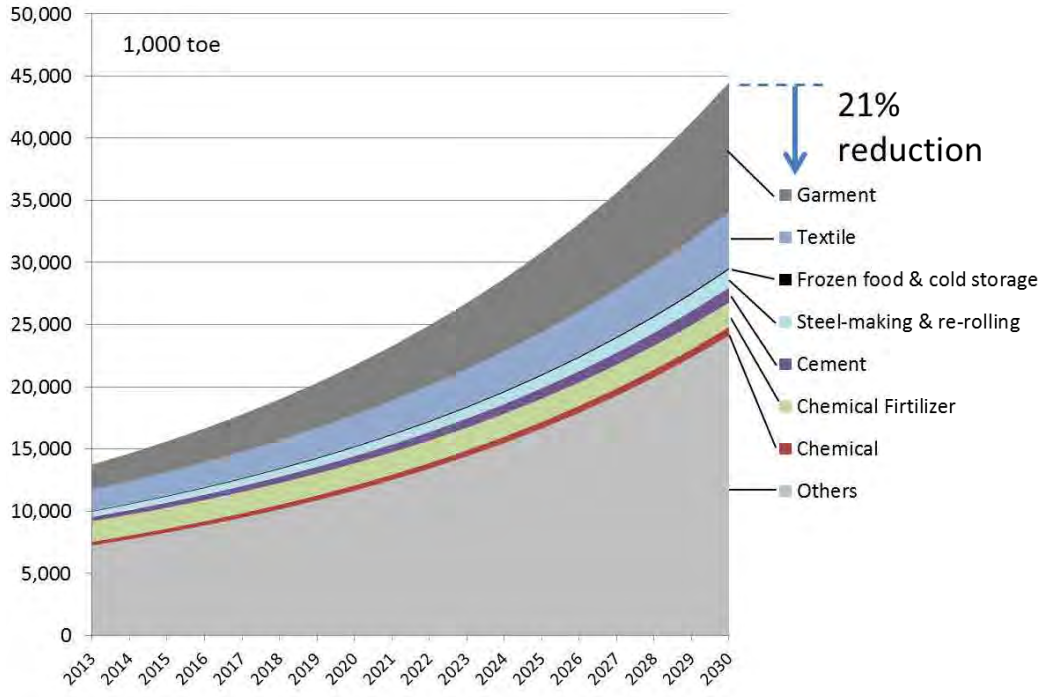
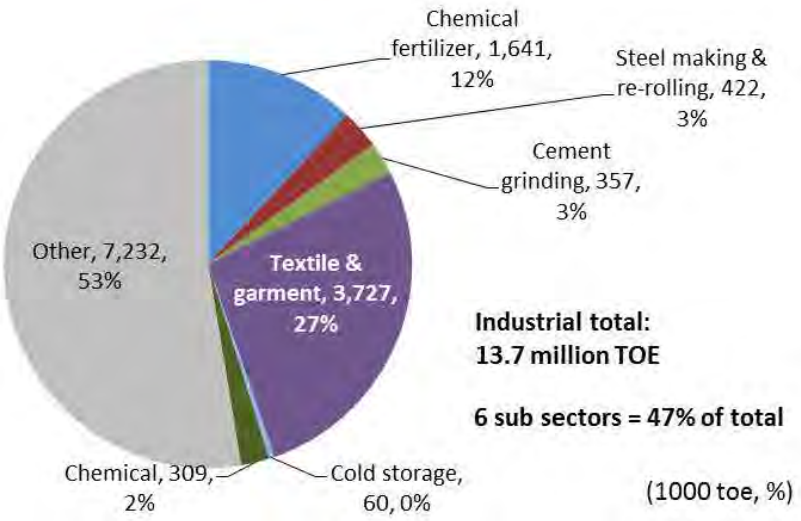


Figure 2.8-3 Energy Consumption Trend (BAU Case) and EE Prospects

By taking up EE measures such as the replacement of non-EE machineries and equipment with EE ones and through the introduction of energy management within each establishment, industrial sector as a whole have the potential of cutting down its energy consumption by about 30%. Economic analysis will be conducted on an assumption that around 70% of this potential (or 21% reduction against BAU energy consumption) can be realized by 2030.

The energy-saving target by 2030 for the industrial sector is set at 21% according to the EE&C Case Stretch Scenario. (Refer to Section 2.7.3) In order to achieve this target, a total energy reduction of over 9 million toe (or a total of 8 million m^3 in natural gas and 10 GWh in electricity) will be needed by 2030. It is assumed that about the half of the target energy savings (or 11% of BAU energy consumption in 2030) can be achieved through the enforcement of energy management (through designation of DCs, appointment of energy managers at DCs and energy audits) and the rest (or 10% of BAU case in 2030) through EE improvement investments (machinery and equipment replacements).

It is recommended to focus on the six largest energy consuming industrial sub sectors, namely, chemical fertilizer, steel-making & re-rolling, cement grinding, textile & garment, cold storage and chemicals, which altogether consists about 47% of the total industrial energy consumption (6.5 million toe/13.7 million toe in 2013). (See Figure 2.8-4)



Source: Compiled by JICA Project Team based on the current gas and electricity consumption data (PETROBANGLA, distribution companies)

Figure 2.8-4 6 Large Energy-consuming Industrial Sub-sectors

(2) Evaluation results

In order to show the economic viability of implementing Energy Management Program, a comparison was made between the annual costs, including administrative costs and investment costs by the establishments, and annual benefits (or the monetary value of energy saved by reducing energy consumption by 21% by 2030 compared with BAU case) for the entire industrial sector.

As shown in Table 2.8-1, except for the inception year of 2015, the benefits surpass the costs, with the annual average net benefit of approx. BDT 100 billion.

Table 2.8-1 Energy Management Program Costs and Benefits (6 Industrial Sub-sectors)

(Unit: million BDT)		2015	2016-2020	2021-2025	2026-2030	Annual Ave.
Benefits		0	56,968	371,940	1,179,117	107,202
Costs	Administration costs	15	8	8	8	7,117
	Investment costs	0	14,230	37,946	61,663	
Benefits-Costs		-15	42,731	333,986	1,117,447	99,611

(3) Calculation assumptions

Annual benefits are calculated as below:

[Annual amount of energy reduced × Unit price of energy (either in kWh or m^3)]

- The amount of energy reduced is equal to 50% of the 21% energy consumption reductions by 2030 against BAU case (or approx. 2.3 million toe), which is assumed to be attainable by appointing DCs in the large energy-consuming six sub industrial sectors.
- It is assumed that industrial sector as a whole have the potential of cutting down its energy consumption by about 30%, 70% of which (i.e., 21%) will be attainable by 2030.
- It is assumed that EE&C investments and energy reductions will be achieved gradually throughout the 15 years between 2016 and 2030.
- Of the total target amount of energy reduced in toe, 70% and 30%, respectively, will be achieved in natural gas and grid electricity.
- Energy conversion factors are 0.2867 toe/MWh and 0.8454 toe/1000m^3Annual benefits will be sustained for 20 years, considering the average legal useful life of industrial machineries and equipment.
- Unit energy prices are 1 kWh =BDT 7.3 and 1 m^3= BDT 5.5

Annual costs are calculated as below:

[Total investment costs (BDT) /15 (year)/20 (years)]

- Total investment costs for implementing EE measures in the industrial sectors amount to approx. BDT 324 billion in total. It is calculated according to the equation below:

[(Amount of electricity reduced by 2030 (kWh) × unit price of electricity (BDT/kWh) + amount of gas reduced by 2030(m^3) × unit price of gas (BDT/m^3)) × average simple payback period (year)]

- It is assumed that the average simple payback period (i.e., the number of years necessary to retrieve the total investment amount by utilizing annual energy savings) is five years.
- It is assumed that the proposed investments will be implemented gradually in 15 years between 2016 and 2030.
- Annual costs of taking EE measures, which mostly concern new purchase of EE equipment and machineries, will be amortized over 20 years (i.e., their average useful life).
- Costs of energy management by DCs will be dismissed, since it is considered that DCs can appoint their energy managers among their employees and additional costs for the implementation of Energy Management will be minimal.

- Administrative costs for implementing Energy Management Program, including those for the development of energy manager training and energy auditor certification systems, are expected to amount to BDT 14.54 million for the preparatory year 2015. For the rest of the years (2016-2030), BDT 1.54 million/year will be needed for information dissemination activities and running costs.

Note that the results of the analysis can vary according to the assumptions made. For instance, if we assume longer period for the average simple payback period (than currently assumed 5 years), the total investment costs will be larger and the annual average net benefit will become smaller accordingly.

As a reference, the total investment costs estimated as of November 2014 for the six large-energy consuming industrial sub sectors are shown in Table 2.8-2.

Table 2.8-2 Proposed EE Measures for 6 Industrial Sub-sectors

EE investment candidates		Unit cost (000 BDT)	Quantity	Investment amount (000 BDT)
1	Chemical fertilizer			
1.1	Replacement of 2 old plants with 3rd generation technology plants	100,000,000	1	100,000,000
1.2	Waste heat recovery technology and rehabilitation in 4 plants	13,000,000	3	39,000,000
2	Steel-making & re-rolling			
2.1	Reheating furnace: Re-generative burner	70,000	10	700,000
2.2	Reheating furnace: Combustion control unit	1,500	20	30,000
2.3	Reheating furnace: waste heat recovery	3,000	20	60,000
2.4	Reheating furnace: heat insulation with ceramic fiber	6,000	20	120,000
2.5	Replcement of induction furnacse with arc furnaces	1,000,000	5	5,000,000
3	Cement grinding			
3.1	Vertical roller mill	250,000	20	5,000,000
4	Textile & Garment			
4.1	Spinning machine	3,000,000	1	3,000,000
4.2	Air Jet Loom (Weaving machine)	2,000,000	1	2,000,000
4.3	Sawing machine	40	100,000	4,000,000
4.4	Lighting: HF TFL and LED lamp	3	100,000	300,000
4.5	Gas engine waste heat recovery	70,000	10	700,000
4.6	Gas turbine cogeneration	1,200,000	3	3,600,000
4.7	Steam boiler waste heat recovery	3,000	30	90,000
4.8	Steam boiler combustion control	1,000	50	50,000
4.9	Once-through steam boiler (2t/h)	3,500	100	350,000
4.1	High efficient stenters	150,000	5	750,000
5	Cold storage			
5.1	Gas compressor renewal	40,000	20	800,000
6	Chemical			
6.1	Caustic soda electrolyte process	2000000	1	2,000,000
Total				167,550,000

Source: Energy audits by JICA Project Team

2.8.4 Economic Viability of EE Labeling Program

The target of the assessment will be major electrical appliances used or to be used in the households. Currently with the support of UNDP/ BRESL, the introduction of EE labeling for six electrical appliances (namely, ACs, refrigerators, and motors, ceiling fans, CFLs and ballasts) has been discussed. EE labeling will affect consumers' purchasing choices by demonstrating clearly the energy efficiency of target electrical appliances (based on the EE standards defined under the EE&C Rule). In addition to the above six appliances, television might be included in future.

(1) Energy consumption trend (BAU case) and EE prospects

Residential sector energy consumption is expected to grow considerably as a result of demographic and economic changes likely to occur in the years to come. A projection of electricity consumption for the residential sector can be provided by multiplying household appliance ownership (i.e. the number of households which own target electric appliances) with the per unit energy consumption (UEC) for each year. Note that UECs are assumed constant over time in the BAU case. (Refer to Figure 2.7-5)[12]

It is estimated that, on average, the per capita energy consumption in residential sector grows at a rate of 6.2%/year during the period between 2010 and 2030. And the total energy consumption amounts in 2030 will be more than 3 times higher than those in 2010. Note that BAU case assumes 'frozen efficiency' in which appliances with the conventional (low EE) technology will continue to be utilized.

The residential sector currently has the energy-saving potential of around 36%. (Refer to Figure 2.7-7) It is temporally targeted to achieve around 80% of the EE&C potential by 2030. In the following analysis, therefore, EE&C case is assumed to reduce by 28.8% the total electricity consumptions in 2030 (BAU case). Figure 2.8-5 shows the comparison of BAU and EE&C case estimates of total electricity consumption by five major household appliances, namely, lightings, refrigerators, TVs, ACs and fans. Depending on the levels of EE product dissemination (as shown in three different market shares: around 5-30% for BAU case and 25-60% for EE&C case, depending on each type of appliance), total electricity consumption varies from 51,614 GWh/year for BAU to 37,215 GWh for EE&C case. The higher the market shares of EE&C appliances, the lower their total energy consumptions become. For the target period between 2016 and 2030, it is assumed that sales of electric appliances (for both replacement and new sales) grow at an annual 6% on average.

[12] National residential electricity consumption in the year y is given by RECy= (Popy/HHSizey) × ΣDiffy,i × UECy,i
Where Diffy,i is the average diffusion of the appliance, in the year y, UECy,i is the average UEC of the appliance i in the year y, Popy and HHSizey are the population and the average household size in year y.

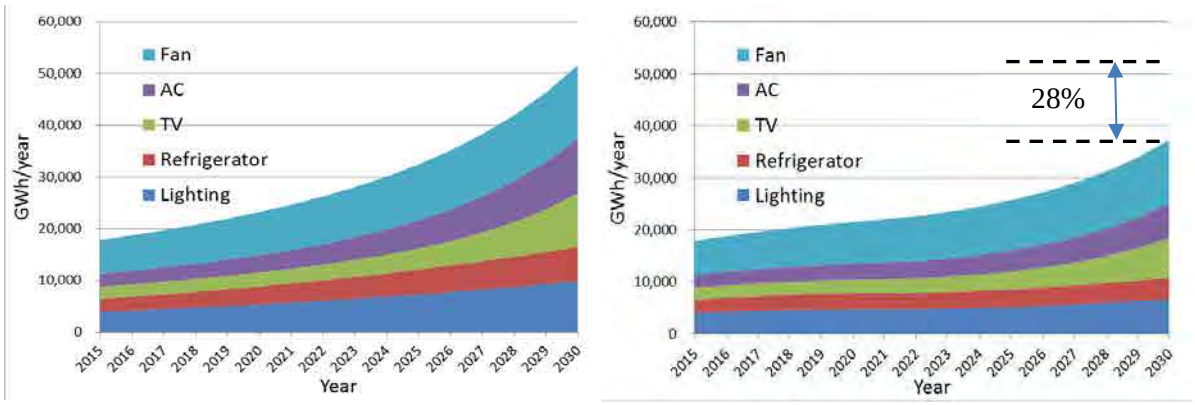


Figure 2.8-5 Comparison of Annual Electricity Consumption of Electric Home Appliances

(2) Evaluation results

EE Labeling Program for the main electric home appliances is economically feasible, according to the evaluation results shown in Table 2.8-3. Total benefits for the implementation of the program will surpass the total costs for the entire target period up to 2030, when included energy subsidy reductions as a part of the economic benefits derived from the program. The annual average net economic benefits of EE Labeling Program will amount to BDT 14 billion during the target period between 2015 and 2030.

Table 2.8-3 EE Labeling Program Costs and Benefits

(Unit: million BDT)		2015	2016-2020	2021-2025	2026-2030	Annual Ave.
Benefits	Benefits from electricity reduction	0	20,830	144,238	337,380	31,403
	Benefits of reduced energy subsidies	0	10,567	73,174	171,159	15,931
Costs	Administration costs	73	75	75	75	19
	Additional costs for EE appliances	45	32,221	165,287	328,873	32,902
Benefits-Costs		-118	-899	52,050	179,591	14,414

Source: Compiled by JICA Project team based on inputs from EE Labeling Program Committee

It is obvious that the costs of the enforcement of EE Labeling Program is minimal compared to the costs of price differences to be borne by the consumers. Therefore, the single most important factor that affects the success of this program is the unit price of electricity, the size of which determines the economic advantage of EE products. The higher the price of electricity, the larger energy savings benefit will be.

Figure 2.8-6 shows how the changes in electricity prices (from BDT 5.75/ kWh to 14.38 (2.5 times of 5.75) or 17.25 kWh (3 times of 5.75)) directly affect the sizes of net economic benefits (excluding the benefits of energy subsidy reductions) for EE&C case. For the fast dissemination of EE type appliances, therefore, the adoption of higher electricity prices will be recommended.

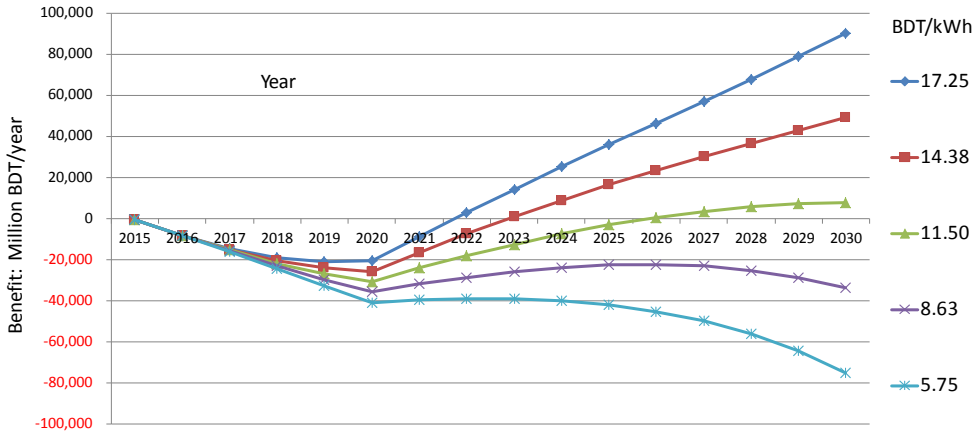


Figure 2.8-6 Changes in Net Economic Benefits by Tariff

(3) Calculation assumptions

Annual benefits are calculated as below.

[Benefits = Annual amount of electricity reduced (kWh/year) through stock replacement & new purchases×(unit price of energy + unit price of energy subsidy)]

Annual amount of electricity reduced (for each appliance) are calculated as below:

[(Amount of stock×annual electricity consumption of BAU case) – (amount of stock×annual electricity consumption of EE case)] where

- Unit price of electricity: 1 kWh = BDT 5.75
- Unit price of energy subsidy: 1 kWh = BDT 3.12

Annual costs are calculated as below.

[Costs = Annual administration costs + (annual costs for choosing EE appliances)]

- Administration costs: BDT 75 million in 2015 as introductory costs and BDT 15 million/year for the rest of the years
- Annual costs for choosing EE appliances: Price gaps between old- and EE-type appliances/10 years (= useful life of electric home appliances)

Refer to Appendix 5 “Economic Analysis on EE Labeling Program” for more details.

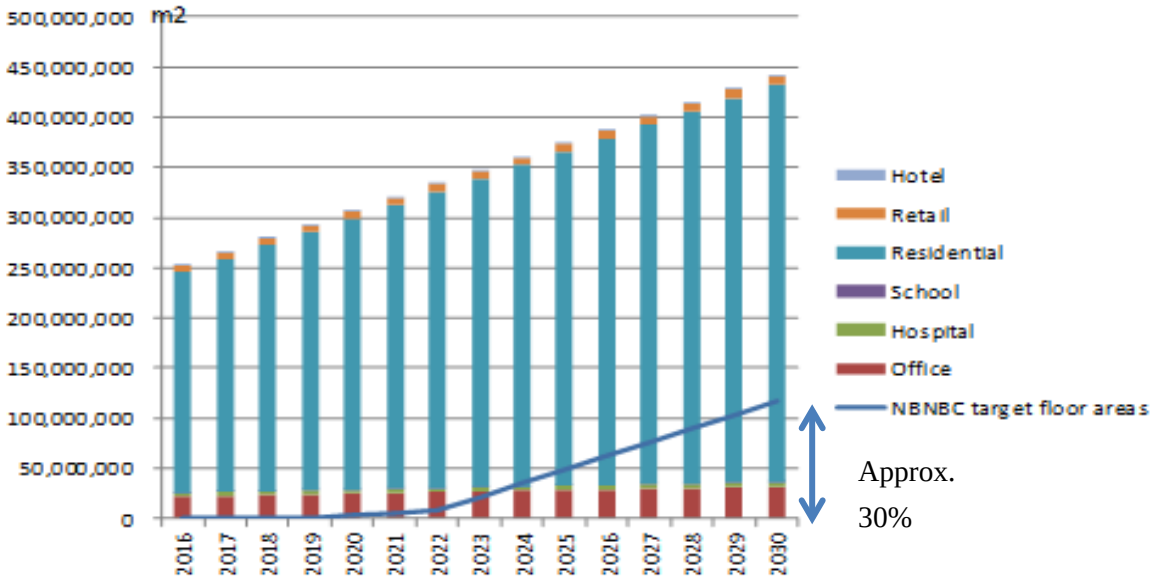
2.8.5 Economic Viability of EE Building Program

BNBC is currently being revised to BNBC [Revised] is currently in the process of amendments (hereinafter referred to as “BNBC [Revised]”) in order to incorporate EE requirements, including building equipment such as HVAC, lighting, fans, hot water supply, lift, escalator, renewable energy options.

As was mentioned in Section 2.4.3, BNBC [Revised] is a mandatory program which will be applied on the new building construction projects. Building owners (both residents and commercial buildings) and developers of buildings are obliged to meet the minimum requirements, standard specifications and recommendations specified in the Code (See Section 2.4.3 (1) 1) for the details), according to the implementation schedule between 2015 and 2022 (See Section 2.4.3 (1) 2) for the details).

(1) Energy consumption trends (BAU case) and EE prospects

Total floor areas (including the stock and new constructions) in the entire Bangladesh in 2015 will be around 250 million m^2[13], which is expected to increase by an annual 4%, on average, between 2016 and 2030 to reach approx. 440 million m^2 in 2030. (See Figure 2.8-7)



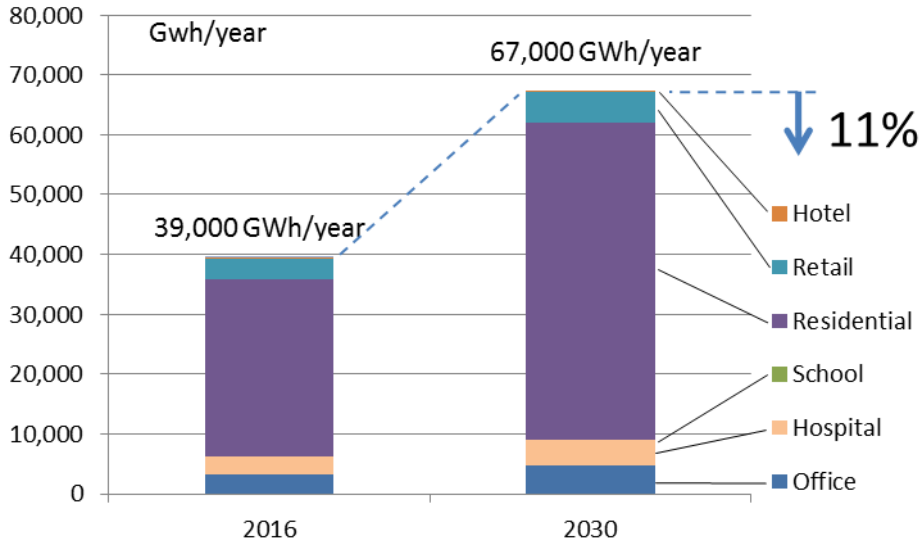
Source: EE Building Program WG

Figure 2.8-7 Expected Growth in Total Floor Areas (m^2) and EE Buildings Targets (2015-2030)

It is estimated that, without the application of BNBC [Revised], additional energy consumptions of 1,980 GWh/year, on average, will be generated between 2016 and 2030. And the majority of the additional energy consumption comes from residential buildings which consist over 80 % of total energy consumptions that arise from newly added floor areas, followed by offices, hospitals and retail shops at around 5% each.

It is expected that, with the introduction of BNBC [Revised], about 25% (approx. 500 GWh/year) of annual increase in additional energy consumption (approx. 1,980 GWh/year) can be reduced between 2016 and 2030, which will amount to approx. 11% reduction (or a total of 7,500GWh=500 GWh×15 year) against the BAU case energy consumption (Approx. 67,000 GWh/year) in 2030 (See Figure 2.8-8).

[13] Estimation is based on real figures of Dhaka in 2008 which was drawn from Comprehensive Disaster Management based Program (CDMP) of the Asian Disaster Preparedness Center (ADPC), based on the assumption that Dhaka consists 50% of total floor areas in Bangladesh.



Source: Compiled by JICA Project Team based on the input from EE Buildings Program WG

Figure 2.8-8 Expected Growth in Total Energy Consumption and EE Potential

(2) Evaluation results

As shown in Table 2.8-4, BNBC [Revised] implementation during the 15 years between 2016 and 2030 will have a considerable economic impact, which amounts to annual average of approx. BDT 15 billion against the annual average costs of about BDT 0.5 billion, or annual average net benefit of BDT 14.8 billion. Moreover, the enforcement of BNBC [Revised] would be economically viable for the planned BNBC [Revised] implementation period between 2015 and 2022 as well as for the following years.

Table 2.8-4 BNBC [Revised] Costs and Benefits

(Unit: million BDT)		2015	2016-2020	2021-2025	2026-2030	Annual Ave.
Benefits		0	4,617	55,342	184,379	15,271
Costs	Administration costs	8	26	20	20	454
	Investment costs	0	363	2,805	4,018	
Benefits-Costs		-8	4,229	52,517	180,341	14,817

Source: Compiled by JICA Project Team based on the data submitted by EE Building Program WG

One has to keep in mind that the results of this evaluation are largely affected by the calculation assumptions, the details of which are summarized below.

(3) Calculation assumptions

Annual benefits will be calculated as follows.

[Annual amount of energy consumption reductions × Unit price of energy]

- Firstly, the annual amount of energy consumption by newly added floor areas (kWh/year) will be calculated by multiplying newly added floor areas of buildings (categorized by sub sector) by their energy consumption intensity (kWh/m^2/year): 147 for offices, 891 for hospitals, 108 for schools, 134 for residential buildings, 595 for retail buildings and 335 for hotels.[14]
- Secondly, annual energy consumption reduction amount in kWh will be calculated by multiplying the annual amount of energy consumption (kWh/year) by energy improvement rates (%): 47% for office buildings, 30% for hospitals, 20% for educational buildings, 43% for residential buildings, 46% for retail buildings and 41% for hotels.[15]
- Unit price of energy are assumed to be fixed as below for the target period (2015-2030):
- Electricity: 1 kWh = 5.75BDT for residential (500 kWh/month users), and 9.58 taka for non-residential buildings; Gas: BDT 268.09 /MCF for hospitals
- For the calculation of energy savings for hospitals, the shares of electricity and gas in total energy consumptions are set at 60% and 40%, respectively. As for the rest of the sub sectors (office, educational, retail, residential and hotel buildings), only electricity consumption is included in the calculation.
- It is anticipated that, by the enforcement of BNBC [Revised], EE measures will be applied to 5% of newly constructed floor areas for residential buildings and 50% for office, hospital, school, retail shop and hotel buildings in 2015, and will all be gradually expanded to 100 % by 2022. Meanwhile, the compliance rate is assumed to improve from 5% to 100% for residential buildings and 25% to 100% for other type of buildings between 2015 and 2022.
- An average of 15-year for EE sustainability (i.e. the number of years during which annual energy savings can be sustained) is expected for all sub sectors.
- For the calculation of energy consumption reduction amounts in toe the following energy unit conversion factors were used: 1kWh = 0.0002867 toe for electricity and 1 m^3=0.0008454 toe for natural gas.

Annual costs pertaining to EE requirements under BNBC [Revised] are calculated based on the following equation.

[Annually constructed floor areas (m^2/year)×Unit costs (USD/m^2) ×additional costs for EE compliance (%)]

- Annually constructed floor areas (m^2/year) are calculated based on the average of the five-year data in Dhaka (2008-2012). [16]Due to data limitation, the total figure for the entire country is calculated on assumption that the share of Dhaka in the total constructed floor areas is approximately 50%.

[14] Housing and Building Research Institute (HBRI), "Bangladesh Green Building Code, Data Collection and Sensitive Analysis Report"

[15] Ibid.

[16] 353,099 m2 for offices, 52,686 m2 for hospitals, 4,278 m2 for educational buildings, 3,243,492 m2 for residential buildings, 96,675 m2 for retail buildings and 2,698 m2 for hotels. (Source: The Comprehensive Disaster Management Program, Asian Disaster Preparedness Center)

[Annually constructed floor areas (m^2/year) = Annual average of the constructed floor areas (2008-2012) of Dhaka × 2]

- It is assumed that, for the entire target period (2016-2030), the unit costs per square meters (USD/m^2) for each sub sector is fixed at the following rate: Office 525; Hospital 825; School 525; Residential 475; Retail 600 and Hotel 1,100.Each unit costs cover the costs to be borne by building owners for new construction of buildings, not including maintenance costs.
- Additional costs for EE measures in compliance with BNBC [Revised] requirements are 6% for offices, 6% for hospitals, 2% for educational buildings, 2% for residential buildings, 7% for retail buildings and 2 for hotels[17].
- For each sub sector, EE costs/year per newly added floor areas were amortized over fifteen years, which is the average legal life of buildings' attachments.
- Administration costs of MOHPW pertaining to the development of EE Building Program (BDT 10 million/ 3 years) are included for the first three years between fiscal years 2015 and 2017, in addition to the running costs (BDT 1.2 million/year) as well as the costs for awareness raising through information disseminations (BDT 2.8 million/year) for the period between 2015 and 2030.

2.8.6 Economic Viability of EE&C Finance Program

(1) Current status

Financial incentives such as low interest loans, subsidies and preferential taxes are to be utilized to mitigate the bottlenecks for promoting the above mentioned regulative measures, namely, Energy Management Program, EE Labeling Program and EE Building Program.

In Bangladesh, however, considering the current state of EE&C including those listed below, it is not the right moment for The Government to set aside extra budgets for providing additional subsidies and preferential tax program to promote EE&C.

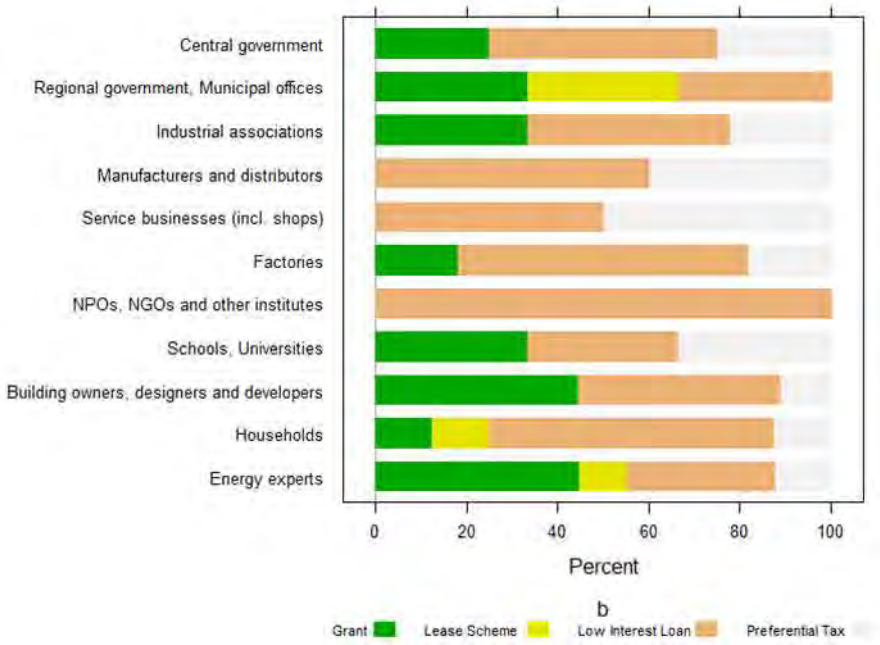
- Prices for energy (gas and electricity) are kept low by the government subsidies, which prevent the development of EE&C awareness among the energy end users
- Because of the above reason, economic incentives for the general public to save energy is very weak, which impedes the development of EE markets (consisting of EE appliance manufacturers and distributors, financial institutions providing EE&C finance and end users).
- Energy subsidies (on power generation, distribution, petroleum products, etc.) are becoming a huge burden on the state coffer (amounting to BDT 282.35 billion in FY2012, more than 3% of GDP).[18]

Considering the current situation, a low interest loan mechanism utilizing concessional funds provided by foreign donor agencies seems plausible for promoting EE&C finance, especially

[17] Housing and Building Research Institute (HBRI), "Bangladesh Green Building Code, Data Collection and Sensitive Analysis Report"

[18] Source: "Energy Subsidies in Bangladesh: Challenges and Opportunities" by Mustafa K. Mujeri, SibanShahana and TahreenTahrima Chowdhury (2013)

knowing that there are apparently strong market needs for such a measure. As a matter of fact, according to our survey on EE&C awareness, almost all participants (97.3%) representing all social segments in both public and private sectors, answered that they would implement EE&C measures if financial support is provided. And 45.4% of them preferred financial support in the form of low interest loan, while the second most dominant response was grants (30.3%)[19] (See Figure 2.8-9).



Source: NewVision Ltd. (Questionnaire survey conducted in 2014)

Figure 2.8-9 Preferred Form of Financial Support

In this section, we will evaluate the economic viability and benefits of implementing "EE&C Finance Program," presented in Clause 2.5, in which SREDA FUND will provide low interest loans to promote EE&C policy measures, namely, energy management, EE labeling and EE building. The program will be divided into two phases: the first phase (with loan disbursement between 2016 and 2018) will be dedicated to financing flagship projects which have significant showcase effects to promote EE&C measures among the general public, and the second phase will be targeted at spreading the EE&C activity all through the country by involving participating financial institutions (PFIs) and participating organizations (POs). (Refer to Clause 2.5 for the details of EE&C Finance Program.)

(2) Results

Under the program phase 1, around 100 industrial and commercial sector EE&C project owners will be financed directly from SREDA FUND and several POs (such as manufacturers, distributors

[19] A questionnaire survey on EE&C awareness was conducted in mid-2014 by NewVision Solutions Ltd., which received 127 effective responses from 277 participants covering all social segments including private and public sectors.

and suppliers which will provide highly EE type appliances to 16,000 households through installment sales) will receive refinance loans.

Around BDT 7.4 billion will be disbursed in three years between 2016 and 2018 based on the predetermined terms and conditions with the owners of the selected candidate EE&C projects; the details are summarized in sub section (3).

The implementation of the phase 1 program (financing flagship projects) will be economically viable, with the benefits surpassing the costs (Benefits – Costs > 0) for most of the period (2016-2037), except for the first five-year period (2016-2020) during which entire loan disbursement will be completed. (See Table 2.8-5) A total EE improvement by 49% for gas and 50% for electricity are expected from flagship projects, which will enable the savings of a total approx. 70 million m^3/year and 30 GWh/year, respectively.

The program is also considered socially and economically profitable, with the economic IRR of 25 %, which is remarkable compared to the current yields of ten-year treasury bonds ranging between 10 and 12%. And this is so even at the current low energy prices (i.e. BDT 6.15/ kWh for electricity and BDT 6.8 /m^3 for natural gas). Once the energy prices start to appreciate in the future, economic IRR will improve drastically. (See Table 2.8-6)

Table 2.8-5 Program Costs and Benefits (2016-2037)

		2016-2020	2021-2025	2026-2030	2031-2035	2036-2037	Annual Ave.
Benefits: (million BDT)	Realized savings	2,354	2,759	2,569	2,433	464	481
	Revolving Loan Fund	4,354	4,193	1,787	1,348	274	543
Costs: (million BDT)	Disbursed loan amount	7,346	0	0	0	0	334
	Fund management fees (0.5% of remaining principal)	130	87	45	21	2	13
Benefits - Costs (Net Benefits)		-768	6,864	4,310	3,760	737	677
ECONOMIC IRR(%)		**25%**					

Source: Compiled by JICA Project Team based on interview with manufacturers, project owners, etc.

Table 2.8-6 Changes in Economic IRR according to Energy Price Appreciation

Economic IRR (%)	Electricity	Gas
25%	BDT 6.15/kWh	BDT 6.8/ m3
27%	BDT 9.15/kWh	BDT 6.8/ m3
31%	BDT 6.15/kWh	BDT 10.2/ m3
33%	BDT 9.15/kWh	BDT 10.2/ m3

Source: Compiled by JICA Project Team

As well, the revolving loan fund (i.e. the principals and interests repayments collected during the period between 2016 and 2037), which amounts to a total of BDT 11.9 billion, can be reinvested as the sources of loans and grants to PFIs and POs in the second phase of this program.

One has to keep in mind, however, that the results of this evaluation is largely affected by the selection of candidate projects, their investment size, lending terms and conditions (such as interest rates, maturity and grace period), energy savings potential and their project lives. For the detailed calculation assumptions, see the sub section (3) below.

Note that the list of candidate projects is subject to changes during the course of this study.

(3) Calculation assumptions

Target investment projects will include EE buildings retrofitting in the public sector and new GB/EEB constructions in the private sector; EE machinery/equipment purchases in industrial sector; and refinancing for installment sales of EE type appliances for the residential sector. (For the details of candidate projects, see Table 2.8-7)

Annual costs will be estimated as below:

[Costs = Loans disbursed in three years (2016-2018) + Administrative and financial costs of managing the SREDA FUND]

- Total amount of loan disbursed (JPY 10 billion or about BDT 7.4 billion at JPY1=BDT 0.74) in the above mentioned three policy target sectors during the intended disbursement years (2016-2018), and
- Administrative and financial costs of managing the SREDA FUND. Financial costs do not include interests and principals payments to MOF which provide concessional funds to SREDA according to a Subsidiary Loan Agreement (SLA), since the repayment of both interest and principals start from the 11th year during the second stage of the EE&C Policy Promotion Loan Program. We assume the lending condition (interest rates, maturity and grace period) of SLA at below 3% in BDT, 40 year including 10-year grace period in order to make it compatible to the lending conditions to be signed between JICA and MOF (0.01% in JPY, 40 years including 10 year grace period).[20] For the financial management of the SREDA FUND, a financial institution will be hired, which will gain all inclusive fee payment of annual 0.5% of the loans outstanding.

Annual benefits are calculated as below:

[Benefits = Realized energy savings + Revolving loan fund]

- Benefits will be energy savings amounts (i.e., reduced amounts of gas and electricity consumptions) to be derived from EE investment projects.

[20] Possible lending condition to SREDA was discussed with the Finance Division of MOF (in August 2014).

- Annual benefits will be calculated by multiplying annual energy-saving amounts (i.e., reduced amounts of gas and electricity consumptions, converted into toe) by unit energy price.
- Annual energy savings will assume to last for the economic life of each investment projects (which is equivalent to legal useful life of equipment/machineries invested). (See Table 2.8-7)
- Unit energy prices: BDT 6.15/ kWh (electricity) and BDT 6.8 /m^3 (gas) for the weighted average tariff rates of all sectors
- It is assumed that 90% of energy savings (market value) will be realized
- Revolving loan fund (i.e., principals & interests collected in 20 years between 2016 and 2037) will amount to approx. BDT 12 billion, including interest earnings of BDT 4.6 billion)
- Lending terms and conditions (i.e., interest rate, maturity and grace period) to end users are set according to the types of project, as shown in Table 2.8-8.

Table 2.8-7 Energy Saving Amount and Economic Life of Candidate Projects

EE&C Program	Details of EE&C projects	Project life (year)	Annual energy reduction amount (toe/year)*
EE Bldgs.	New GB (10,000m2: AC, lighting, etc.) (4 units)	12	287
	New EEB (5,000m2: AC, lighting, etc.) (4 units)	12	143
Energy Mgmt.	Lighting (Replacement of CFL with LED/25W) for textiles (20,000 lamps for 10,000m2) (11units)	10	72
	Once-through boiler (6 t/h) (3 units)	20	1,606
	Gas turbine cogeneration (6-10MW) for textiles (3 units)	20	16,988
	Exhaust heat recovery(100,000 t/h) for steel (3 units)	20	1,711
	High efficient weaving machines (100 sets)(1 unit)	20	1,192
	Biogas power generation (2kW) for poultry (30 units)	20	3
	Biogas power generation(400kW) for poultry (2 units)	20	573
	Ammonia cooling/ chilling (10,000t) for food processing (6 units)	30	201
	Medium sized public buildings retrofit (500 m2: AC, lighting) (4 units)	10	11
	Large public buildings retrofit (5,000m2: AC, lighting) (4 units)	10	109
EE Labeling	AC & Refridgerator (1,000 sets) (16 units)	5	115

*1kWh= 0.0002867 toe; 1 m^3=0.0008454 toe

Table 2.8-8 Lending Conditions for Borrowers

1) Public sector buildings EE retrofiting		
Interest rates	3	%
Maturity	5	years
Grace period	1	years
2) Green and EE buildings		
Interest rates	9	%
Maturity	20	years
Grace period	3	years
3) Industrial sector EE equipment investment		
Interest rates	6	%
Maturity	7	years
Grace period	2	years
3) Refinancing for EE appliances installment sales		
Interest rates	6	%
Maturity	3	years (36 months)
Grace period	0	years

2.8.7 Cost Effectiveness Analysis of Target EE&C Projects

In order to effectively prioritize the Government budget allocation, cost effectiveness analysis was conducted for several public and private sector EE&C projects representing each EE&C policy measures. The calculation formula is as below:

$$(a + c – d) / b$$

Where:

a: Annual investment costs for the Government (BDT/year)

b: Annual energy reduction amount (toe/year)

c: Annual investment costs for the private sector EE&C investments (BDT/year)

d: Annual economic benefits of private-sector energy reduction (BDT/year)

(1) Results

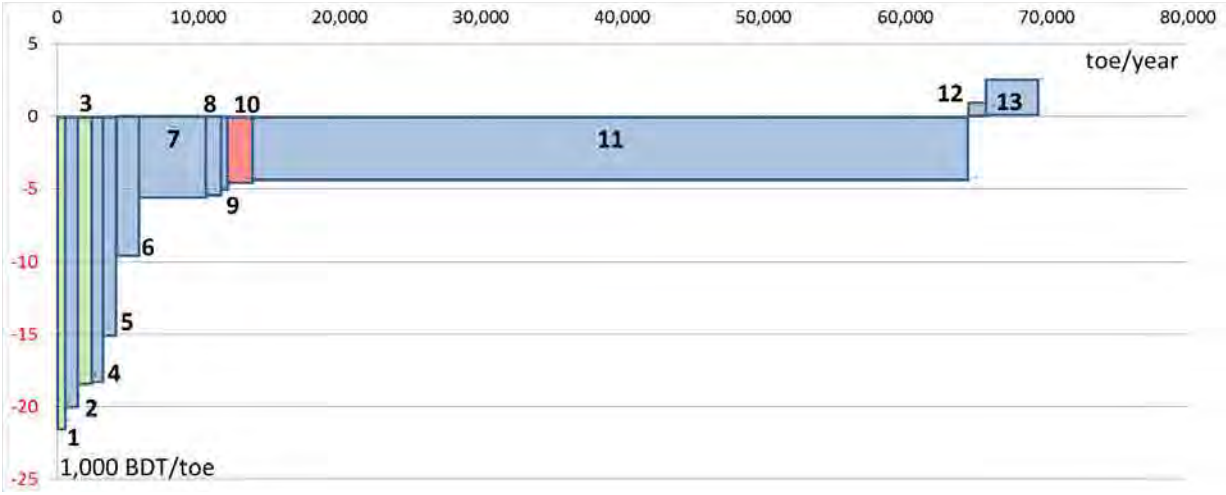
According to the calculation formula and assumptions listed above, the costs per unit of energy (BDT/toe) for the candidate projects included under EE&C Promotion Program Phase 1 (Flagship Program) were plotted into a bar chart, to create a marginal abatement costs (MAC) curve of the selected EE&C projects (See Figure 2.8-10). (Refer to also Appendix 6 “Cost Effectiveness Analysis of Target EE&C Projects” for the concrete data used to draw up the figure.)

The lower left of x- and y- axis shows the group of projects that are most cost effective, whereas the upper right of the axes shows the least cost effective one.

The area of a square represents the net costs of an EE&C project, with the height and width

representing, respectively, the unit costs and quantity of energy saved. Those projects that appear below the horizontal axis can be implemented at a net benefit, while those above the horizontal axis can be implemented at a net cost.[21]

Project Nos. 2, 4, 5, 6, 7, 8, 9, 11, 12 and 13 will be promoted by the enactment and enforcement of Energy Management Program; project No. 10 will be accelerated through the implementation of EE Labeling Program; and project Nos. 1 and 3 will be accelerated by the enactment of BNBC [Revised].



Notes: Numbers represent the following EE&C projects:
1. New EEB (lighting, etc., 4 units), 2. Biogas power generation for poultry (2kW, 30 units), 3. New GB (lighting, etc., 4 units), No. 4: Ammonia cooling/ chilling for food processing (10,000t, 3 units), 5. Lighting for textiles (LED/25W, 20,000 lamps×11units), 6. Biogas power generation for poultry (400kW, 2 units), 7. Once-through boiler (6 t/h, 3 units), 8. Cement kiln (5,000 t/day, 4 units), 9. Large public buildings retrofit (AC, lighting, 4 units), 10. AC & Refrigerator (16,000 households), 11. Gas turbine cogeneration (6-10MW, 2 units), 12. High efficient weaving machine (100 sets, 1 unit), 13. Exhaust heat recovery for steel (100,000 t/h, 2 units)
Source: Compiled by JICA Project Team based on independently collected data

Figure 2.8-10 MAC Curve of EE&C Flagship Projects

(2) Calculation assumptions:

1) Annual costs (USD/year), either those to be borne by the Government (a) or the private sector (c), were amortized over the legal useful life of the project, which is equivalent of the legal useful life of EE equipment/machinery. In addition, O&M costs are included.

2) Annual energy reduction amount (toe/year) (b) is the expected amount of energy to be reduced by using EE technology compared with the conventional technology. Energy unit conversion factors are:

1 kWh = 0.0002867 toe for electricity

1 m^3 = 0.0008454 toe for natural gas

[21] One has to keep in mind that MAC curve is only an indicator for clarifying the lowest cost opportunities among the candidate EE&C projects. They do not consider other factors which will affect investment decisions such as changes in the business mix of the economy, changes in lifestyles, technological innovations, etc. And the costs included in the calculations are not exhaustive (include only upfront costs and O&M costs).

3) Annual economic benefits of private-sector energy reduction (USD/year) (d) are calculated as below:

[Annual energy reduction amount (b)×Unit price of energy]

Where, the unit energy prices are assumed as the following:

- Electricity: 9.58 BDT/kWh for buildings sector other than residences, 7.3 BDT/kWh for industrial sector, and 5.75 BDT/kWh for residential sector
- Gas: 5.5 BDT/m^3 for industrial sector

2.8.8 Cost Effectiveness Analysis of EE&C Programs

In addition to the above, cost effectiveness of the three EE&C programs, namely, Energy Management Program, EE Labeling Program and EE Buildings Program, during the 15 years between 2016 and 2030 were analyzed by drawing a MAC curve as shown in Figure 2.8-11. The calculation formula will be as the following:

$$[(a + c) – (d + e)] / b$$

Where:

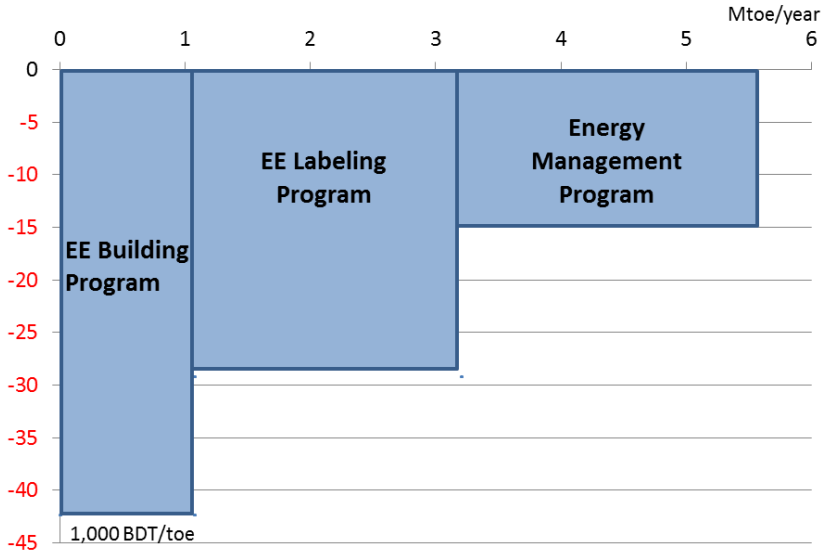
a: Annual administrative costs for the Government (BDT/year)
b: Annual amount of energy reduced (toe/year)
c: Annual investment costs for the private sector EE investments (BDT/year)
d: Annual economic benefits of private-sector energy reduction (BDT/year)
e: Annual economic benefits of the Government (BDT/year) in terms of the annual amount of energy subsidies reduced

(1) Results

In the MAC curve, program which require the lowest costs (BDT) per unit of energy saved (toe) will be placed at the lower left of the diagram and the program with the highest cost will be placed at the upper right of the diagram (See Figure 2.8-11).

For the effective allocation of limited resources, it is wise for the Government to prioritize the implementation of EE&C programs according to their cost effectiveness. In other words, the first priority in cost effectiveness would be the implementation of EE buildings, followed by EE Labeling Program and Energy Management Program. Besides as for the first priority in EE&C reduction volume would be the implementation of EE Labeling Program, followed by Energy Management Program and EE Building Program.

In case the first priority is energy reduction volume, the order of implementation would be EE labeling program, Energy management program and EE building program, given that all programs can be implemented at a net benefit.



Source: Compiled by JICA Project Team

Figure 2.8-11 MAC Curve of Energy Consumption Reductions for EE&C Programs

(2) Calculation assumptions (Refer to Appendix 7 "Cost Effectiveness Analysis of EE&C Programs")

1) Annual administrative costs for the Government (USD/year) (a) during the target period (2016-2030) are calculated as the following:

[Total costs×1/15]

- For Energy Management Program: USD 438,000×1/15 = USD29,200/year = BDT 2.3 million
- For EE Labeling Program: USD 6,250,000×1/15 = Approx. USD 416,600/year = BDT 32.5 million
- For EE Buildings Program: USD 1,130,000×1/15 = Approx. USD 75,300/year = BDT 5.9 million
- Currency conversion rate: USD 1 = BDT 78

2) Annual amount of energy saved (toe/year) (b) during the target period is calculated as below:

[Annual amount of energy saved (kWh or m^3) in 2030×15 years×1/2×1/15]

Where annual amount of energy saved in 2030 is calculated as below for each program:

(For Energy Management Program)

- It is assumed that 4.67 million toe or 70% of 30% (=21%) energy reduction potential in the industrial sector can be achieved by 2030, and 50% of which is assumed to be attained through energy management and EE&C investments in 6 large energy-consuming sub industrial sectors. Calculation equation is as below:

[44,460,000 toe (gas, electricity, coal, oil) in 2030×0.5×0.21 = 4,668,000 = 4,670,000 toe]

- Of the total energy reduction in toe, 30% and 70% respectively, are assumed to be attainable in electricity and gas (4,890 GWh, and 3.9 billion m^3)

[4,670,000×0.3/0.2867 = 4,886,641 MWh]

[4,670,000×0.7/0.0008454 = 3,866,808,611 m^3]

- Energy unit conversion factors are: 1 kWh = 0.0002867 toe for electricity and 1 m^3 = 0.0008454 toe for natural gas

(For EE Labeling Program)

- It is assumed that 4.3 million toe (14,900 GWh) or 80% of 36% electricity saving potential (=28.8%) in the residential sector can be attainable by 2030. Calculation equations are as below:

[51,614 GWh/year in 2030 (BAU)×0.288 = 14,865 GWh/year = 14,900 GWh]

[14,865 GWh/year×286.7 = 4,261,796 toe = 4,260,000 toe]

(For EE Buildings Program)

- It is assumed that 2.15 million toe (7,500 GWh = 500 GWh/year×15) or about 11% of the total energy consumption by new construction of buildings can be saved by 2030. Calculation equations are as below:

[500 GWh/year×15 years =7,500 GWh in 2030]

[7,500×286.7＝2,150,250 toe]

3) Annual investment costs (BDT) to be borne by the private sector (c) during the target period are calculated as below:

[Total investment costs / Average legal useful life of the representative equipment/machineries/15 years]

- Where, the total investment costs are calculated by the following equation:

[Total investment costs= annual amount of energy saved (toe/year) in 2030×Unit energy price (BDT/toe)×simple payback period (5 years)]×1.3

- The average useful life for Energy Management Program, EE Labeling Program and EE buildings program are 20 years, 10 years and 15 years, respectively.
- Unit energy prices are assumed as: 9.58 BDT/kWh for buildings sector other than residential sector, 7.3 BDT/kWh for industrial sector, 5.75 BDT/kWh for residential sector and 5.5 BDT/m^3 for industrial sector
- O&M costs of around 30% of the initial investment costs will be needed during the 15 years between 2016 and 2030.
- Simple payback period for each program is assumed to be 5 years

4) Annual economic benefits (BDT/year) of private-sector energy reduction (d) during the target period are calculated according to the equation below:

[Annual amount of energy saved (kWh/year or m^3/year) in 2030×15 years×1/2×Unit energy price (BDT/kWh or BDT/m^3)×1/15]

- It is assumed that unit energy prices are fixed for the target period (2016-2030): 9.58 BDT/kWh for buildings sector other than residential sector, 7.3 BDT/kWh for industrial sector, 5.75 BDT/kWh for residential sector and 5.5 BDT/m^3 for industrial sector
- It is considered that [annual amount of energy saved in 2030×15 years×1/2] is equal to the total accumulated amount of energy saved during the 15 years between 2016 and 2030; and the economic benefit is assumed to be generated gradually over the same period.

5) Annual amount of energy subsidies saved (BDT/year) (e) during the target period (2016-2030) is calculated on an assumption that the grid electricity is subsidized at the rate of BDT 3.12 /kWh.

[Annual amount of energy saved (toe/year)/energy unit conversion factor (toe/kWh)×3.12 (BDT/kWh)]

2.9 Capacity Development and Awareness Raising

2.9.1 Capacity Development of SREDA

(1) Roles of SREDA

SREDA will be the leading governmental organization on capacity development and EE&C awareness raising for related governmental organizations, private sector and residential sector. To lead nationwide capacity development and awareness raising efficiently and effectively, the capacity of SREDA itself should be fostered at first. Capacity of SREDA can be improved in conjunction with donors' supports, such as GIZ and JICA.

(2) Staffs' competencies

Staffs in charge of the EE&C programs are expected to have wide range of competencies. Table 2.9-1 shows required knowledge for staffs.

Table 2.9-1 Staffs' Competencies

Staff	Knowledge
Overall	■ Communication with stakeholders
Energy Management Program	■ Energy data collection and analysis ■ Communication with industrial sector and associations
EE Labeling Program	■ Basic knowledge in S/L (Standards and Labeling) ■ Basic EE technology on home appliances ■ Present market condition ■ Communication with manufacturers and dealers

Staff	Knowledge
EE Building Program	■ Basic EE technology on buildings and houses ■ Building code ■ Communication with building owners and designers
EE&C Finance Program	■ Available financing source for EE&C ■ Communication with financial institutions
IT infrastructure	■ Skill to operate IT
EE&C awareness raising	■ Communication with industries and industrial associations ■ Communication with Ministry of Education and schools/universities ■ Utilization of media
Economic and financial analysis	■ Economy on energy ■ Outline of EE&C programs and technology
Climate change	■ Knowledge on global warming ■ Kyoto mechanism, CDM, etc.

The industrial associations to collaborate with SREDA are shown in Table 2.9-2.

Table 2.9-2 Industrial Associations

Abbreviation	Name of association
BGMEA	Bangladesh Garment Manufactures & Exporters Association
BKMEA	Bangladesh Knitwear Manufactures & Exporters Association
BTMEA	Bangladesh Textile Mills Association
BRMA	Bangladesh Re-Rolling Mills Association
BCMA	Bangladesh Cement Manufactures Association
FBCCI	The Federation of Bangladesh Chambers and Industry

SREDA should manage stakeholder meetings during the process of program forming, implementation and review. Apart from meeting formation, SREDA is expected to have good relation with stakeholders, as EE&C program should be implemented and operated fulfilling the interest of the various kinds of stakeholders in the country. Table 2.9-3 shows major parties of stakeholders, which should be involved in the EE&C programs.

Table 2.9-3 Stakeholders (Parties)

Program	Stakeholder (Party)
Overall	■ The academy
Energy management	■ Large energy consumers ■ industrial associations
EE labeling	■ BAB, BSTI ■ Manufacturers, importers, shops and associations ■ Consumer groups ■ Stakeholders in foreign countries
EE building	■ MOHPW ■ Building designers and associations ■ Construction companies and associations

EE&C financing	■ Financial institutions (BB,IDCOL and private banks)
IT	■ IT firm
Awareness raising	■ Schools and universities, media companies
Economic analysis	■ Consulting form
Climate change	■ DOE
Energy data collection	■ Energy suppliers and distributers ■ Petrobangla, BPC

(3) Operation and maintenance

Regulations must be checked, reviewed and modified as required, reflecting the circumstances, such as industrial development, appliance market condition and technology development. Therefore, SREDA must have administrative capability not only for regulations enactment but also for their operation and upgrade.

(4) Optimal organizational structure

Current number of the staffs in SREDA in charge of EE&C is 13. The number will increase to 28 in 2015 at the head office, but no staffs in provincial offices. In near future, staffs in provincial offices maybe become necessary for disseminating the EE&C programs nationwide effectively and conveniently. Table 2.9-4 is a tentative staffing plan in head office and provincial offices in 2020 and after.

Table 2.9-4 Number of SREDA Staffs in Charge of EE&C

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Head office	28 stuffs					31stuffs										
Provincial office	0 stuffs					30 stuffs										

Table 2.9-5 shows role and assignment of the staffs which will be finally assigned in 2020.

Table 2.9-5 Staffing Plan in 2020

Office	Team	Staffing	Roles
Head office	Overall	Director x 1	■ Overall
	DCs, energy audit and certification	Manager x 1	■ DCs, energy audit and certification
		Sub-manager x 1 Staff x 3	■ DCs designation ■ Collection and analysis of DCs report ■ Benchmarking

Office	Team	Staffing	Roles
		Sub-manager x 1 Staff x 3	■ EM, CEA and ACEA certification
		Sub-manager x 3 Staff x 9	■ Energy audit
	EE labeling	Manager x 1 Staff x 2	■ Label certification ■ Provision of BDSs and criteria ■ Home appliances market research ■ Building equipment
	Energy data collection	Sub-manager x 1 Staff x 2	■ Energy data collection (supply side and demand side) ■ Making statistics
	Awareness, publication	Sub-manager x 1 Staff x 2	■ Awareness program ■ Publication
	Sub-total: 31		
Local office (20 area)	Overall	Sub-manager x 1 Staff x 1 or 2 x 20 area Sub-total: 30	■ Energy data collection (supply side and demand side) ■ EM, CEA and ACEA certification ■ Home appliances market research ■ Report to the head office
Total 61			

2.9.2 Network Needed for National Capacity Development

Since SREDA was just established, its human resources and budget is not sufficient at present. In order to make SREDA a center of national EE&C implementation, besides SREDA's own capacity development, the sections in charge of EE&C should be firstly provided or assigned in all governmental organizations establishing tight relation with SREDA. Secondly, SREDA should make approaches to the stakeholders through relevant governmental organizations. Nationwide network on EE&C implementation including international donors, related associations and the academy should be finally formulated and operated setting SREDA at the center. National capacity building should be achieved through the network by means of information exchange and technology transfer.

2.9.3 Awareness Raising for Industrial, Commercial and Business Sectors

(1) Overview

Private sector's voluntary EE&C actions are expected. SREDA and governmental organizations should provide various kinds of information, advertisement, events and tools for awareness raising of EE&C to the private sectors.

(2) National EE&C award and yearly electricity week

Capacity development and awareness raising for private sectors should be implemented through National EE&C Award, in accordance with yearly electricity week, monthly seminar and monthly focus group seminar, which should be implemented, focusing on the effective target sectors successively. National EE&C Award should be given for companies and for energy managers

whose activities are worth being highly evaluated and as good examples for the people.

National EE&C Award ceremony, exhibition of energy technologies and equipment, and international seminars and workshop on EE&C are to be held in the electricity week which is held early December, annually. Educational materials, such as leaflets, posters and booklets are to be distributed during the time.

(3) Monthly seminar and monthly focus group discussion

SREDA is carrying out seminars and focus group discussion for target energy consumers monthly. These activities should be improved and continued. Focus group seminars should be implemented focusing on the effective target sectors. The target sector will be shifted time to time.

(4) Efforts by industrial associations

All industrial associations are conscious of cost reduction and sustainable operation of their business. In this context, SREDA should communicate with them and make information sharing on effective EE&C measures and imaginable future risks on energy supply etc. SREDA and related governmental organizations should lead the establishment of EE&C focusing committee in each industrial sub-sector.

2.9.4 Awareness Raising for Residential Sector

(1) Overview

Awareness raising in schools, universities and other educational sites is most important for residential sector. Provision of knowledge and conscious on energy and EE&C to students will influent their family through EE&C action at home, and finally cause awareness raising in the society.

(2) EE&C school/university program initiative

The EE&C school program initiative will be formulated focusing on school children. Through the discussion with their parents and knowing their present energy consumption condition, the children can understand what energy consuming appliances are, and how to save them etc.

SREDA will conduct EE&C school program, which will be a joint program with Ministry of Education. The target of this school program will be students under 15 years old in primary and secondary school.

School/university curricula on EE&C for primary, secondary and higher educational institutions, universities or autonomous bodies will be prepared by SREDA and related organizations, and fixed into their syllabus. The School/University Text Book Board will review the curricula

periodically.

The following actions will be adopted in school/university curricula:

- Showing of video clips and documentaries on EE&C practices and their benefits.
- Organizing spot quiz.
- Introducing educational posters for EE&C in schools/universities.
- Organizing thematic art competition.
- Motivational talks by experts or professionals

(3) Media campaign

Media campaign will be implemented through effective media, such as televisions, newspapers and advertising boards, discussions, street campaigns, school campaigns, competitions with prizes, etc. SREDA will conduct media campaigns in cooperation with related governmental and/or private organizations and programs. Table 2.9-6 shows example of cost estimation for media campaign. SREDA will select media to maximize effects within the budget.

Table 2.9-6 Cost Estimation for Media Campaign

Category	Unit cost	Estimated cost	
TV	30,000 BDT/ 60 second	27,000,000 BDT	5 times/day x 30 days x 6 months
Newspaper	1,000,000 BDT/half page	12,000,000 BDT	12 times
Radio	2,000 BDT/minute	3,600,000 BDT	5 times/day x 30 days x 12 months
Printing	10,000 BDT/1,000 pieces	10,000,000 BDT	1,000,000 pieces
Billboard	500,000 BDT/10 pieces	10,000,000 BDT	200 pieces
Banner	300 BDT/piece	29,280,000 BDT	488 regions x 50 pieces x 4 times
Voice SMS	1,200 BDT/minute	60,000,000 BDT	50,000,000 persons x 1 time
Text SMS	500 BDT/characters	25,000,000 BDT	50,000,000 persons x 1 time

2.9.5 SREDA's Immediate Action for Capacity Development and Awareness Raising

SREDA should take immediate actions as shown in Table 2.9-7 and 2.9-8. Leading of "Government Own Initiative on EE&C Implementation" is included in the Table.

Table 2.9-7 SREDA's Immediate Action for Capacity Development

	2015										2016					
	Mar.	Apr.	May	June	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June
1. SREDA's Capacity Development Plan																
■ Assignment of the planning task leader																
■ Assignment of leaders and staffs by EE&C program																
■ Drafting and issue of the plan				▼												
2. Achievement of SREDA staff's compitency							Acquisition of EM certificate									
■ Expert staffs (5) on Energy Management Program													▼			
■ Expert staffs (3) on EE Labeling Program																
■ Expert staffs (2) on EE Building Program																
■ Expert staffs (2) on EE Finance Program																
■ Expert staffs (2) on IT infrastructure																
■ Expert staffs (2) on econonic and financial analysis (including energy data collection/analysis)																
■ Expert staff on climate change																
3. EE&C network formulation																
■ Network with other governmental organizations																
■ Network with industrial associations																
■ Network with AC, refrigerator and TV manufacturers																
■ Network with other appliance manufacturers																
■ Network with building owners, designers, etc.																
■ Network with financial institutes (banks, etc.)																
■ Network with media, educational institutes, etc																
4. Development of SREDA Website																
■ Maintenance of SREDA Website (No additional fee)																
■ Additional development for existing contents																
■ Development of new contents																
5. Government own initiative on EE&C implementation																
■ Formulation of "Action Plan Development Committee"																
■ Meetings of the Committee								▼		▼		▼				
■ Drafting and issue of the Action Plan																
■ Government top's approval and issue of the plan															▼	

Table 2.9-8 SREDA's Immediate Action for Awareness Raising

	2015										2016					
	Mar.	Apr.	May	June	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June
1. Award Guideline																
■ Appointment of WG member																
■ WG meetings																
■ Drafting of Award Guideline																
■ Finalization of Award Guideline																
■ Issue of Award Guideline																

	2015										2016					
	Mar.	Apr.	May	June	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June
2. School/University Programe																
■ Appointment of EE&C Education Committee member										■						
■ Committee meetings											■	■	■	■	■	
■ Drafting of educational curriculums												■	■	■	■	
■ Finalization of educational curriculums															■	
■ Issue of educational curriculums																■
3. Media Campaign Plan																
■ Appointment of WG member	■															
■ WG meetings		■	■	■	■	■	■									
■ Drafting of Media Campaign Plan			■	■	■	■	■									
■ Finalization of Media Campaign Plan							■									
■ Selection of Outsourcing Company by competition								■								
■ Implementation of Media Campaign									■	■	■	■	■	■	■	■
■ Moniroting & Feedback of effect										■	■	■	■	■	■	■

2.10 National Budget Plan on EE&C Policies and Programs

2.10.1 Overview

Budget for FY2015 must be fixed by the end of July 2015. SREDA and JICA Project Team has made tentative budget plan on EE&C programs in five years as below. Personnel expenses of SREDA staffs are excluded:

2.10.2 Common Works

Budget for common works of SREDA for EE&C programs implementation is as shown in Table 2.10-1.

Table 2.10-1 Budget Plan for Common Works (1,000 BDT)

Fiscal year	2015-2016	2016-2017	2017-2018	2018-2019	2019-2020
Administration	2,000	2,000	2,000	2,000	2,000
Cross-cutting research	1,000	1,000	1,000	1,000	1,000

2.10.3 Energy Management Program

Necessary budget for program implementation is as shown in Table 2.10-2 and 2.10-3.

Table 2.10-2 Budget Plan for Energy Management Program (1,000 BDT)

Fiscal year	2015-16	2016-17	2017-18	2018-19	2019-20
Administration	600	600	600	600	600
Training	10,150	150	150	150	150
Certification	3,390	390	390	390	390
Information and awareness	400	400	400	400	400

Table 2.10-3 Budget Contents for Energy Management Program

Item	Explanation
Administration	■ Operation of seminars, committee meetings, etc. ■ Maintenance of data collection system, incl. data servers and a PC
Training	■ Some portion of the training fee will be bone by the participants ■ Provision of machine, instruments for lecture and training ■ Payment for lecturers
Certification	■ Examination, registration ■ Practical test, lecure cost for practical test
Information and awareness	■ Program instruction brochures for private sectors

2.10.4 EE Labeling Program

Necessary budget for program implementation is shown on Table 2.10-4 and 2.10-5. The budget for EE testing facility has low and high cost. The low cost is from BSTI's budget plan, and high cost is suggested by JICA Project Team. SREDA should know that low cost test facility may not assure stable accuracy and convenient maintainability.

Table 2.10-4 Budget Plan for EE Labeling Program (1,000 BDT)

Fiscal year	2015-16	2016-17	2017-18	2018-19	2019-20
Administration	1,200	1,200	1,200	1,200	1,200
EE test facility (installation)	Refrigerator, AC, fan 70,000 -120,000	Motor 30,000 -50,000	0	0	0
EE test facility (operation and maintenance)	10,000	10,000	10,000	10,000	10,000
Information and awareness	5,000	5,000	5,000	5,000	5,000

Table 2.10-5 Budget Contents for EE Labeling Program

Item	Explanation
Administration	■ Market research, committee meetings and WGs venue, etc. ■ Sample pick-up test ■ SREDA's man-power fee is excluded.
EE test facility (installation)	■ Test facilities installation ■ Initial training of test staffs
EE test facility (operation and maintenance)	■ Test staffs man-power fee, calibration, etc. ■ Subsidies for direct cost of appliance EE measurement tests. (When mandatory program is applied, SREDA should consider about monetary support for the manufacturers. remaining cost will be paid by manufacturers and importers)
Information and awareness	■ Program instruction brochures for shops and customers
Other	■ Cost for label affixing is excluded.

2.10.5 EE Building Program

Necessary budget for program implementation is shown on Table 2.10-6 and 2.10-7. Allocation between MOHPW and SREDA should be defined.

Table 2-10-6 Budget Plan for EE Building Program (1,000 BDT)

Fiscal year	2015-16	2016-17	2017-18	2018-19	2019-20
Administration	1,200	1,200	1,200	1,200	1,200
Information and awareness	2,800	2,800	2,800	2,800	2,800
Development	6,000	6,000	depends	depends	depends

Table 2.10-7 Budget Contents for EE Building Program

Item	Explanation
Administration	■ Check and monitoring of EE&C measures under BNBC [Revised] implementation ■ Check and review for BNBC [Revised] promotion and GBG development ■ Collection and analysis of buildings energy consumption data
Information and awareness	■ Capacity development for local governments and relevant agnecies ■ Awareness of the importance of EE&C for designers , constructors and consumers
Development	■ Manual for BNBC [Revised] (2015-2018) ■ Notification and periodical report system (2015-2017) ■ Green Building Assessment System (2023-2027)

2.10.6 EE&C Finance Program

Necessary budget for program implementation is shown on Table 2.10-8 and 2.10-9.

Table 2.10-8 Budget Plan for EE&C Finance Program (1,000 BDT)

Fiscal year	2015-16	2016-17	2017-18	2018-19	2019-20
Administration (Operating cost for Technical Standard Committee – Printing, Communication, and other fees)	500	500	500	500	500
Budget to operate specified programs supported by donors	depends	depends	depends	depends	depends
Information and awareness	500	500	500	500	500

Table 2.10-9 Budget Contents for EE&C Finance Program

Item	Explanation
Administration	■ Program operation (annual basis) ■ Analysis and review for EE&C Finance Programs ■ Communication with MOF and financial institutions
Budget to operate specified programs supported by donors and/or MOF	■ Program specified operation budget
Information and awareness	■ Campaign about importance of EE&C and effective incentive mechanisms for financial institutions and consumers

2.10.7 Capacity Development and Awareness Raising

Necessary budget for awareness raising program implementation is shown on Table 2.10-10 and 2.10-11. Capacity development for global warming issue is included.

Table 2.10-10 Budget Plan for Capacity Development and Awareness Raising (1,000 BDT)

Fiscal year	2015-16	2016-17	2017-18	2018-19	2019-20
SREDA homepage	15,000	15,000	15,000	15,000	15,000
Electricity week	60,000	60,000	60,000	60,000	60,000
EE&C award	2,200	2,200	2,200	2,200	2,200
School/University Program	10,000	10,000	10,000	10,000	10,000
Media Campaign	176,880	176,880	176,880	176,880	176,880

Table 2.10-11 Budget Contents for Capacity Development and Awareness Raising

Item	Explanation
SREDA homepage	■ Up-dating , amendment and improvement
Electricity week	■ Seminars, exhibisition, display, printings
EE&C award	■ Expenditure for accomodation, etc.
School/University programs	■ Art competition, etc.
Media campaign	■ TV, Newspaper, SMS, etc.

2.11 Remaining Issues

2.11.1 Issues on EE&C Master Plan, Relevant Regulations and Standards

There are several remaining issues in target regulations to finalize, act and engage. Suitable human resources, budget and effective cooperation with donor agencies will be secured to deal with the issues. As for target time line, please refer to Annex “EE&C Master Plan”.

2.11.2 EE&C Master Plan for Transportation Sector

EE&C Master Plan for transportation sector will be formulated in the near future. In Bangladesh, energy consumption in transportation sector is the third largest and is increasing steadily. The matters to be discussed are 1) city planning coordination, 2) mass transportation with less air pollution shifting 3) traffic jam, etc. The discussion to formulate "EE&C Master Plan for Transportation Sector" will be led by a collaboration of SREDA and Dhaka Transport Coordination Board (DTCB) and other related local authorities.

2.11.3 Supply-side EE&C Plan

Supply-side EE&C master plan will be drafted under on-going JICA Power Supply Master Plan (PSMP) Project. It is important that supply-side and demand-side plans should be discussed at the same time. Demand side EE&C is considered to be one new energy source, known as Negawatt. SREDA has a plan to include power plants as the targets of national Energy Management Program.

2.11.4 Energy Tariff System

Historically and politically the energy prices in Bangladesh have been set at lower levels, lower than the costs. Such low costs come from a huge amount of government subsidy and this prevents people from saving energy. And in the near future around 2020, Bangladesh will have to import gas and coals from abroad, because domestic energy consumption has been steadily increasing.

In this context, a revision/increase of electricity and gas tariffs is worth being considered to keep sustainable and healthy development of the economy. The measures to be discussed are 1) more effective TOU (time of use) tariff, 2) fuel price adjustment tariff, which has been applied in Japan and recently in Indonesia to reduce energy subsidy.

2.11.5 Establishment of Comprehensive Documentation on Energy and EE&C Policies and Programs

The Government should establish comprehensive documentation on EE&C policies and programs for EE&C implementation. SREDA should lead the coordination of all official documents making clear relation between the documents. Table 2.11-1 shows the rough structure of official documents on energy and EE&C which include plans, rules, regulations, standards, guidelines and other relevant documents.

Table 2.11-1 Structure of Official Documents on Energy and EE&C

Policy & Program	Plan	Rule & Regulation	Standard, Guideline, etc.
Overall	Action Plan for EE&C (Power Division, MPEMR) Interim Action Plan for Improvement of Energy Efficiency & Conservation (2012-2016)	SREDA Act - Organization of SREDA - Roles and power of SREDA EE&C Rule Provision and application of: - Energy management program - EE Labeling Program - EE Building Program - EE&C finance - Energy tariff system	
Monitoring and review	EE&C Master Plan - EE&C Target - Roadmap - EE&C programs		Energy Monitoring Manual - Energy consumption data collection mechanism - Energy statistics
Government's own initiative on EE&C implementation	EE&C Action Plan for the governmental organizations - EE&C Target - Roadmap - EE&C programs		Green Purchase Guideline - Green products list - EE products list
Energy Management Program		Regulation on Energy Management Program - Designated large energy consumers - Certification of EM, CEA and ACEA - Periodical reporting - Benchmarking	ISO 50001; Energy management system Certification Guideline of EM,CEA and ACEA - Qualification - Examination Format of reports
EE Labeling Program		Regulation on EE Labeling Program - Label certification procedure - EE measurement method - Star rating criteria - Accreditation of laboratories - Price, penalty, etc.	BDSs - EE measurement method - Label design ISO, IEC - EE measurement method Label application form Mutual Recognition Agreement - Accreditation of laboratories

Policy & Program	Plan	Rule & Regulation	Standard, Guideline, etc.
EE Building Program		New Version of Bangladesh National Building Code (BNBC [Revised]) - EE&C requirement - Building permission	Format of Notification and Periodical Report EE&C Building Manual Green Building Guideline - EE&C requirement Green Building Assessment System
EE&C Finance Program		Taxation Circular - Provision of EE&C preferential taxation	EE Equipment/Appliance List (Technical Appraisal Standards)
EE&C education		Education Circular - Provision of EE&C education	EE&C Curriculum Guideline - Text Book Curriculum of schools, madrasas and colleges
Energy supply side and energy tariff	Power Supply Master Plan	Electricity Act - Electricity tariff Gas Act - Gas tariff Bangladesh Energy Regulatory Commission Act	Policy Guidelines for the Enhancement of Private Participation in the Power Sector 2008
Relating policies and programs	Bangladesh Climate Change Strategy and Action Plan 2009	Environment Conservation Rules (ECR) 1997 - Ozone protection - Pollution control Regulation on Consumer Products - Safety - Minimum performance	

2.11.6 Formulation of Committees and WGs (Summary)

SREDA should establish relevant committees and WGs for further discussion on development and implementation EE&C programs. Table 2.11-2 shows formation of committees and WGs.

Table 2.11-2 Formation of Committees and WGs

Program	Name of committee and WG	Member from	Discussion item/material
Energy Management Program	Energy Management Program Committee	- Academy -	- EE&C Rules - Regulation on Energy Management Program - Program implementation
	- Chemical fertilizer industry WG - Steel industry WG - Cement industry WG - Paper & pulp industry WG - Chemical industry WG - Glass industry WG - Ceramics industry WG - Textile & garment industry WG - Building WG	- Industrial association - Major companies - Energy experts - Academy -	- Benchmark targets - Technology requirement and MEPS on production equipment
	- Certification Committee	- Energy experts - Academy	Certification material for EM, CEA and ACEA
EE Labeling Program	EE Labeling Program Committee	- Academy - Consumers group - Laboratories - Accreditation bodies	- EE&C Rules - Regulation on EE Labeling Program - Program implementation
	- Lighting WG (Inc. ballast) - Refrigerator WG - AC WG - TV WG - Fan WG - Induction motor WG	- Industrial association - Major companies - Energy experts - Academy	- EE measurement method - Star rating criteria - MEPS
EE Building Program	EE Building Program WG	- Academy - Developers - Architects, designers - Energy experts	- BNBC [Revised] - GBG - Program implementation
EE&C Finance Program	Technical Standard Committee	- Manufacturers - Academy - Building developers	- Preparation and revision of EE equipment/appliance
EE&C education	EE&C Education Committee	- Academy - Ministry of Education - Educational Department	- EE&C awareness raising program

Chapter 3

Project Achievement

Chapter 3 Project Achievements

3.1 Project Achievements

Project achievements are summarized in Table 3.1-1.

Table 3.1-1 Project Achievements

Item	Project Achievement
Overall	- "EE&C Master Plan (Draft) was prepared by SREDA jointly with JICA Project Team. EE&C target and major EE&C programs were sorted and proposed. - Present situation of energy consumption by sector and industrial sub-sector was analyzed. - Stakeholders meetings (committees and WGs) have been started. - Initial introduction of EE&C Master Plan (Draft) to Bangladesh people has been carried out through seminars and other meetings. - Initial capacity development of SREDA's staffs was done through the Project.
Energy Management Program	- "Framework of Energy Management Program" was prepared. Actual procedure and criteria of the program were proposed. - Present situation of EE&C implementation was evaluated through energy audits on sites and experienced persons meeting.
Energy consumption data collection mechanism	- Proto type of periodical energy consumption data collection mechanism was developed.
EE Labeling Program	- "Framework of EE Labeling Program" was prepared. Actual procedure and criteria of the program were proposed. - Present situation of home appliance market was grasped. - Current BDS's problems were pointed. Recommendation for settlement was proposed. - Basic theory and information on S/L (Standard & Labeling) was shared by the stakeholders through the meetings.
EE Building Program	- Present situation of buildings EE&C implementation was grasped - Measures for enforcement of BNBC [Revised] were proposed. - Relation between BNBC [Revised] and GBG was confirmed.
EE&C Finance Program	- EE&C Finance Programs suitable for Bangladesh were proposed.
Capacity development and awareness raising	- SREDA's optimal organization structure was proposed. - EE&C awareness raising programs were proposed.
IT infrastructure	- SREDA's website was developed linking with the periodical energy consumption data collection mechanism.
Global warming countermeasures	- Global warming countermeasures linked with EE&C programs ware proposed.
Economic analysis on EE&C programs	- Methodology of economic analysis on EE&C programs was introduced, and monetary simulations of EE&C programs were done.
Other	- Simulation of electricity demand curves up to 2030 was carried out.

3.2 Project Schedule

Table 3.2-1 shows the schedule of the Project.

Table 3.2-1 Project Schedule

	2014												2015		
	Jan.	Feb.	Mar.	Apr.	May	June	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Reports	▽Inception report		▽Progress report						Interim report ▽	Draft final report ▽				Final report▽	
Committees		▼1st JCC ▼1st Seminar				▼2nd JCC			▼3rd JCC	2nd Seminar ▼	▼4th JCC		5th JCC▼ 3rd Seminar▼		
JICA Missions															
Local consultants															

Appendices

Appendix 1: Examples of EE&C Financial Incentives in Asian Countries

Appendix 2: SREDA & IDCOL Profiles

Appendix 3: SREDA Fund Management Institution (Terms and Reference Draft)

Appendix 4: EE&C Promotional Activities by International Donor Agencies

Appendix 5: Economic Analysis on EE Labeling Program

Appendix 6: Cost Effectiveness Analysis of Target EE&C Projects

Appendix 7: Cost Effectiveness Analysis of EE&C Programs

Appendix 8: Energy Consumption Forecast up to 2030

Appendix 1:
Examples of EE&C Financial Incentives in Asian Countries

Examples of EE&C Financial Incentives in Asian Countries

Country	Name	Types of incentives			Executing agency	Target sector			Eligible period	Sources of funds	Description
		Subsidies	Loans	Tax		Governmental	Industrial	Residential			
Japan	Eco-Point System for Green Home Appliances	X			METI (Ministry of Economy, Trade and Industry), MOC (Ministry of Internal Affairs and Communications), and MOE (Ministry of Environment)		X	X	2009 – 2011	Government budget	- Eco-points can be exchanged for coupons, prepaid cards, energy efficient products (e.g. LED bulbs) etc. - Target appliances: ACs (air conditioners), refrigerators, and TVs
	Low-interest Loans for EE Promotion		X		Japan Development Bank (former organization of DBJ)		X		1975 –	Government Budget (Oil & coal tax)	- Government owned policy-based financial institutions provide low interest loans for industrial sector EE equipment replacement, EE products manufacturing, EE buildings, ESCO projects, etc.
	Environmental Rating (ER)		X		DBJ (Development Bank of Japan)		X		2004 –	Own budget	- Providing special interest rate (low interest) - ER-certified borrowers can also apply for interest subsidy program provided by Ministry of Environment (MOE)
	Green Tax System for SMEs			X	METI and MLIT (Ministry of Land, Infrastructure, and Tourism)		X		2011 – 2014	--	- Tax reduction: 7% of purchase value of EE equipment - Special depreciation: 30% of purchase value, in addition to the normal depreciation for the equipment

Country	Name	Types of incentives			Executing agency	Target sector			Eligible period	Sources of funds	Description
		Subsidies	Loans	Tax		Governmental	Industrial	Residential			
China	Efficient lightbulb subsidy program	X			China Development and Reform Commission and MOF (Ministry of Finance)		X	X	2008 – 2014	N/A	- Subsidies will be provided from the government to energy efficient light bulbs (e.g. CFLs) manufacturers which are selected through tenders. - Manufacturers sell their customers with discount prices: 50% off from the market price for individual customers, and 30% off from the total procurement cost for business customers
	Subsidies for Efficient Household Appliances	X			China State Council			X	2012 – 2013	N/A	- Subsidize the purchase of a variety of low-consumption household electrical appliances (including flat-panel TVs, refrigerators, washing machines, and air conditioners), energy saving light bulbs and LEDs, vehicles with engines smaller than 1.6L, and highly-efficient electrical machinery. - Fund size: RMB 26.5 billion (USD 4.2 billion)
	Vehicle tax reduction for energy saving and new energy automobiles			X	MOF, Ministry of Science and Technology, and State Administration of Taxation		X	X	2012 –	--	- Tax reduction: Reduce 50% of vehicle tax for energy saving vehicles - Tax exemption: for new energy vehicles (electric cars, hybrid cars, etc.)

Country	Name	Types of incentives			Executing agency	Target sector			Eligible period	Sources of funds	Description
		Subsidies	Loans	Tax		Governmental	Industrial	Residential			
South Korea	Financial Incentives for Large Energy Consuming Companies	X		X	KEMCO (Korea Energy Management Corporation)		X		2007 –	Government budget	- Large energy consuming companies (over 2 ktoe / year) have to carry out mandatory energy audits every 5 years; in the case of small and medium sized enterprises (under 5 ktoe / year) up to 90 percent of the audit costs can be subsidized. - Tax credits covering up to 20 percent of the investment cost
	Carbon Cashbag (rebate program)	X			MOE and local governments			X	2008 – 2009	Both central and local government budget (50% - 50%)	- Rebate program for individuals whose points are stored on a “Carbon Cashbag card”. - Points can be used for discounts on public transportation, basic utilities charges, purchases of other appliances, or tickets to 10 cultural events. (The system covers 33 electronic goods.) - 1pt. = 3 KFW (0.25 cents USD)
	Article 25-2 of the Special Taxation Case Restriction Act			X	Tax Office and Ministry of Strategy and Finance		X	X	2013 –	--	- An amount equal to 10/100 of the relevant investment amount shall be deducted from the income tax or corporate tax for the relevant taxation year - Energy saving facilities specified by the order of the Ministry of Strategy and Finance

Country	Name	Types of incentives			Executing agency	Target sector			Eligible period	Sources of funds	Description
		Subsidies	Loans	Tax		Governmental	Industrial	Residential			
Singapore	Energy Efficiency Improvement Assistance Scheme (EASe)	X			NEA (National Environment Agency)		X		2005 –	Public fund: Sustainable Energy Fund (SEF)	- Manufacturing companies and building sectors that wish to receive energy assessment (energy audit) can apply for the program, which funds up to 50% of the cost of an energy audit and energy saving measure implemented by ESCOs. - Over a 5-yer period, the maximum amount of funding to any single facility or building is capped SGD 200,000.
	Grant for Energy Efficient Technologies (GREET)	X			NEA and Economic Development Board (EDB)		X		N/A (active)	Government budget	- To encourage owners and operators of new and existing industrial facilities to invest in energy efficient equipment or technologies. - Grant Quantum: Typical funding of up to 20% of the qualifying costs, capped at $4 million per project.
	SME Energy Efficiency Initiative	X			SEAS (Sustainable Energy Authority of Singapore)		X		2013 –	N/A	- Providing up to SGD 5,000 for supporting energy audit fee for companies which have less than 200 employees OR annual sales turnover of not more than SGD 100million.

Country	Name	Types of incentives			Executing agency	Target sector			Eligible period	Sources of funds	Description
		Subsidies	Loans	Tax		Governmental	Industrial	Residential			
	One-Year Accelerated Depreciation Allowance for Energy Efficient Equipment and Technology (ADAS)			X	NEA		X		Active	--	- The capital expenditure on the qualifying energy efficient or energy-saving equipment can be written off or depreciated in one year instead of three. - Any person carrying on a trade, profession or business in Singapore is eligible. - The applicant must own the equipment and use it for business purposes only. - Eligible equipment lists are provided.
Malaysia	GTFS (Green Technology Financing Scheme)		X		GreenTech Malaysia (technical) and Credit Guarantee Corporation (financial)		X		2010 –	Public Fund	- Loans for green technology (energy-saving, environmentally friendly equipment and technical services) suppliers and users to support their capital investments (at interest rates 2% lower than the market rate) - Government guarantee: up to 60% of the total loan amount
Thailand	Incandescent Phase-out Scheme	X			EGAT (Electricity Generating Authority in Thailand)			X	2007 – 2010	ENCON Fund (a public fund) and own budget	- Give away 800,000 CFLs to stimulate public recognition - Selling low-priced CFLs with 1-year warranty throughout the country in cooperation with suppliers participating in the program - Public campaign and market advertising

Country	Name	Types of incentives			Executing agency	Target sector			Eligible period	Sources of funds	Description
		Subsidies	Loans	Tax		Governmental	Industrial	Residential			
	Promoting the Use of New Thinner Tube-T5		X		EGAT		X	X	2009 – 2014	ENCON Fund	- To encourage companies to replace to T5 tube with no installment fee (0%) for 2 years (monthly installment).
	Energy Efficiency Revolving Fund (EERF)		X		DEDE (Department of Alternative Energy and Energy Development)		X		2003 – 2013	ENCON Fund (public fund from oil revenue)	- Soft loan (low-interest loan) program (blended with Bank's original loan) for capital investment (EE equipment installation costs)
Indonesia	Clean Technology Fund		X		Trust Fund Committee		X		2012 –	Donor fund (grants and loans from ADB, IBRD, and IFC)	- Concessional financing for public and private sector - To accelerate Indonesian initiatives to promote energy efficiency and renewable energy, and to help reach the objective of increasing electricity access from 65 percent of the population to 90% percent by 2020. - Fund size (2013): USD 5,470 million (Co-Financing: Geothermal 4,960 million + EE/RE 510 million) from ADB, IBRD, IFC, etc.
Vietnam	Energy Efficiency and Renewable Energy Project		X		MOF and VDB (Vietnam Development Bank)		X		2009 – 2012	ODA Loans from JICA (on-lending)	- Two-step loan program to facilitate EE&C capital investment. – PFIs conduct technical appraisals by eligible equipment list ("Energy Saving Equipment List" in India) - In India, now the third phase has been implemented.

Country	Name	Types of incentives			Executing agency	Target sector			Eligible period	Sources of funds	Description
		Subsidies	Loans	Tax		Governmental	Industrial	Residential			
India	SIDBI Financing Scheme for Energy Saving Projects in MSME Sector		X		MOF (sovereign guarantee) and SIDBI (Small Industries Development Bank of India)		X		2008 – ongoing	ODA loans from JICA	- Phase 1 (2008-2011): JPY 30 billion for more than 2700 EE projects, with average EE rate of 35.7% - Energy Saving Equipment List was prepared for screening EE projects - Phase 2 (2011-2013) and Phase 3 (ongoing) each allocated JPY 30 billion
	BESCOM Efficient Lighting Program (BELP)		X		BESCOM (local utility)		X	X	2004 (Ph.1) 2007 (Ph.2)	Donor fund (grants from WB) and own fund	- Phase 1 (demo-phase): Up to 300,000 lamps (CFLs and FTLs) with discount prices were distributed in Bangalore urban district - Phase 2: Targeted 2.6 million customers distributed by instalment sales, provided by 3 lighting suppliers (Philips, Osram, and Asian Electronics) with 1-year warranty.
Turkey	EE&C Retrofitting	X			MOE and Urbanization	X			Not imple-mented	ODA loans from JICA	- Budget allocation for retrofitting government buildings to become energy efficient ones. (Replacing to EE ACs, LED bulbs, etc.)

(Note: this is not an exhaustive list of all EE&C measures in Asia)

Appendix 2:
SREDA & IDCOL Profiles

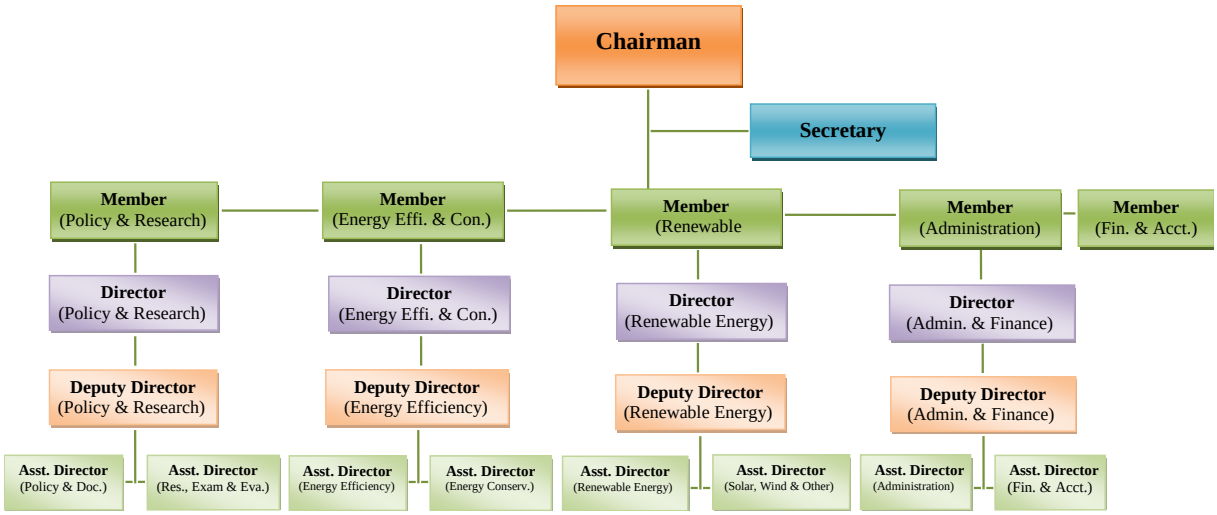
Appendix - 2

1. SREDA Organization Profile & Chart

Organization Profile

1. SREDA was established in May 2014 according to the SREDA ACT approved by the National Parliament in December 2012.
2. SREDA is a 100% government owned authority with a mandate to operate independently
3. SREDA is an affiliated body of MPEMR (Power Division) and will work under the administrative linkage of Power Division (PD)
4. SREDA will submit annual budget proposal to MOF for its administrative expenditures (surplus=unspent amount will be refunded to MOF annually)
5. According to SREDA ACT (Clause no. 19, Chapter 16), SREDA is granted with the authority to manage the SREDA fund.
6. Among the non-full-time Board of Directors, there are five representatives from major ministries including MOF
7. The executive directors, both full-time and non-full-time members, will be the Joint Secretary of the Government who will be appointed by the Ministry of Public Administration. Joint Secretary of the Government will be nominated by the respective ministries and SREDA will publish the Notification)
8. Upon an approval from the Government, SREDA can borrow from financial institutions with sovereign guarantees (i.e. MOF will provide credit guarantees to SREDA)
9. According to plan, the manpower of SREDA will be 61 excluding 11 non-full time members of the Board of Directors (5 from major ministries, 6 from the private sector) Research/EEC/RE/Admin departments will each consists of One Director, one Deputy Director and Two Assistant Director and several supporting staff and few persons in the Finance & Accounting Department (One Director and few assistants). So far, seven executives, including the chairman, have been assigned to SREDA.
10. The head office of SREDA will be located in Dhaka. In the long run, there is scope to open the branches in the major cities.

Organization Chart



2. IDCOL Corporate Profile & Organization Chart

Corporate Profile

IDCOL was established on 14th May 1997 by GOB. The largest shareholder is ERD which has 99% of the total share. The Company was licensed by the Bangladesh Bank as a non-bank financial institution (NBFI) on 5 January 1998. Since its inception, IDCOL is playing a major role in bridging the financing gap for developing medium to large-scale infrastructure and renewable energy projects in Bangladesh. The company now stands as the market leader in private sector energy and infrastructure financing in Bangladesh.

Corporate Profile of IDCOL

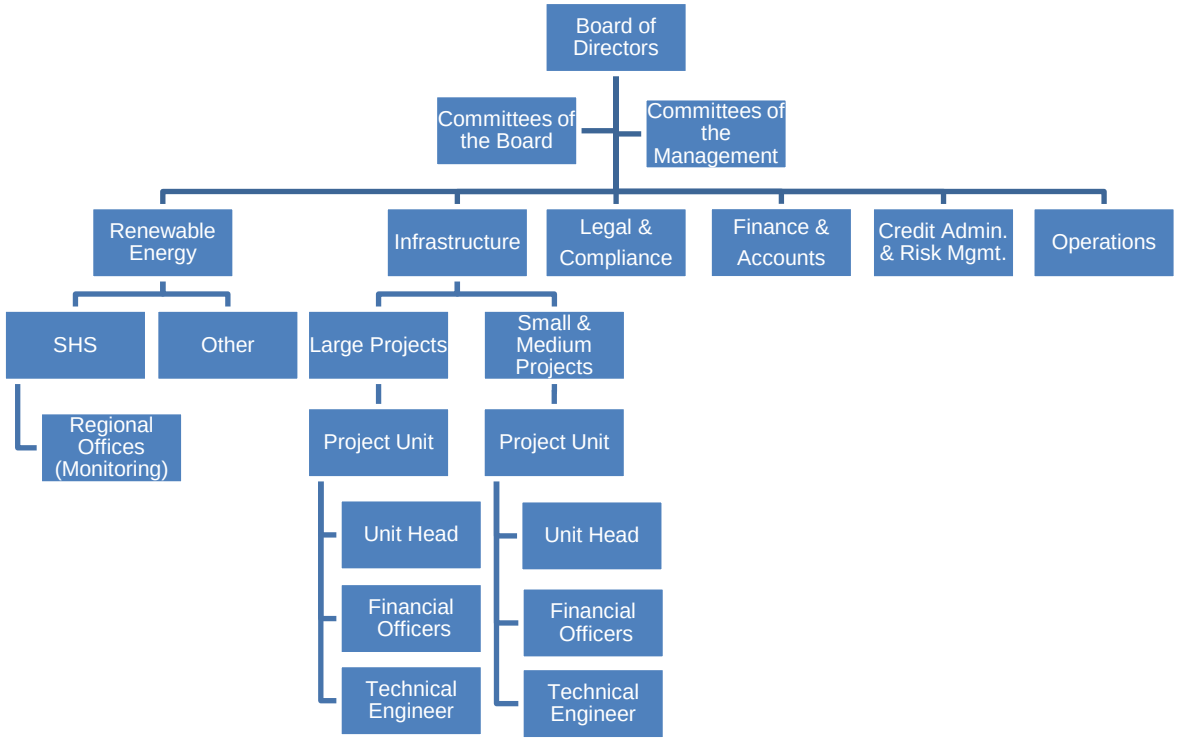
<table>
<tr><td>Legal Form</td><td>Companies Act 1994</td><td colspan="2">Milestones</td></tr>
<tr><td>Commencement of Business</td><td>14 May 1997</td><td>14 May 1997</td><td>Incorporation of the Company</td></tr>
<tr><td>Type of Financial Institution</td><td>NBFI
(Non-Bank Financial Institution)</td><td>5 Jan 1998</td><td>Licensing from Bangladesh Bank as NBFI</td></tr>
<tr><td>Equity</td><td>Shareholders' equity: BDT 4,106 million
Paid-up capital: BDT 2,600 million</td><td>16 Jul 2002</td><td>Signing of Project Agreement with IDA and Financing Agreement with GEF under Rural Electrification and Renewable Energy Development Project (REREDP)</td></tr>
<tr><td>Shareholders</td><td>ERD: 99.99%
Mr. Mohammad Mejbahuddin (Chairman, IDCOL): 0.002%
Others (individuals): 0.001%
Total: 100% (26,000,000)</td><td>1 Jan 2003</td><td>Commencement of Solar Home System Program (SHS)</td></tr>
<tr><td></td><td></td><td>5 Nov 2014</td><td>Celebration marking the installation of 3 million SHS by the Honorable Prime Minister</td></tr>
<tr><td colspan="2">Board of Management</td><td colspan="2">Registered Office, Branches, Employees, etc.</td></tr>
<tr><td colspan="2" rowspan="4">● 4 senior government officials: Secretary of ERD (Chairman), Senior Secretary of FD, General Secretary of Educational ministry, Secretary of Power Division (MPEMR)
● 2 prominent business personalities: Lawyer, Managing Director of private company
● 1 professional practitioner from the private sector
● 1 full-time Executive Director & CEO (Mr. Mr. Mahmood Malik): Joined IDCOL in 2012. Used to work at Standard Chartered Bank (SCB) as a Regional Head of Transaction Sales in Dubai, and head of Financial Institution of SCB in Bangladesh.</td><td>Registered Office</td><td>Dhaka, Bangladesh
(UTC Building, 16th Floor, 8 Panthapath, Kawran Bazar, Dhaka-1215, Bangladesh)</td></tr>
<tr><td>Branches</td><td>13 offices*
(Dhaka, Faridpur, Rangpur, Bahmanbaria, Sylhet, Chittagong, Barisal, Khulna, Borguna, Laxmipur, Mymensingh, Bogra)
*Monitoring office for RE programs only – no service for end-users provided</td></tr>
<tr><td>Number of Employees</td><td>260 (headquarter: 63)</td></tr>
<tr><td>Subsidiaries</td><td>None</td></tr>
</table>

Services
● **Areas of Projects:** Renewable Energy (RE), Infrastructure development, Energy Efficiency ● **Types of Services:** Project finance, corporate finance, debt and equity arrangement, grant & technical assistance, training & capacity building and advisory services

(Source: IDCOL Annual Report 2013-2014, interviews)

In IDCOL, there are 2 project departments and 4 common departments. Renewable Energy Department is mainly manages SHS Program and other RE projects, and Infrastructure Department are managing both large and medium-small infrastructure development projects[1] such as building power plants. In the Infrastructure Department, 4 members in one group, 1 unit head, 2 finance officers, and 1 technical engineer, conduct appraisals and monitoring of the projects. For Infrastructure Department, 10 – 30 projects are handled per year. For RE Department, standardized loan procedures make it possible to handle hundreds of projects per year, mostly under the SHS Program.

Organization Chart of IDCOL (not officially disclosed)



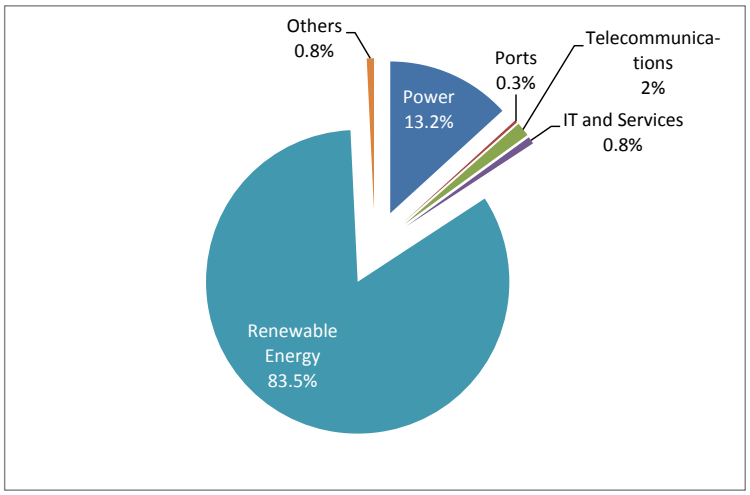
(Drawn based on Annual Report 2013 – 2014 and interviews)

[1] Large projects: a project whose cost will be 100 crore Taka (BDT 1 billion) and above

Target Business Sector

IDCOL provides financial supports for developing infrastructure (power plants, etc.), renewable energy and energy efficiency projects and programs. Major sector to provide loans is renewable energy, especially SHS Program.

IDCOL: Sector-wise Loan Portfolio (2013 – 2014)



(Data Source: IDCOL Annual Report 2013-2014)

Financial Conditions

IDCOL's financial condition is basically stable. IDCOL has adequate assets and funding resources to provide loans. According to the Financial Statement in 2013 – 2014, net profit after tax in the period was BDT1.54 billion, which is 40% more than the previous year (2012 – 2013). Total loan outstanding is increasing year by year but NPL ratio in the last 2 years are less than 1%, which is much lower than the average rate in Bangladesh (12.8%). The funding sources are mainly loans and grants from donor funds, which are government-guaranteed and very concessional lending conditions. The funding source of loans from donor funds are on-lend from MOF in BDT.

There are 2 other financial institutions whose business model is similar to IDCOL. One is BIFFL (Bangladesh Infrastructure Finance Fund Limited) and the other is BIFC (Bangladesh Industrial Finance Company Limited).

BIFFL is a new organization established in 2011. The board of management has approved four large and medium-sized infrastructure projects in 2013 but they have not yet ready for disbursement. BIFC started their business almost the same timing as IDCOL but their main business target is rather small: leasing and term loans for corporate houses and SMEs.

Even if these two organizations can provide financial support to infrastructure and industrial development as well as IDCOL, the table below shows that IDCOL is the best choice at the moment with the view of financially soundness and size of asset.

Comparison of Three NBFIs: IDCOL, BIFFL, and BIFC

(unit: BDT million)

	IDCOL (Established in 1997)			BIFFL (Established in 2011)			BIFC (Established in 1998)		
	2013 -2014	2012 -2013	2011 -2012	2013	2012	2011	2013	2012	2011
Main business	Project finance: renewable energy, infrastructure, energy efficiency			Project finance: infrastructure (PPP projects), renewable energy			Leasing and financing (term loans, SME finance, etc.): industrial sectors		
Capital	4,106	2,793	1,852	18,988	17,742	16,522	1,233	1,188	774
Total assets	48,843	37,240	24,427	21,249	19,030	16,908	9,608	8,732	7,622
Total loans	28,855	24,513	17,393	--	--	--	7,559	6,902	6,176
NPL	232.3	198.8	404.3	--	--	--	775.0	842.8	392.5
NPL provisions	215.4	162.8	180.5	--	--	--	249.2	247.6	138.4
Net profit after tax	1,453	1,035	626	1,246	1,220	522	46	10	15
EPS (BDT)	55.87	60.21	52.16	7.97	7.62	3.26	0.71	0.15	0.25
DER (times)	10.17	11.33	11.24	--	--	--	6.13	5.80	7.98
CAR (%)	8.4%	7.44%	7.58%	89.3%	93.2%	97.7%	12.8%	13.6%	10.2%
NPL ratio (%)	0.80%	0.81%	2.32%	--	--	--	10.3%	12.2%	6.4%
NPL provisions ratio (%)	92.7%	81.9%	44.6%	--	--	--	32.2%	29.4%	35.3%
Loan/Assets (%)	59.08%	65.82%	71.20%	--	--	--	78.7%	79.0%	81.0%
ROA (%)	2.97%	2.78%	2.56%	6%	6.41%	3.09%	0.48%	0.11%	0.20%
ROE (%)	35.38%	37.07%	33.80%	6.71%	6.87%	3.16%	3.73%	0.84%	1.94%
Shareholders	・ Government: 99.99% (ERD) ・ Private (companies and individuals): 0.01% (mainly Board of Directors)			・ 100% government owned company (Ministry of Finance: 99%)			・ Local (50%) / Foreign (50%) ・ Shareholders are private companies and individuals ・ Top shareholder is Five Continents Credit Ltd., Hong Kong (19.39%)		
Chairman	Mr. Mohammad Mejbahuddin (Secretary of ERD)			Mr. Abul Maal A Muhith (Honorable Minister, MOF)			Ms. Umme Kulsum Mannan (Representing Pioneer Dresses Ltd.)		
Number of Employees	260 (headquarter: 63)			N/A			62		
Branches	13 (Monitoring only)			0			3		
Principal source of fund	Donor grants and loans			Interest revenue from FDR and SND accounts (100%)			Borrowing from commercial banks (credit lines)		

-- : no data

(All data is collected from Annual Reports of each organization.)

The findings from the table above are as follows:

- **Financial Statements of BIFFL**: No data regarding loans has been on the financial statements since establishment because BIFFL has not started financial services yet. BIFFL has made agreement with IDCOL to receive capacity building for credit appraisals. Also, GOB signed the agreement with ADB to provide technical assistance to BIFFL for fund management support. Under the situation, their present income comes only from interest revenue deposited in other commercial banks.
- **Size of assets and loans**: IDCOL has the largest assets and loans among three organizations. BIFC is the smallest assets and loans, about 1/5 of the size of IDCOL's.
- **Earnings per share (EPS)**: All of three organizations have profit. Especially, IDCOL earns good deals of profit from their business now.
- **Capital Adequacy Ratio (CAR)**: Bangladesh Bank (BB) instructs that all banks and NBFIs in Bangladesh are targeted to set CAR 10% and above according to the BASEL II/III. However, IDCOL cannot reach the target. CAR of BIFFL is almost 100% because capital equity is their only assets and there is no liability with them now.
- **Non-Performing Loan (NPL)**: Although the loan outstanding is increasing, NPL ratio of IDCOL keeps less than 1% in the last 2 years. As for BIFC, the NPL ratio is lower than the average of banking sector in Bangladesh (12.8%) but NPL provisions are as low as around 30%, which is not enough to cover the whole amount of classified loans.
- **Return on Assets (ROA)**: For ROE, all of three organizations are above the average of banking sector in Bangladesh (0.61%), but it is still low. Among three organizations, BIFFL is the highest rate but their income is only from deposit earnings.
- **Return on Equity (ROE)**: Among three organizations, ROE of IDCOL is much higher than other two organizations. For BIFFL and BIFC, their ROE do not reach the average of banking sector in Bangladesh (8.21%). Especially for BIFC, since the main funding source is inter-bank loan, it may have a risk of reducing the liquidity if the profit is compressed as the inter-bank lending rate rises. As a result, IDCOL is high ROA and ROE, which means their business is profitable and efficient.
- **Shareholders**: IDCOL and BIFFL are government-owned organizations which mean that they may be able to receive sovereign loan directly from donor fund with government guarantee. BIFC is a private financial institution whose major shareholder is Hong-Kong-based finance company (19.39%).
- **Number of employees**: The number of IDCOL (260 employees) is including technical inspectors in 13 regional offices.
- **Branches**: IDCOL has 13 monitoring offices nationwide. BFIC has only 3 branches (Chittagong, Uttara, Narayanganj). BIFFL does not have any branch at present.

Appendix 3:
SREDA Fund Management Institution
(Terms and Reference Draft)

Appendix - 3

SREDA FUND MANAGEMENT INSTITUTION
(TERMS OF REFERENCE DRAFT)

A qualified financial institution will be appointed as the SREDA FUND MANAGEMENT INSTITUTION (SFMI) to manage concessional loans to be provided to the Sustainable and Renewable Energy Development Authority (SREDA) by the Japan International Cooperation Agency (JICA) for the execution of the JICA Energy Efficiency Policy Promotion Program (hereinafter referred to as "this Program").

Where

1. JICA loans will be credited to the Sustainable and Renewable Energy Development Authority Fund (SREDA FUND) defined according to SREDA ACT (Clause 2, Section 19, Chapter 6), and stored in the special account earmarked solely for this Program.

2. SFMI shall meet the following qualifications:
   a) SFMI shall be a licensed financial institution, either a scheduled bank or non-bank financial institution (NBFI), approved by the Bangladesh Bank, according to SREDA ACT (Clause 3, Section 19, Chapter 6)
   b) SFMI shall have a sound financial track record at least for the past three consecutive fiscal years, with non-performing loan ratio below 10% and capital adequacy ratio above 12%.

3. SFMI shall meet the following responsibilities with an exemption Clause:
   a) To manage JICA loans credited to the special account earmarked for the Program under the SREDA FUND by disbursing loans to and collecting repayments (both principals and interests) from the borrowers under the Flagship Program (Phase 1) of this Program.
   b) To manage revolving loan fund account (i.e. a pool of principal repayments) and interest earnings account (i.e. a pool of interest earnings, net of management fees) under the EE&C Policy Promotion Program (Phase 2) of this Program
   c) To ensure debt collection through regular monitoring of borrowers, and may reschedule and restructure loans after a well-defined loan re-assessment procedure, with the approval of SREDA (Financial Management Committee).
   d) To support SREDA with the selection of flagship projects by providing opinions at technical screening stage.
   e) To ensure financial viability of flagship projects by conducting financial screening
   f) To monitor and compile EE&C effects of flagship projects for reporting to SREDA
   g) SFMI will be exempted from the above mentioned responsibilities in case when any flagship project goes bankrupt due to force majeure or a project is no longer viable due to unanticipated changes in market condition.

4. SFMI shall be granted the following authorities:
   a) SFMI will be appointed as the signatory to the special account earmarked for this Program, and therewith have the right to sign sub-loan agreement with end users as well as withdraw funds upon receipt of the request from borrowers within 10 business days.
   b) Financial decision made by SFMI shall not be disregarded by SREDA (Financial Management Committee), provided that SREDA (Program Steering Committee) gives their approval at technical screening stage.
   c) SFMI will have the right to change lending conditions only if it is considered unavoidable to ensure collection of principals and interests, with the consent of SREDA (Financial Management Committee).

5. Loan approval procedures shall be as below:
   a) SREDA Program Steering Committee will approve a list of flagship projects based on technical appraisals conducted by SREDA officials with the support of outsourced expertise.
   b) SFMI will give final approvals of each flagship project based on financial appraisals

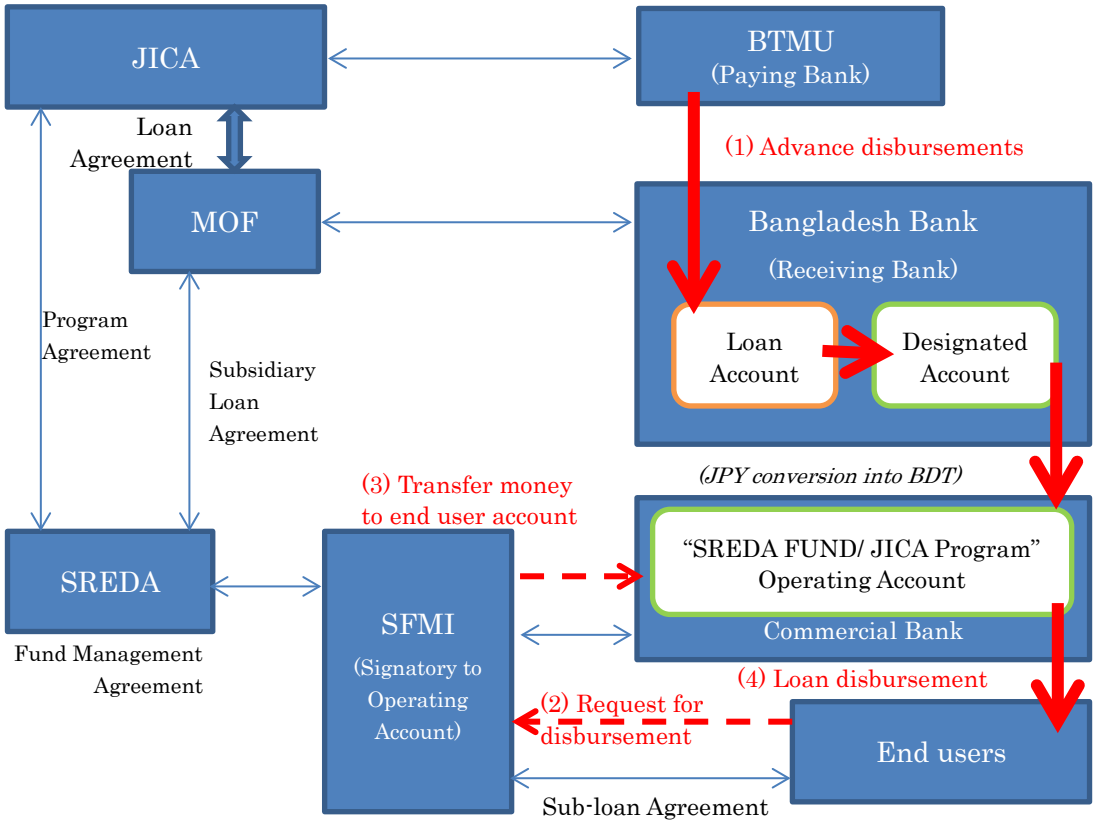
6. Loan disbursement procedures will be as below: (see chart "Loan Disbursement Procedures")
   a) JICA, according to the Loan Agreement signed between JICA and the Bangladesh Ministry of Finance (MOF), will make advance disbursements based on six-months financial forecast to a loan account, a non-resident yen account (hereinafter referred to as "Loan Account"), opened and maintained in yen at the Bangladesh Bank (BB) with the Bank of Tokyo Mitsubishi (BTM) (hereinafter referred to as "Paying Bank").
   b) MOF will transfer the disbursed amount from Loan Account to a designated account opened and maintained in yen at BB from which all eligible expenditures will be made (hereinafter referred to as "Designated Account) for SREDA-JICA Energy Efficiency Policy Promotion Program.
   c) MOF, after converting Japanese yen into Bangladesh taka, will transfer disbursed amount from Designated Account to a special account opened and maintained in taka by SREDA FUND at a commercial bank (hereinafter referred to as "Program Operating Account") according to the Subsidiary Loan Agreement signed between MOF and SREDA.
   d) Borrower (project owner) will request SFMI for loan disbursements according to a sub-loan agreement with SFMI
   e) SFMI will withdraw money from the Operating Account and transfer it to the bank account of the borrower.
   f) SFMI will report to SREDA every three months regarding the amount of funds utilized and the next six-month loan disbursement projections.
   g) MOF, upon request from SREDA, will request advance disbursement in yen to JICA every three months based on six-month financial forecast submitted with sufficient details to enable JICA to verify the reliability of the forecast.

h) JICA shall make disbursement in yen within 15 business day from the date of receipt of the request by paying into the Loan Account.

7. Remuneration (all-inclusive annual fees) for SFMI will be 0.5-1% per year of the loans outstanding at the end of the previous fiscal year.

8. Contracting parties include the following:
   a) The Japan International Cooperation Agency (JICA),
   b) The Sustainable and Renewable Energy Development Authority (SREDA) and
   c) The Infrastructure Development Corporation Limited (IDCOL).

JICA loan disbursement procedures



Appendix 4:
EE&C Promotional Activities by International Donor Agencies

EE&C Promotional Activities by International Donor Agencies

Donor	Project Name	Types of Support	Description	Implementing Agency / Target Sector	Total Investment	Energy Saving Volume and CO_2 Reduction	Project Period
ADB	Bangladesh Industrial Energy Efficiency Finance Program (BIEEFP)	Loan and TA	<u>Loan:</u> - Extended a non-sovereign loan facility and technical assistance to the IIDFC and other financial institutions for on-lending to eligible/ bankable energy efficiency projects. <u>TA:</u> - Conducted energy audits of 120 industrial facilities, about 20 in each sector, and created bankable energy efficiency reports and recommendations that can form the basis of a business model acceptable to financial institutions.	Target sector: High EE&C potential sectors: 1. Textiles (including garments and leather) 2. Steel 3. Cement clinker 4. Ceramics & glass 5. Chemicals (including fertilizer and pulp and paper) 6. Agro-industries (including food processing, sugar, and jute industries)	<u>Loans:</u> USD 30 million (IIDFC: USD 6 million, Prime Bank: USD 24 million) <u>TA:</u> USD 1.5 million	(Expected output) - Industries are expected to reduce their gas, coal, and power consumption by at least 20% per unit of production - Contributing energy savings equipment at least 350 GWh by 2015 - Reduction in carbon emissions: 300,000 - 600,000 by 2015	2011 - 2013
GIZ	Sustainable Energy for Development (SED) Program	TA	- Draw up rules for SREDA and Energy Conservation Act - Work with BSTI to set and certify compliance with EE&C	MPEMR (SREDA) and BSTI	N/A	N/A	2008 - 2020
	Renewable Energy and Energy Efficiency Programme	Grant and TA	- The program supports the use of energy-saving appliances and production process, such as solar energy systems and biogas plants. GIZ is advising the MPEMR on ways to improve the legal and institutional framework for the energy sector. - Supporting SHS program conducted by IDCOL. - This program also works with other organizations such as UK Department for International Department (DFID), USAID, ADB, UNDP, and World Bank.	MPEMR (SREDA) and NGOs	N/A	(Achievement in 2010) - Energy-efficient stoves use 30 - 50% less fuel compared to traditional stoves. - An improved system for parboiling rice system enable people to reduce rice husk more than 50%	2007 - 2011

Donor	Project Name	Types of Support	Description	Implementing Agency / Target Sector	Total Investment	Energy Saving Volume and CO_2 Reduction	Project Period
UNDP (with GEF)	Improving Kiln Efficiency in Brick Making Industry	Grant	- To replace old kilns to new ones by the year 2011. New kiln was installed Hybrid Hoffman Kiln (HHK) coming from Germany. Since the specification of HHK was too high for Bangladesh, kiln was customized in China and installed to Bangladesh to meet their needs - There are 15 projects going on and CO_2 is regarded to reduce half as present situation when the project is completed.	Implementing Agency: Department of Environment Target Sector: Brick Industry	USD 4,090,000 (GEF: USD 3 million, UNDP: USD 1 million, Other donors and funds: USD 90,000)	(Achievement as of December 2012: installed 5 HHKs) - 6 kilotons of coal usage - 16 kilotons of CO_2 emission	2005 - March 2015
	BRESL (Barrier Removal to the Cost Effective Development and Implementation of Energy Standards and Labelling)	TA	- This project aims at rapidly accelerating the adoption and implementation of energy standards and labelling throughout Asia. - Target products: Room A/Cs, refrigerators, electric fans, electric motors, ballasts for fluorescent tubes, and CFLs	BSTI	USD 7 million for 6 countries (USD 1 million for Bangladesh)	N/A (The volume will be figured out when the testing facility is ready in Bangladesh.)	2010 - June 2015
USAID	CCEB (Catalyzing Clean Energy in Bangladesh) (Task3: Industrial Energy Efficiency Analysis and Adoption)	Grant and TA	<u>Grants:</u> - A maximum of 30% total project cost will be available to private sector SMEs. Grants will leverage private sector investment (cost-share), amounting to no less than 70% of the total cost, and may be in the form of provision of engineering services or procurement equipment. This program aims to support at least 40 EE project transactions facilitated to achieve EE&C. <u>TA:</u> - Capacity Building: Supporting long-term sustainability and replication of industrial energy efficiency measures by strengthening private and public sector capacity building for	Target: Private sector SMEs (textiles, frozen-food, steel rerolling, and jute)	<u>Grant:</u> USD 2 million <u>TA:</u> USD 13 million	(Task 3: Estimation) Investment: BDT 197.24 million (implementation of EEMs) - Result of energy savings (textiles): 281,603 GJ worth BDT 65.7 million - Total annual reduction of Carbon emission: 17,575 tones	2013 - 2017

Donor	Project Name	Types of Support	Description	Implementing Agency / Target Sector	Total Investment	Energy Saving Volume and CO_2 Reduction	Project Period
			energy efficiency projects. The project provides energy audit and consulting services. - Energy Audit: Conducted walk-through energy audits for 29 textile plants to find energy conservation measures in the plants.				
World Bank	ELIB (Efficient Lightning Initiative of Bangladesh)	Grant	- Since phase 1, there are approximately 30 million energy efficient CFLs which are replaced from incandescent lamps at household sector. It is said that nearly 30MW of power and a huge amount of money were saved as a result of phase 1. - Phase 2 is under discussion.	Power Division (MPEMR), REB, GIZ and IDCOL	USD 15 million	(Achievement in Phase 1: Distributed 10.5 million CFLs) - saved 154MW power - purchased over EUR 6.5 million for purchasing carbon credits for a period of 3 years (2011-2013)	2010

Appendix 5:
Economic Analysis on EE Labeling Program

Appendix - 5

Economic Analysis on EE Labeling Program

1. Scope, Objective and EE&C Target

1.1 Scope

- Electric home appliances in this research includes lightings, refrigerators, TVs, ACs and fans which consist the majority share of the residential sector electricity consumption.
- Simulation will be carried out for the period between 2015 and 2030. Initial data in 2015 is the estimation based on 2014 data.

1.2 Objective and EE&C Target

- To estimate the stock and electricity consumption of major household appliances
- To conduct cost-benefit analysis of the EE Labeling Program by firstly fixing the BAU case, and secondly estimating the EE&C case
- The target of the EE&C case is to cut electricity consumption by 28% in 2030 compared with that of the BAU case.

2. Calculation Method

i. Assume two typical types, namely, old-type (non-energy efficient) and EE (energy efficient) type

ii. Estimate the current stocks of the five target electric appliances, both old-type and EE type.

iii. Estimate the annual sales of the two types of the five appliances based on the current sales amount and by assuming the growth rates in Table 2-1.

Table 2-1 Sales Growth Rate

	For replacement	For new purchase
Lightings	6.0%	6.0%
Refrigerators	6.0%	6.0%
TVs	35.0%	35.0%
ACs	20.0%	20.0%
Fans	6.5%	6.5%

iv. Replacement purchases include those of a) old-type to old-type, b) old-type to EE-type and c) EE-type to EE-type. The rest is the new purchase, which can be separated into the purchase of a) old-type and b) EE-type appliances.

v. The share of sales of EE type appliances in the total sales are assumed as shown in Table 2-2.

Table 2-2 EE Type Sales Share

	BAU case	EE&C case final
Lightings	5%	80%
Refrigerators	5%	80%
TVs	30%	80%
ACs	5%	80%
Fans	5%	80%

The EE type share in EE&C case will increase gradually from 2015 to 2020 and maintain the same share thereafter up to 2030.

vi. Electricity consumption of EE-type appliances can be calculated by multiplying EE rates by the electricity consumption amount of the old-type appliances. EE rates are assumed as shown in Table 2-3.

Table 2-3 Electricity Consumption (kWh/year/set) and EE Rate (EE/Old)

	Old type	EE type	EE Rate
Lightings	47	28	-40%
Refrigerators	471	236	-50%
TVs	150	75	-50%
ACs	2,160	1,080	-50%
Fans	145	109	-25%

vii. Annual electricity consumption of each appliance is calculated by the following equation:
[Number of stocks × annual electricity consumption (kWh/year)]
In order to calculate the annual economic benefits of reduced electricity consumptions, the following equation will be used:
[Annual electricity consumption (kWh/year) of the BAU case – that of the EE&C case].

viii. Price gaps between old-type and EE-type appliances are fixed as shown in Table 2-4.

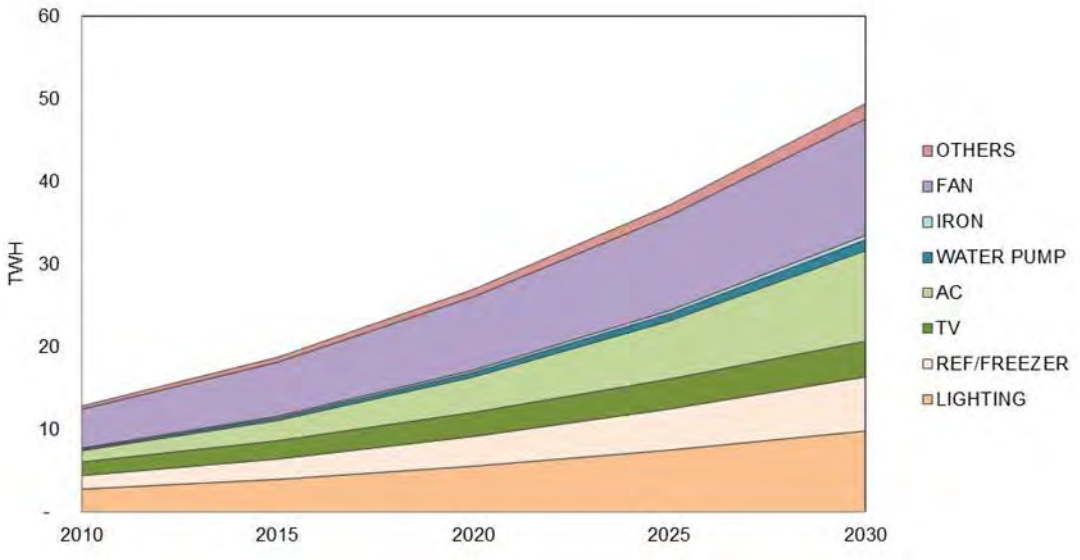
Table 2-4 Price (BDT/set) and Price Gap Rate (EE/Old)

BDT/set	Old type (2015-30)	EE type (2015)	EE type (2030)	Price gap (2015)	Price gap (2030)
Lightings	300	900	600	200%	100%
Refrigerators	28,000	56,000	42,000	100%	50%
TVs	10,000	20,000	15,000	100%	50%
ACs	60,000	90,000	78,000	50%	30%
Fans	2,700	3,375	3,105	25%	15%

Price gaps are reduced by half gradually in the fifteen years between 2015 and 2030.

ix. Calculate the net economic benefits of purchasing EE-type products based on the comparison of price differences between the BAU- and EE-type appliances by utilizing the equation below:
[Amount of electricity reduced (kWh/year)×electricity tariff – administration costs – price gaps between old- and EE-type appliances]
Administration cost for the EE labeling program includes the introduction costs of BDT 75 million in 2015 and the running costs of BDT 15 million/year for the rest of the years.

x. Firstly, BAU case model is made, adjusting parameters to fit the result of electricity consumption in 2015 and 2020, given by "Modeled Residential Electricity Consumption by End Use 2010-2030" which was conducted by NewVision Solution Ltd. under the Project. (See Figure 2-1)



Source: "Market Research on Equipment and Appliances" NewVision Solution Ltd., 2014

Figure 2-1 Modeled Residential Electricity Consumption by End Use 2010-2030

3. Lighting

3.1 Old/EE types

Various types of lamps including incandescent lamps, CFLs, linear (tube) FLs are used in residences. LED has already appeared in the market. The following are the kinds of lamps representing the old- and EE-type appliances to simplify the calculation.

Old-type: a mix of incandescent lamp, CFLs and FLs

EE-type: a mix of LED and high efficiency FL

3.2 Calculation condition

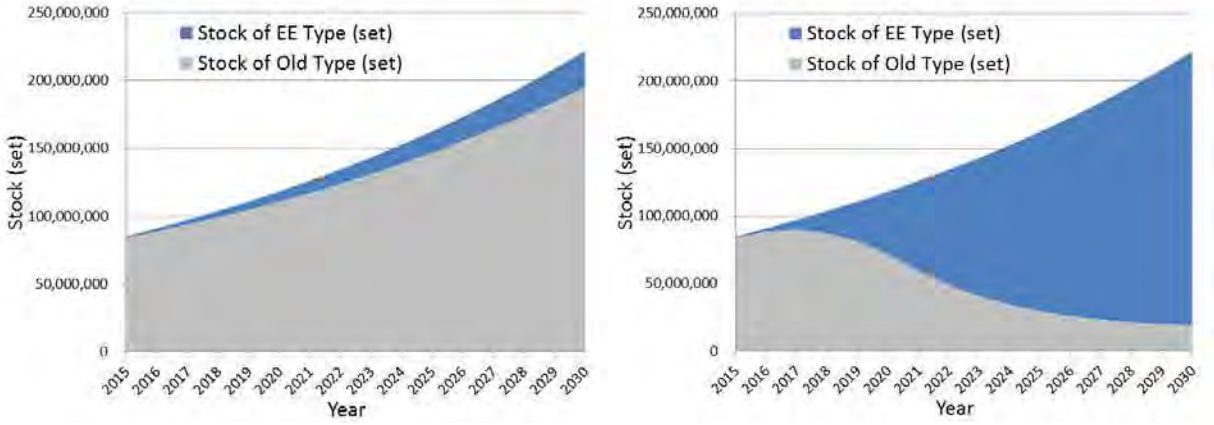
Calculation condition and parameters are shown in Table 3-1.

Table 3-1 Calculation Condition (Lighting)

Lighting		
Stock (2015)	Old type	84,000,000 set
	EE type	1,000,000 set
Annual sales (2015)	Annual sales	23,500,000 set/year
	Rate of replace	75%
Sales Growth	Replace	6.0%
	Newly buy	6.0%
EE type sales share	BAU case	2015-2030: 5%
	EE&C case	2015-2020: 5% to 80% 2021-2030: 80%
Annual electricity consumption	Old type	47 kWh/year
EE Ratio	Old type - EE type	-40%
Price	Old type	300 BDT/ set
	Price Gap Rate Old type – EE type	2015-2030: +200% to +100%

3.3 Trends in the stock of old- and EE-type appliances

Trends in the stock of old- and EE-type appliances are calculated in BAU and EE&C cases, as shown in Figure 3-1.



A: BAU Case B: EE&C Case

Figure 3-1 Stock by Type of Appliance (old/EE) (Lighting)

4. Refrigerator

4.1 Old/EE types

In order to simplify the calculation, the following are assumed to represent the old- and EE-type appliances.

Old type: 200 litter, 2 doors type (5 years old)

EE type: 200 litter, 2 doors type (inverter, high performance heat insulation)

4.2 Calculation condition

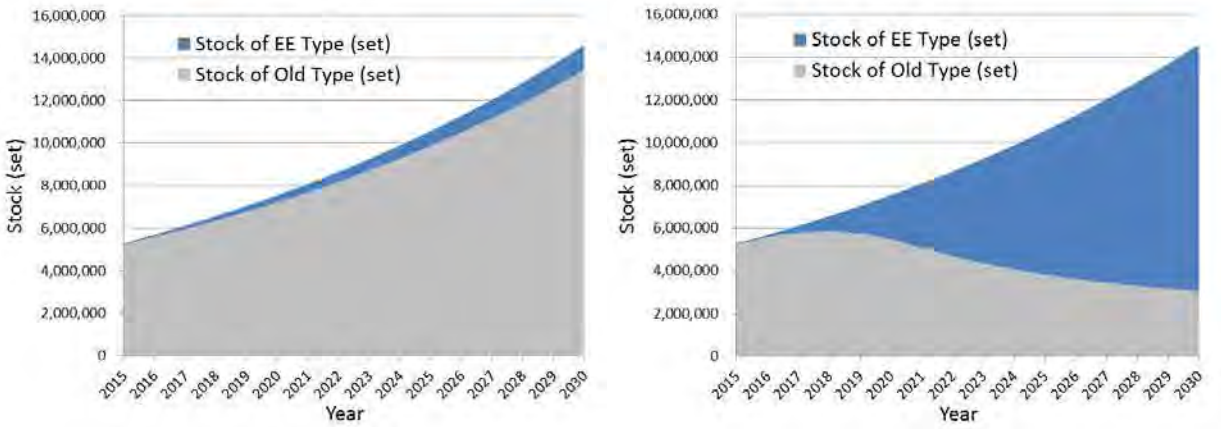
Calculation condition and parameters are shown in Table 4-1.

Table 4-1 Calculation Condition (Refrigerator)

Refrigerator		
Stock (2015)	Old type	5,237,923 set
	EE type	50,000 set
Annual sales (2015)	Annual sales	1,000,000 set/year
	Rate of replace	60%
Sales Growth	Replace	6.0%
	Newly buy	6.0%
EE type sales share	BAU case	5%
	EE&C case	2015-2020: 5% to 80% 2021-2030: 80%
Annual electricity consumption	Old type	471 kWh/year
EE Ratio	Old type - EE type	-50%
Price	Old type	28,000 BDT/ set
	Price Gap Rate Old type – EE type	2015-2030: +100% to +50%

4.3 Trend in the stock of old- and EE-type appliances

Trends in the stock of old- and EE-type appliances are calculated in BAU and EE&C cases as shown in Figure 4-1.



A: BAU Case B: EE&C Case

Figure 4-1 Stock by Type of Appliance (old/EE) (Refrigerator)

5. TV

5.1 Old/EE types

In order to simplify the calculation, the following are assumed to represent the old-and EE-type appliances.

Old type: 20 inch, CRT

EE type: 20inch, LCD with LED back light

5.2 Calculation condition

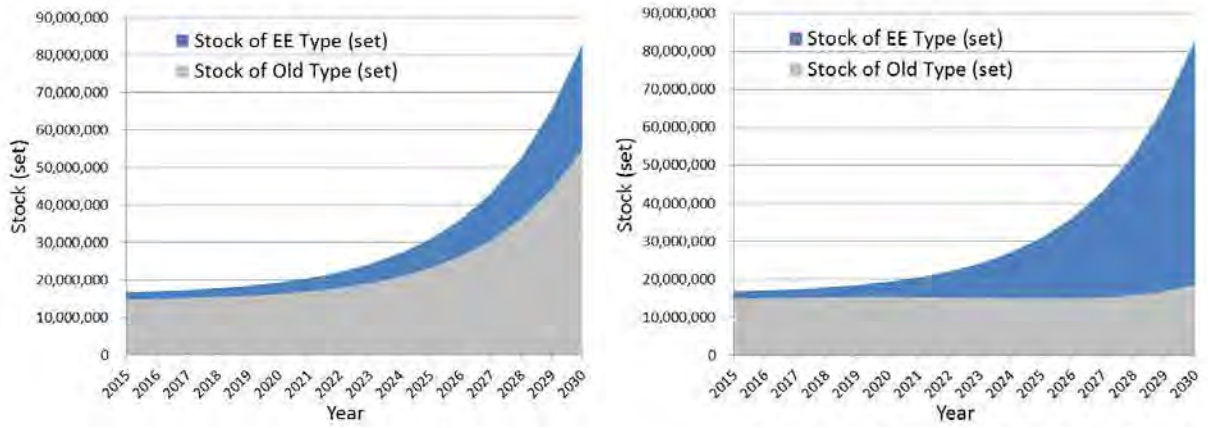
Calculation condition and parameters are shown in Table 5-1.

Table 5-1 Calculation Condition (TV)

TV		
Stock (2015)	Old type	14,802,474 set
	EE type	2,000,000 set
Annual sales (2015)	Annual sales	370,000 set/year
	Rate of replace	30%
Sales Growth	Replace	35%
	Newly buy	35%
EE type sales share	BAU case	30%
	EE&C case	2015-2020: 5% to 80% 2021-2030: 80%
Annual electricity consumption	Old type	150 kWh/year
EE Ratio	Old type - EE type	-50%
Price	Old type	10,000 BDT/ set
	Price Gap Rate Old type – EE type	2015-2030: +100% to +50%

5.3 Trends in the stock of old- and EE-type appliances

Trends in the stock of old- and EE-type appliances in both BAU and EE&C cases are calculated as shown in Figure 5-1.



A: BAU Case B: EE&C Case

Figure 5-1 Stock by Type of Appliance (old/EE) (TV)

6. AC

6.1 Old/EE types

In order to simplify the calculation, the following are assumed to represent the old-and EE-type appliances.

Old type: split type, 1.0 ton, COP 2.5

EE type: split type, 1.0 ton, inverter type, CSPF 5.0

6.2 Calculation condition

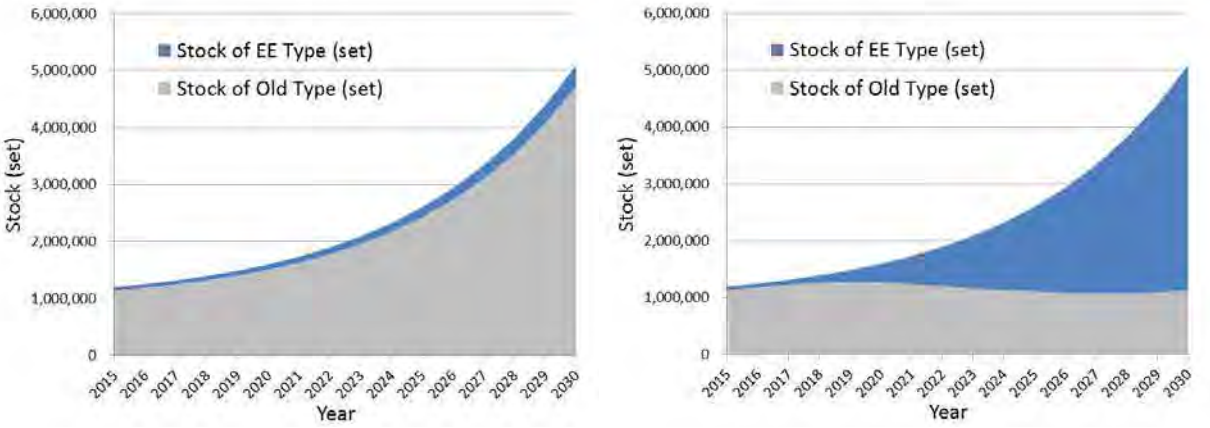
Calculation condition and parameters are shown in Table 6-1.

Table 6-1 Calculation Condition (AC)

AC		
Stock (2015)	Old type	1,135,672 set
	EE type	60,000 set
Annual sales (2015)	Annual sales	90,000 set/year
	Rate of replace	40%
Sales Growth	Replace	20%
	Newly buy	20%
EE type sales share	BAU case	5%
	EE&C case	2015-2020: 5% to 80% 2021-2030: 80%
Annual electricity consumption	Old type	2,160 kWh/year
EE Ratio	Old type - EE type	-50%
Price	Old type	60,000 BDT/ set
	Price Gap Rate Old type – EE type	2015-2030: +50% to +30%

6.3 Trends in the stock of old- and EE-type appliances

Trends in the stock of old-and EE-type appliances in both BAU and EE&C cases are calculated as shown in Figure 6-1.



A: BAU Case B: EE&C Case

Figure 6-1 Stock by Type of Appliance (old/EE) (TV)

7. Fan

7.1 Old/EE types

In order to simplify the calculation, the following are assumed to represent the old- and EE-type appliances.

Old type: 56 inch dia., with low efficient motor

EE type: 56 inch dia., with high efficient motor

7.2 Calculation condition

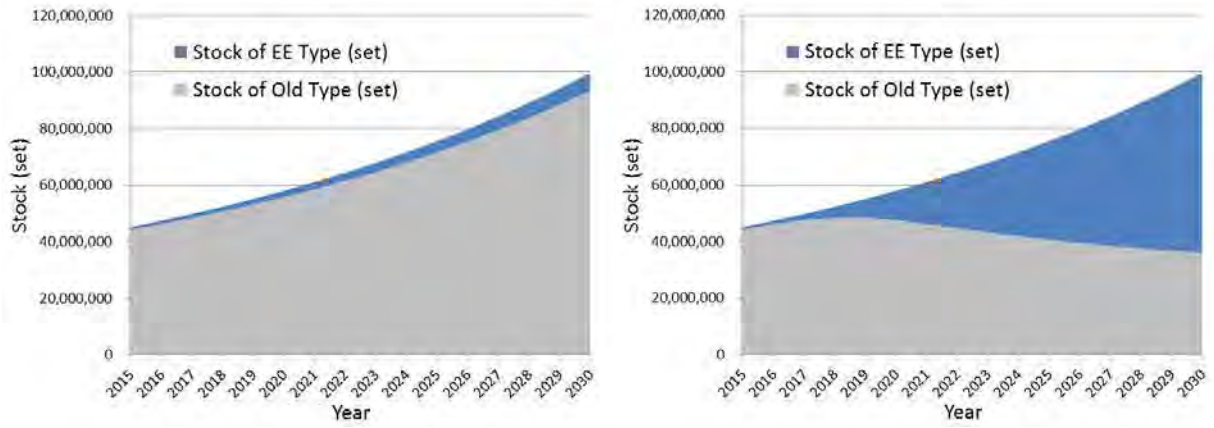
Calculation condition and parameters are shown in Table 7-1.

Table 7-1 Calculation Condition (Fan)

Fan		
Stock (2015)	Old type	44,154,000 set
	EE type	1,000,000 set
Annual sales (2015)	Annual sales	4,500,000 set/year
	Rate of replace	50%
Sales Growth	Replace	6.5%
	Newly buy	6.5%
EE type sales share	BAU case	5%
	EE&C case	2015-2020: 5% to 80% 2021-2030: 80%
Annual electricity consumption	Old type	145 kWh/year
EE Ratio	Old type - EE type	-25%
Price	Old type	2,700 BDT/ set
	Price Gap Rate Old type – EE type	2015-2030: +25% to +15%

7.3 Trends in the stock of old- and EE-type appliances

Trends in the stock of old- and EE-type appliances in both BAU and EE&C cases are calculated as shown in Figure 7-1.

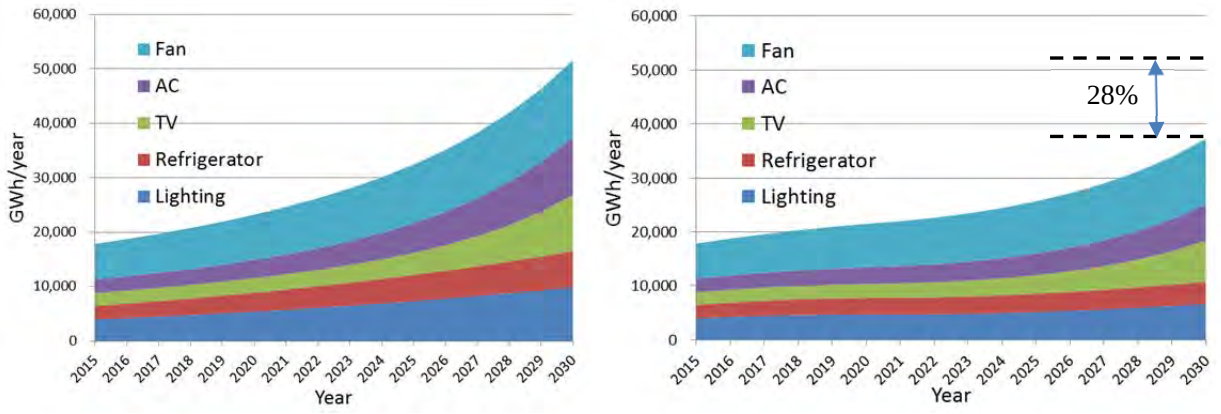


A: BAU Case B: EE&C Case

Figure 7-1 Stock by Type of Appliance (old/EE) (Fan)

8. Electricity Consumption

Comparison of annual electricity consumption by appliance for the BAU case (left hand side) and the EE&C case (on the right hand side) is shown in Figure 8-1. In the EE&C case, 28% reductions in the total electricity consumption will be achieved in 2030. Table 8-1 shows the EE&C achievement (or the rate of electricity reduction compared with the BAU case) by year.



A: BAU Case B: EE&C Case

Figure 8-1 Annual Electricity Consumption by Appliance

Table 8-1 EE&C Achievement by Year

Year	2015	2020	2025	2030
Rate of electricity reduction compared with the BAU Case	0.0%	-7.5%	-21%	-28%

9. Net Economic Benefits

Economic benefits depend on the levels of electricity tariff. Table 9-1 and Figure 9-1 shows the changes in the net economic benefits by tariff. Tariffs are set at the rates 1.0, 1.5, 2.0, 2.5 and 3.0 times of the present tariff rate (BDT 5.75/kWh) for the residential sector.

Table 9-1 Net Economic Benefits (in BDT million) by Electricity Tariff

Electricity tariff (BDT/kWh)	2015	2020	2025	2030
17.25	-518	-20,738	35,766	90,296
14.38	-518	-25,743	16,278	48,898
11.50	-518	-30,748	-3,209	7,500
8.63	-518	-35,753	-22,696	-33,899
5.75	-518	-40,757	-42,184	-75,297

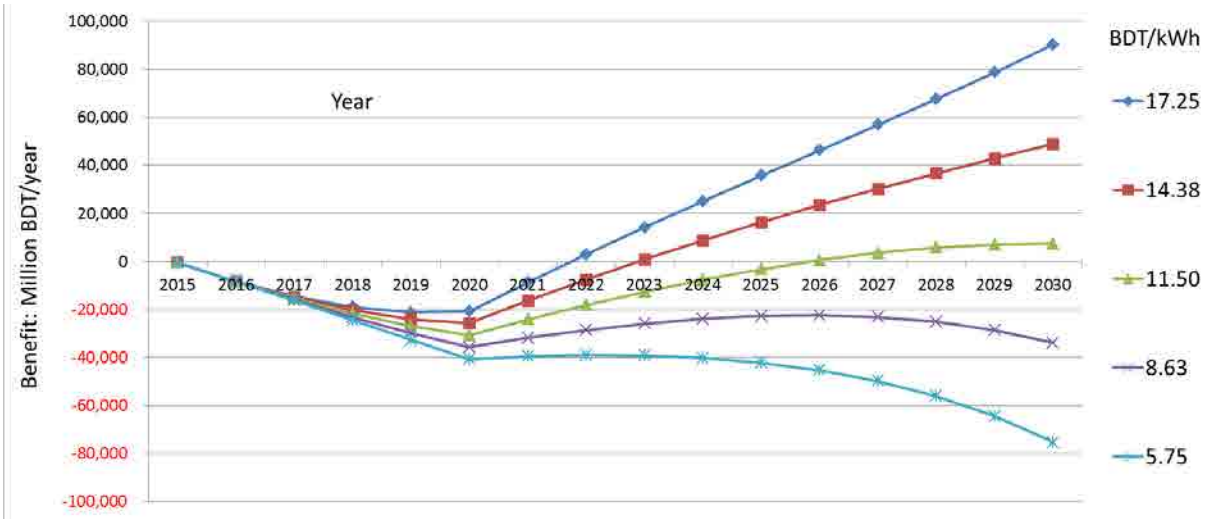


Figure 9-1 Net Economic Benefits by Electricity Tariff

Costs for the EE labeling program is taken into account for the calculation of EE&C case. Table 9-2 shows the breakdown of the costs.

Table 9-2 Cost of EE Labeling Program

	2015	2016-2030 (every year)
Lighting	5 Million BDT	3 Million BDT/year
Refrigerator	30 Million BDT	3 Million BDT/year
TV	5 Million BDT	3 Million BDT/year
AC	30 Million BDT	3 Million BDT/year
Fan	5 Million BDT	3 Million BDT/year

10. MAC (Marginal Abatement Cost) Curves

Figure 10-1, 10-2 and 10-3 are MAC curve of the five appliances by electricity tariff. The useful life of each appliance is assumed to be 10 years.

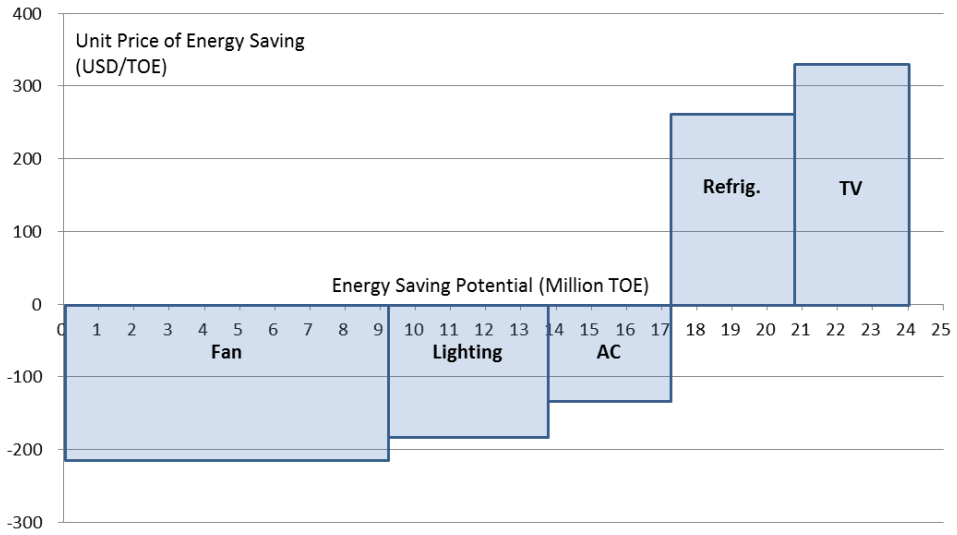


Figure 10-1 MAC Curve (with Current Electricity Price)

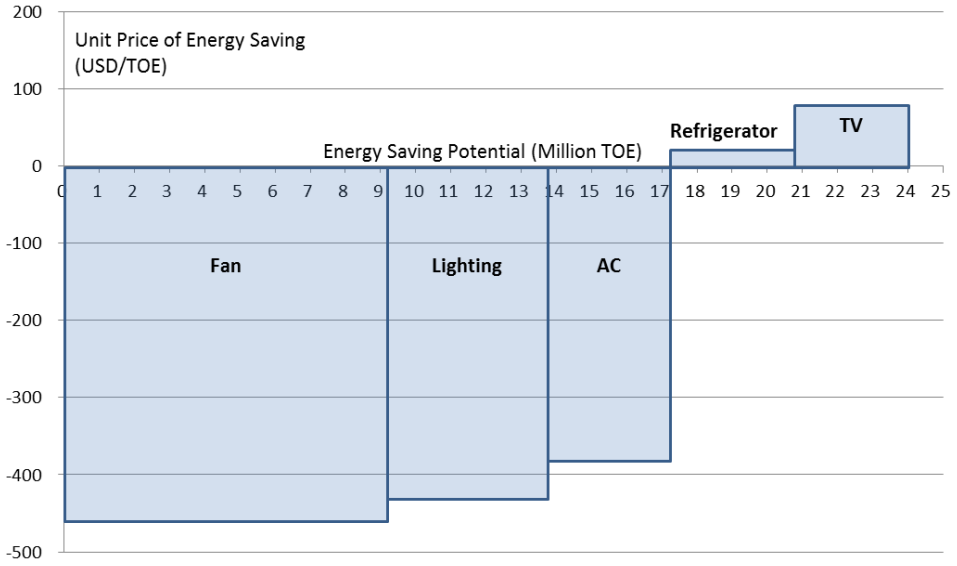


Figure 10-2 MAC Curve (with Double Electricity Price)

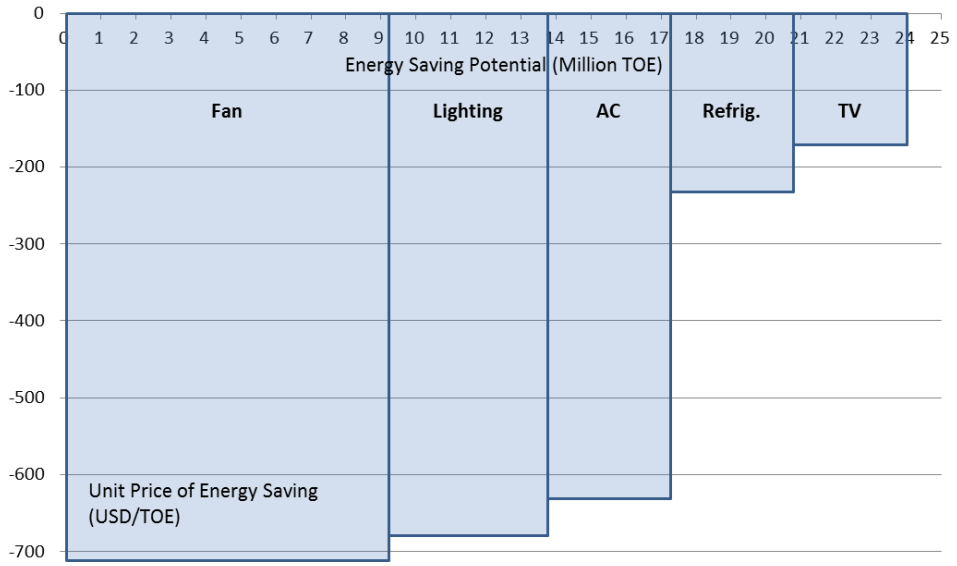


Figure 10-3 MAC Curve (with Triple Electricity Price)

Appendix 6:
Cost Effectiveness Analysis of Target EE&C Projects

Cost Effectiveness Analysis of Target EE&C Projects

	EE projects	Govt. costs (a) (BDT/year)	Energy redution amount (b) (toe/year)	Unit	Private sector investment costs (c) (BDT/year)	Economic benefit of private sector energy reductions (d)(BDT/year)	Unit	Cost effectiveness of energy reduction [(a+c−d)/b] (BDT/toe)	Unit	Total project costs *3 (BDT)	EE sustainable years (year)	Annual energy reduction amount	Unit	Total amount of energy reduced for the Project	Unit	Unit price of energy*1	Unit	Converted unit price of energy (BDT/toe)*2	Unit	Simple payback period (year)
EE Building	Medium sized public buildings retrofit (AC, lighting) for 4 units	1,248,000	44	toe	0	1,456,160	BDT	−4,777	BDT	12,480,000	10	0.2	GWh	2	GWh	9.58	BDT/kWh	33,415	BDT/toe	9
	Large public buildings retrofit (AC, lighting) for 4 units	12,480,000	436	toe	0	14,561,600	BDT	−4,777	BDT	124,800,000	10	1.5	GWh	15	GWh	9.58	BDT/kWh	33,415	BDT/toe	9
	New Green Building (lighting, etc.) for 4 units	0	1,147	toe	17,940,000	38,320,000	BDT	−17,771	BDT	215,280,000	12	4.0	GWh	48	GWh	9.58	BDT/kWh	33,415	BDT/toe	6
	New Energy Efficiecy Building (lighting, etc.) for 4 units	0	573	toe	7,176,000	19,160,000	BDT	−20,900	BDT	86,112,000	12	2.0	GWh	24	GWh	9.58	BDT/kWh	33,415	BDT/toe	4
Energy Management	Once-through boiler (6 t/h, 3 units)	0	4,819	toe	5,880,000	31,349,534	BDT	−5,285	BDT	117,000,000	20	5,700,000	m3	114,000,000	m3	5.50	BDT/m3	6,506	BDT/toe	4
	Gas turbine cogene (6-10MW, 2 units)	0	50,964	toe	117,600,000	331,559,500	BDT	−4,198	BDT	2,340,000,000	20	60,284,441	m3	1,205,688,820	m3	5.50	BDT/m3	6506	BDT/toe	7
	Lighting (LED/25W) for textiles (20,000 lamps×11units)	0	787	toe	8,580,000	20,047,698	BDT	−14,565	BDT	85,800,000	10	2.7	GWh	27	GWh	7.30	BDT/kWh	25,462	BDT/toe	4
	Ammonia cooling/ chilling (10,000t) for food processing (3 units)	0	602	toe	4,696,500	15,330,000	BDT	−17,662	BDT	140,400,000	30	2.1	GWh	63	GWh	7.30	BDT/kWh	25,462	BDT/toe	9
	Exhaust heat recovery (100,000 t/h) for steel (2 units)	0	3,421	toe	31,200,000	22,258,169	BDT	2,614	BDT	312,000,000	20	4,047,000	m3	80,940,000	m3	5.50	BDT/m3	6,506	BDT/toe	14
	Cement kiln (5,000 t/day, 4 units)	0	1,147	toe	23,400,000	29,200,000	BDT	−5,058	BDT	468,000,000	20	4.0	GWh	80	GWh	7.30	BDT/kWh	25,462	BDT/toe	16
	High efficient weaving machine (100 sets, 1 unit)	0	1,192	toe	31,200,000	30,353,400	BDT	710	BDT	390,000,000	20	4.2	GWh	83	GWh	7.30	BDT/kWh	25,462	BDT/toe	13
	Biogas power generation (400kW) for poultry (2 units)	0	1,720	toe	28,080,000	43,800,000	BDT	−9,138	BDT	351,000,000	20	6.0	GWh	120	GWh	7.30	BDT/kWh	25,462	BDT/toe	8
	Biogas power generation (2kW) for poultry (30 units)	0	745	toe	4,563,000	18,980,000	BDT	−19,341	BDT	91,260,000	20	2.6	GWh	52	GWh	7.30	BDT/kWh	25,462	BDT/toe	5
EE	AC & Refrigerator (16,000 households)	0	1,835	toe	28,704,000	36,800,000	BDT	−4,412	BDT	287,040,000	10	6.4	GWh	64	GWh	5.75	BDT/kWh	20,056	BDT/toe	8

Notes::
*1: Electricity prices (only grid power): 9.58 BDT/kWh for buildings sector other than residences, 7.3 BDT/kWh for industrial sector, 5.75 BDT/kWh for residential sector; and industrial sector gas price is 5.5 BDT/m3
*2: 1 GWh=286.7 toe, 1 m3=0.0008454 toe
*3: USD 1=BDT78

Appendix 7:
Cost Effectiveness Analysis of EE&C Programs

Cost Effectiveness Analysis of EE&C Programs

Program	Cost efficiency of the Program (BDT/toe) [(a + c) – (d + e)]/ b	Annual administrative costs (BDT/year) (a)	Annual amount of energy reduced (toe/year) (b)	Annual investment costs (BDT) to be borne by the private sector (c)	Annual economic benefits (BDT/year) of private-sector energy reduction (d)	Annual amount of energy subsidies reduced (BDT/year) (e) *2	Annual amount of energy reduced in 2030 (toe/year)	Of which, electricity (KWh/year)	Of which, natural gas (m3/year)	Total investment costs (BDT)*1	Useful life of the machineries (years)	Payvack period of EE&C investments (years)
Energy Management Program	-14,928	2,277,600	2,335,000	1,233,698,425	28,469,963,653	7,623,160,098	4,670,000	4,886,641,088	3,866,808,611	370,109,527,492	20	5
EE Labeling Program	-29,185	32,500,000	2,130,874	3,703,820,640	42,736,392,000	23,189,137,920	4,261,747	14,864,832,000	-	555,573,096,000	10	5
EE Buildings Program	-42,361	5,876,000	1,075,125	2,075,666,667	35,925,000,000	11,700,000,000	2,150,250	7,500,000,000	-	467,025,000,000	15	5

Note: Energy unit conversion factors are as below:

*1: Including O&M costs (30% of initial investmen costs)

*2: Grid electricity is subsidized at the rate of BDT 3.12/kWh (4 US cent/kWh)

1 kWh=	0.0002867	toe for electricity	
1 m3=	0.0008454	toe for natural gas	
			107,131,355,653 BDT/year
			5,540,999 toe
			5,541.0 Ktoe
Unit price of electricity:			19,326,818 kWh
1) Industrial sector	1 kWh= 7.3	BDT	2,237 KW
2) Buildings sector (excluding houses)	9.58	BDT	
3) Residential sector	5.75	BDT	
Unit price of natural gas:			
Industrial sector	1 m3= 5.5	BDT	
Eelectricity subsidy	1 kWh= 3.12	BDT	
Currency conversion:	1 USD= 78	BDT	

Appendix 8:
Energy Consumption Forecast up to 2030

Forecast of Sector-wise Energy Consumption (up to 2030)

Business As Usual (BAU) Scenario

Sector	Unit	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Industrial	kTOE	13,811	14,709	15,678	16,724	17,854	19,075	20,394	21,822	23,366	25,038	26,849	28,812	30,940	33,247	35,751	38,469	41,421	44,627
Residential	kTOE	8,008	8,380	8,772	9,187	9,625	10,088	10,577	11,094	11,640	12,218	12,829	13,475	14,158	14,881	15,646	16,456	17,313	18,219
Commercial	kTOE	1,253	1,378	1,516	1,667	1,834	2,017	2,219	2,441	2,685	2,954	3,249	3,574	3,931	4,324	4,757	5,232	5,756	6,331
Agriculture	kTOE	1,491	1,535	1,581	1,629	1,678	1,728	1,780	1,833	1,888	1,945	2,003	2,063	2,125	2,189	2,255	2,322	2,392	2,464
Total	kTOE	24,562	26,002	27,548	29,207	30,991	32,908	34,970	37,190	39,580	42,155	44,930	47,924	51,154	54,642	58,409	62,480	66,881	71,642
TOE/GDP	TOE/million BDT	2.37	2.22	2.22	2.21	2.19	2.17	2.16	2.14	2.13	2.14	2.16	2.17	2.18	2.20	2.22	2.24	2.27	2.29
TOE/GDP Improvement (compared to 2013 base)	%	0.0	6.1	6.0	6.8	7.5	8.2	8.8	9.4	9.9	9.4	8.9	8.3	7.7	6.9	6.1	5.2	4.3	3.3
									Target 15%	2.01								Target 20%	1.89

Target: Scenario 1 (15% in 2021, 20% in 2030 in TOE/GDP improvement)

Sector	Unit	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Industrial	kTOE	13,811	14,709	15,678	16,549	17,479	18,474	19,538	20,676	21,894	23,279	24,746	26,295	27,925	29,635	31,420	33,272	35,180	37,130
Residential	kTOE	8,008	8,380	8,772	9,099	9,440	9,797	10,171	10,561	10,970	11,397	11,823	12,243	12,648	13,030	13,375	13,670	13,893	14,022
Commercial	kTOE	1,253	1,378	1,516	1,662	1,799	1,959	2,134	2,324	2,631	2,887	3,166	3,471	3,803	4,165	4,559	4,986	5,450	5,951
Agriculture	kTOE	1,491	1,535	1,581	1,618	1,655	1,694	1,733	1,772	1,813	1,857	1,901	1,944	1,987	2,028	2,067	2,104	2,138	2,168
Total	kTOE	24,562	26,002	27,548	28,927	30,373	31,924	33,575	35,333	37,308	39,420	41,636	43,953	46,363	48,858	51,421	54,032	56,662	59,271
TOE/GDP	TOE/million BDT	2.37	2.22	2.22	2.18	2.14	2.11	2.07	2.04	2.01	2.00	2.00	1.99	1.98	1.97	1.96	1.94	1.92	1.89
TOE/GDP Improvement (compared to 2014 base)	%	0.0	6.1	6.0	7.7	9.4	11.0	12.5	13.9	15.0	15.3	15.6	15.9	16.3	16.8	17.3	18.0	18.9	20.0

(scenario assumption)	Feasible EE&C volume	progress in 2021*	progress in 2030																
Industiral reduction ratio	21.0%	30%	80.0%	0.0%	0.0%	0.0%	1.1%	2.1%	3.2%	4.2%	5.3%	6.3%	7.0%	7.8%	8.7%	9.7%	10.9%	12.1%	13.5%	15.1%	16.8%
Residential reduction ratio	28.8%	20%	80.0%	0.0%	0.0%	0.0%	1.0%	1.9%	2.9%	3.8%	4.8%	5.8%	6.7%	7.8%	9.1%	10.7%	12.4%	14.5%	16.9%	19.8%	23.0%
Commercial reduction ratio	10.0%	20%	60.0%	0.0%	0.0%	0.0%	0.3%	1.9%	2.9%	3.8%	4.8%	2.0%	2.3%	2.6%	2.9%	3.3%	3.7%	4.2%	4.7%	5.3%	6.0%
Agriculture reduction ratio	20.0%	20%	60.0%	0.0%	0.0%	0.0%	0.7%	1.3%	2.0%	2.7%	3.3%	4.0%	4.5%	5.1%	5.8%	6.5%	7.4%	8.3%	9.4%	10.6%	12.0%

Stretch: Scenario 2 (Sector's Feasible Reduction Pontential base)

Sector	Unit	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Industrial	kTOE	13,811	14,709	15,678	16,432	17,229	18,073	18,967	19,912	20,913	22,199	23,561	25,000	26,519	28,117	29,792	31,544	33,367	35,255
Residential	kTOE	8,008	8,380	8,772	8,967	9,163	9,361	9,561	9,762	9,964	10,318	10,674	11,030	11,384	11,732	12,070	12,393	12,696	12,972
Commercial	kTOE	1,253	1,378	1,516	1,653	1,803	1,967	2,145	2,339	2,551	2,794	3,059	3,349	3,664	4,007	4,379	4,784	5,223	5,698
Agriculture	kTOE	1,491	1,535	1,581	1,602	1,622	1,642	1,661	1,681	1,700	1,735	1,770	1,803	1,836	1,867	1,897	1,924	1,949	1,971
Total	kTOE	24,562	26,002	27,548	28,653	29,817	31,043	32,335	33,695	35,127	37,045	39,064	41,183	43,403	45,722	48,138	50,645	53,235	55,897
TOE/GDP	TOE/million BDT	2.37	2.22	2.22	2.16	2.11	2.05	1.99	1.94	1.89	1.88	1.87	1.86	1.85	1.84	1.83	1.82	1.80	1.79
TOE/GDP Improvement (compared to 2013 base)	%	0.0	6.1	6.0	8.6	11.0	13.4	15.7	17.9	20.0	20.4	20.8	21.2	21.7	22.1	22.6	23.1	23.8	24.6

(scenario assumption)	Feasible EE&C volume	progress in 2021**	progress in 2030																
Industiral reduction ratio	21.0%	50%	100%	0.0%	0.0%	0.0%	1.8%	3.5%	5.3%	7.0%	8.8%	10.5%	11.3%	12.2%	13.2%	14.3%	15.4%	16.7%	18.0%	19.4%	21.0%
Residential reduction ratio	28.8%	50%	100%	0.0%	0.0%	0.0%	2.4%	4.8%	7.2%	9.6%	12.0%	14.4%	15.6%	16.8%	18.1%	19.6%	21.2%	22.9%	24.7%	26.7%	28.8%
Commercial reduction ratio	10.0%	50%	100%	0.0%	0.0%	0.0%	0.8%	1.7%	2.5%	3.3%	4.2%	5.0%	5.4%	5.8%	6.3%	6.8%	7.3%	7.9%	8.6%	9.3%	10.0%
Agriculture reduction ratio	20.0%	50%	100%	0.0%	0.0%	0.0%	1.7%	3.3%	5.0%	6.7%	8.3%	10.0%	10.8%	11.7%	12.6%	13.6%	14.7%	15.9%	17.1%	18.5%	20.0%

* Pilot program will achieve these progresses, leading to 20% TOE/GDP improvement (2021 target achievement)

**50% progress of potential leading to 20% TOE/GDP improvement (2030 target achievement)

Forecast of Resource-wise Energy Consumption (up to 2030)

Business As Usual (BAU) Scenario

Resource	Unit	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Electricity	kTOE	10,271	11,037	11,864	12,759	13,727	14,774	15,908	17,135	18,464	19,904	21,465	23,157	24,993	26,984	29,145	31,491	34,038	36,805
Natural Gas	kTOE	12,096	12,691	13,327	14,006	14,733	15,510	16,342	17,234	18,190	19,215	20,316	21,498	22,769	24,136	25,608	27,192	28,899	30,739
Oil	kTOE	1,529	1,576	1,624	1,674	1,725	1,779	1,834	1,892	1,952	2,013	2,078	2,144	2,213	2,285	2,360	2,437	2,518	2,602
Coal	kTOE	666	698	733	768	806	845	886	929	975	1,022	1,072	1,124	1,179	1,237	1,297	1,360	1,426	1,496
Total	kTOE	24,562	26,002	27,548	29,207	30,991	32,908	34,970	37,190	39,580	42,155	44,930	47,924	51,154	54,642	58,409	62,480	66,881	71,642
TOE/GDP	TOE/million BDT	2.37	2.22	2.22	2.21	2.19	2.17	2.16	2.14	2.13	2.14	2.16	2.17	2.18	2.20	2.22	2.24	2.27	2.29

Target: Scenario 1 (15% in 2021, 20% in 2030 in TOE/GDP improvement)

Sector	Unit	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Electricity	kTOE	10,271	11,037	11,864	12,643	13,458	14,339	15,282	16,292	17,455	18,664	19,941	21,283	22,689	24,150	25,660	27,203	28,762	30,313
Natural Gas	kTOE	12,096	12,691	13,327	13,864	14,429	15,030	15,667	16,344	17,079	17,898	18,754	19,645	20,568	21,520	22,496	23,490	24,491	25,489
Oil	kTOE	1,529	1,576	1,624	1,661	1,698	1,737	1,777	1,818	1,861	1,907	1,953	1,999	2,043	2,086	2,126	2,163	2,197	2,225
Coal	kTOE	666	698	733	760	789	818	849	881	913	950	988	1,026	1,064	1,102	1,140	1,176	1,211	1,245
Total	kTOE	24,562	26,002	27,548	28,927	30,373	31,924	33,575	35,333	37,308	39,420	41,636	43,953	46,363	48,858	51,421	54,032	56,662	59,271
TOE/GDP	TOE/million BDT	2.37	2.22	2.22	2.18	2.14	2.11	2.07	2.04	2.01	2.00	2.00	1.99	1.98	1.97	1.96	1.94	1.92	1.89
TOE/GDP Improvement (compared to 2014 base)	%	0.0	6.1	6.0	7.7	9.4	11.0	12.5	13.9	15.0	15.3	15.6	15.9	16.3	16.8	17.3	18.0	18.9	20.0

Stretch: Scenario 2 (Sector's Reduction Pontential base)

Sector	Unit	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Electricity	kTOE	10,271	11,037	11,864	12,508	13,188	13,907	14,667	15,470	16,319	17,415	18,576	19,802	21,096	22,456	23,881	25,370	26,918	28,520
Natural Gas	kTOE	12,096	12,691	13,327	13,747	14,189	14,653	15,142	15,656	16,196	16,946	17,731	18,552	19,407	20,297	21,218	22,170	23,148	24,148
Oil	kTOE	1,529	1,576	1,624	1,643	1,663	1,682	1,701	1,721	1,740	1,778	1,816	1,853	1,889	1,924	1,958	1,990	2,020	2,047
Coal	kTOE	666	698	733	755	777	801	824	848	872	906	941	976	1,011	1,046	1,081	1,115	1,149	1,182
Total	kTOE	24,562	26,002	27,548	28,653	29,817	31,043	32,335	33,695	35,127	37,045	39,064	41,183	43,403	45,722	48,138	50,645	53,235	55,897
TOE/GDP	TOE/million BDT	2.37	2.22	2.22	2.16	2.11	2.05	1.99	1.94	1.89	1.88	1.87	1.86	1.85	1.84	1.83	1.82	1.80	1.79
TOE/GDP Improvement (compared to BAU Scenario)	%	0.0	6.1	6.0	8.6	11.0	13.4	15.7	17.9	20.0	20.4	20.8	21.2	21.7	22.1	22.6	23.1	23.8	24.6

[Conversion Factor]

		Unit
Electricity	0.2867	TOE/MWh
Natural Gas	0.8454	TOE/1,000m3
Oil	0.8956	TOE/kL
Oil	0.9	MMT/kL

[Nominal GDP]

		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Nominal GDP (constant price 2013/14)	billion BDT	10,380	11,696	12,390	13,246	14,165	15,151	16,210	17,347	18,554	19,662	20,839	22,090	23,420	24,802	26,276	27,848	29,525	31,314

1. Forecast of Electricity Consumption (GWh) (up to 2030)

Business As Usual (BAU) Case

Sector	Growth Rate(%)	Unit	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Industrial		GWh	12,292	13,428	14,673	16,038	17,535	19,176	20,976	22,950	25,115	27,491	30,097	32,956	36,093	39,535	43,313	47,458	52,009	57,003
Chemical	5.0	GWh	101	106	111	116	122	128	135	142	149	156	164	172	181	190	199	209	220	231
Chemical Firtilizer	1.0	GWh	327	330	334	337	340	344	347	351	354	358	361	365	369	372	376	380	384	387
Cement	7.5	GWh	667	717	770	828	890	957	1,029	1,106	1,189	1,278	1,374	1,477	1,588	1,707	1,835	1,972	2,120	2,279
Steel-making & re-rolling	7.5	GWh	515	553	595	639	687	739	794	854	918	987	1,061	1,140	1,226	1,318	1,417	1,523	1,637	1,760
Brick	5.0	GWh	23	24	25	26	27	29	30	32	33	35	37	39	41	43	45	47	49	52
Glass	10.0	GWh	17	19	21	23	25	27	30	33	36	40	44	48	53	59	64	71	78	86
Frozen food & cold storage	5.0	GWh	208	219	230	241	253	266	279	293	308	323	339	356	374	393	412	433	454	477
Petroleum refinary	10.0	GWh	2	3	3	3	4	4	4	5	5	6	6	7	8	8	9	10	11	12
Sugar	0.0	GWh	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Pulp & Paper	4.0	GWh	76	79	83	86	89	93	97	101	105	109	113	118	122	127	132	138	143	149
Jute mills	10.0	GWh	207	228	251	276	304	334	367	404	445	489	538	592	651	716	788	866	953	1,048
Textile	6.0	GWh	321	340	360	382	405	429	455	482	511	542	574	609	645	684	725	769	815	864
Garment	10.0	GWh	772	850	934	1,028	1,131	1,244	1,368	1,505	1,656	1,821	2,003	2,203	2,424	2,666	2,933	3,226	3,549	3,904
Sanitary and tiles industry	10.0	GWh	175	192	212	233	256	282	310	341	375	412	454	499	549	604	664	731	804	884
Others	10.0	GWh	8,876	9,764	10,741	11,815	12,996	14,296	15,725	17,298	19,027	20,930	23,023	25,326	27,858	30,644	33,708	37,079	40,787	44,866
Residential	6.2	GWh	18,265	19,392	20,589	21,860	23,210	24,642	26,163	27,778	29,493	31,314	33,247	35,299	37,478	39,792	42,248	44,856	47,625	50,565
Commercial	10.0	GWh	3,556	3,912	4,303	4,733	5,207	5,727	6,300	6,930	7,623	8,386	9,224	10,147	11,161	12,277	13,505	14,856	16,341	17,975
Agricultural	3.0	GWh	1,713	1,764	1,817	1,872	1,928	1,986	2,045	2,107	2,170	2,235	2,302	2,371	2,442	2,515	2,591	2,668	2,749	2,831
TOTAL		GWh	35,826	38,496	41,383	44,503	47,879	51,531	55,485	59,765	64,402	69,425	74,869	80,772	87,174	94,119	101,656	109,839	118,723	128,374
CO2 Emission		Mt-CO2	24.00	26.06	28.31	30.76	33.43	36.34	39.52	43.00	46.79	50.93	55.45	60.39	65.79	71.70	78.16	85.22	92.95	101.42

Target: Scenario 1 (15% in 2021, 20% in 2030 in TOE/GDP improvement)

Sector	Unit	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Industrial	GWh	12,292	13,428	14,673	15,870	17,167	18,572	20,095	21,745	23,533	25,559	27,739	30,076	32,576	35,240	38,065	41,047	44,173	47,427
Residential	GWh	18,265	19,392	20,589	21,650	22,764	23,933	25,159	26,445	27,794	29,210	30,641	32,072	33,481	34,841	36,116	37,261	38,219	38,915
Commercial	GWh	3,556	3,912	4,303	4,718	5,107	5,563	6,058	6,598	7,471	8,196	8,989	9,854	10,797	11,825	12,943	14,157	15,473	16,897
Agliculture	GWh	1,713	1,764	1,817	1,859	1,902	1,946	1,991	2,036	2,083	2,134	2,184	2,234	2,283	2,330	2,375	2,418	2,457	2,491
Total	GWh	35,826	38,496	41,383	44,097	46,939	50,013	53,303	56,824	60,881	65,099	69,553	74,236	79,137	84,236	89,500	94,883	100,322	105,729
(scenario assumption)																			
Industiral reduction ratio		0.0%	0.0%	0.0%	1.1%	2.1%	3.2%	4.2%	5.3%	6.3%	7.0%	7.8%	8.7%	9.7%	10.9%	12.1%	13.5%	15.1%	16.8%
Residential reduction ratio		0.0%	0.0%	0.0%	1.0%	1.9%	2.9%	3.8%	4.8%	5.8%	6.7%	7.8%	9.1%	10.7%	12.4%	14.5%	16.9%	19.8%	23.0%
Commercial reduction ratio		0.0%	0.0%	0.0%	0.3%	1.9%	2.9%	3.8%	4.8%	2.0%	2.3%	2.6%	2.9%	3.3%	3.7%	4.2%	4.7%	5.3%	6.0%
Agriculture reduction ratio		0.0%	0.0%	0.0%	0.7%	1.3%	2.0%	2.7%	3.3%	4.0%	4.5%	5.1%	5.8%	6.5%	7.4%	8.3%	9.4%	10.6%	12.0%
CO2 Emission	Mt-CO2	24.00	26.06	28.31	30.48	32.77	35.27	37.97	40.88	44.23	47.75	51.51	55.50	59.73	64.17	68.81	73.62	78.55	83.53

Stretch: Scenario 2 (Sector's Reduction Pontential base)

Sector	Unit	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Industrial	GWh	12,292	13,428	14,673	15,758	16,921	18,169	19,508	20,942	22,478	24,373	26,410	28,596	30,936	33,434	36,093	38,915	41,896	45,033
Residential	GWh	18,265	19,392	20,589	21,335	22,095	22,868	23,652	24,445	25,246	26,444	27,662	28,895	30,134	31,370	32,591	33,782	34,926	36,002
Commercial	GWh	3,556	3,912	4,303	4,694	5,120	5,584	6,090	6,641	7,242	7,933	8,686	9,507	10,402	11,375	12,433	13,582	14,828	16,178
Agliculture	GWh	1,713	1,764	1,817	1,840	1,864	1,886	1,909	1,931	1,953	1,993	2,033	2,072	2,110	2,146	2,180	2,211	2,240	2,265
Total	GWh	35,826	38,496	41,383	43,627	46,000	48,508	51,158	53,959	56,919	60,743	64,792	69,070	73,581	78,325	83,297	88,490	93,890	99,477
(scenario assumption)																			
Industiral reduction ratio		0.0%	0.0%	0.0%	1.8%	3.5%	5.3%	7.0%	8.8%	10.5%	11.3%	12.2%	13.2%	14.3%	15.4%	16.7%	18.0%	19.4%	21.0%
Residential reduction ratio		0.0%	0.0%	0.0%	2.4%	4.8%	7.2%	9.6%	12.0%	14.4%	15.6%	16.8%	18.1%	19.6%	21.2%	22.9%	24.7%	26.7%	28.8%
Commercial reduction ratio		0.0%	0.0%	0.0%	0.8%	1.7%	2.5%	3.3%	4.2%	5.0%	5.4%	5.8%	6.3%	6.8%	7.3%	7.9%	8.6%	9.3%	10.0%
Agriculture reduction ratio		0.0%	0.0%	0.0%	1.7%	3.3%	5.0%	6.7%	8.3%	10.0%	10.8%	11.7%	12.6%	13.6%	14.7%	15.9%	17.1%	18.5%	20.0%
CO2 Emission	Mt-CO2	24.00	26.06	28.31	30.15	32.12	34.21	36.44	38.82	41.35	44.56	47.98	51.64	55.53	59.66	64.04	68.66	73.51	78.59

2. Fore cast of Natural Gas Consumption (MMCM) (up to 2030) ※Derived from industrial and service sector's nominal GDP

Business As Usual (BAU) Case

Category	Growth Rate(%)	Unit	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Industrial		1000m3	11,157	11,786	12,458	13,178	13,950	14,778	15,666	16,619	17,643	18,744	19,927	21,199	22,569	24,044	25,633	27,346	29,194	31,188
Chemical	5.0	1000m3	333	350	367	386	405	425	446	469	492	517	543	570	598	628	659	692	727	763
Chemical Firtilizer	1.0	1000m3	1,838	1,857	1,875	1,894	1,913	1,932	1,951	1,971	1,991	2,011	2,031	2,051	2,072	2,092	2,113	2,134	2,156	2,177
Cement	7.5	1000m3	197	212	228	245	264	283	305	328	352	378	407	437	470	505	543	584	628	675
Steel-making & re-rolling	7.5	1000m3	327	351	377	406	436	469	504	542	583	626	673	724	778	836	899	966	1,039	1,117
Brick	5.0	1000m3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glass	10.0	1000m3	9	10	11	12	13	14	16	17	19	21	23	26	28	31	34	37	41	45
Frozen food & cold storage	5.0	1000m3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Petroleum refinary	10.0	1000m3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sugar	0.0	1000m3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pulp & Paper	4.0	1000m3	146	152	158	164	171	178	185	192	200	208	216	225	234	243	253	263	274	285
Jute mills	10.0	1000m3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Textile	6.0	1000m3	1,876	1,988	2,107	2,234	2,368	2,510	2,661	2,820	2,989	3,169	3,359	3,560	3,774	4,000	4,240	4,495	4,765	5,050
Garment	10.0	1000m3	2,181	2,399	2,639	2,903	3,194	3,513	3,864	4,251	4,676	5,143	5,658	6,224	6,846	7,531	8,284	9,112	10,023	11,025
Sanitary and tiles industry	10.0	1000m3	179	197	217	239	263	289	318	349	384	423	465	512	563	619	681	749	824	906
Captive Power	4.9	1000m3	4,071	4,269	4,477	4,696	4,924	5,164	5,416	5,680	5,957	6,248	6,552	6,872	7,207	7,558	7,926	8,313	8,718	9,143
Residential	1.8	1000m3	2,875	2,926	2,977	3,029	3,082	3,136	3,191	3,247	3,304	3,361	3,420	3,480	3,541	3,603	3,666	3,730	3,795	3,862
Commercial	10.0	1000m3	252	277	305	335	369	405	446	491	540	594	653	718	790	869	956	1,052	1,157	1,273
Agricultural	3.0	1000m3	23	24	24	25	26	27	28	28	29	30	31	32	33	34	35	36	37	38
Total		1000m3	14,308	15,012	15,764	16,568	17,427	18,346	19,331	20,385	21,516	22,729	24,031	25,430	26,933	28,550	30,290	32,164	34,183	36,360
CO2 Emission		Mt-CO2	28.09	29.48	30.95	32.53	34.22	36.02	37.96	40.03	42.25	44.63	47.18	49.93	52.88	56.06	59.48	63.15	67.12	71.39

Alternative Scenario 1

Sector		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Industrial	1000m3	11,157	11,786	12,458	13,040	13,657	14,313	15,008	15,747	16,532	17,427	18,366	19,347	20,370	21,432	22,528	23,652	24,796	25,948
Residential	1000m3	2,875	2,926	2,977	3,000	3,023	3,046	3,068	3,091	3,113	3,136	3,152	3,162	3,163	3,155	3,134	3,099	3,046	2,972
Commercial	1000m3	252	277	305	334	362	394	429	467	529	580	636	698	764	837	916	1,002	1,095	1,196
Agliculture	1000m3	23	24	24	25	26	26	27	27	28	29	29	30	31	31	32	33	33	34
Total	1000m3	14,308	15,012	15,764	16,399	17,067	17,778	18,532	19,332	20,202	21,171	22,184	23,237	24,329	25,455	26,610	27,785	28,970	30,150
(scenario assumption)																			
Industiral reduction ratio	%	0.0%	0.0%	0.0%	1.1%	2.1%	3.2%	4.2%	5.3%	6.3%	7.0%	7.8%	8.7%	9.7%	10.9%	12.1%	13.5%	15.1%	16.8%
Residential reduction ratio	%	0.0%	0.0%	0.0%	1.0%	1.9%	2.9%	3.8%	4.8%	5.8%	6.7%	7.8%	9.1%	10.7%	12.4%	14.5%	16.9%	19.8%	23.0%
Commercial reduction ratio	%	0.0%	0.0%	0.0%	0.3%	1.9%	2.9%	3.8%	4.8%	2.0%	2.3%	2.6%	2.9%	3.3%	3.7%	4.2%	4.7%	5.3%	6.0%
Agriculture reduction ratio	%	0.0%	0.0%	0.0%	0.7%	1.3%	2.0%	2.7%	3.3%	4.0%	4.5%	5.1%	5.8%	6.5%	7.4%	8.3%	9.4%	10.6%	12.0%
CO2 Emission	Mt-CO2	9.59	10.16	10.78	11.33	11.92	12.54	13.20	13.91	14.68	15.53	16.43	17.37	18.36	19.39	20.46	21.56	22.68	23.82

Alternative Scenario 2

Sector		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Industry	1000m3	11,157	11,786	12,458	12,948	13,462	14,002	14,569	15,165	15,791	16,618	17,486	18,395	19,344	20,334	21,361	22,424	23,518	24,638
Residence	1000m3	2,875	2,926	2,977	2,956	2,934	2,910	2,885	2,857	2,828	2,839	2,846	2,849	2,847	2,840	2,828	2,809	2,783	2,750
Commercial	1000m3	252	277	305	332	362	395	431	470	513	562	615	673	736	805	880	962	1,050	1,145
Agliculture	1000m3	23	24	24	25	25	25	26	26	26	27	27	28	28	29	29	30	30	31
Total	1000m3	14,308	15,012	15,764	16,261	16,784	17,333	17,911	18,519	19,158	20,045	20,974	21,945	22,956	24,008	25,098	26,224	27,381	28,564
(scenario assumption)																			
Industiral reduction ratio	%	0.0%	0.0%	0.0%	1.8%	3.5%	5.3%	7.0%	8.8%	10.5%	11.3%	12.2%	13.2%	14.3%	15.4%	16.7%	18.0%	19.4%	21.0%
Residential reduction ratio	%	0.0%	0.0%	0.0%	2.4%	4.8%	7.2%	9.6%	12.0%	14.4%	15.6%	16.8%	18.1%	19.6%	21.2%	22.9%	24.7%	26.7%	28.8%
Commercial reduction ratio	%	0.0%	0.0%	0.0%	0.8%	1.7%	2.5%	3.3%	4.2%	5.0%	5.4%	5.8%	6.3%	6.8%	7.3%	7.9%	8.6%	9.3%	10.0%
Agriculture reduction ratio	%	0.0%	0.0%	0.0%	1.7%	3.3%	5.0%	6.7%	8.3%	10.0%	10.8%	11.7%	12.6%	13.6%	14.7%	15.9%	17.1%	18.5%	20.0%
CO2 Emission	Mt-CO2	9.59	10.16	10.78	11.24	11.72	12.22	12.76	13.32	13.92	14.70	15.53	16.41	17.33	18.29	19.30	20.35	21.44	22.57

3. Forecast of Oil Consumption (MMT) (up to 2030)

Business As Usual (BAU) Case

Sector	Growth Rate(%)	Unit	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Industrial	4.9	MMT	189	198	208	218	229	240	251	264	277	290	304	319	335	351	368	386	405	424
Residential	1.8	MMT	342	348	355	361	367	373	380	387	393	400	407	414	422	429	437	444	452	460
Commercial	10.0	MMT	20	22	25	27	30	33	36	39	43	48	53	58	64	70	77	85	93	102
Agliculture	3.0	MMT	985	1,014	1,045	1,076	1,109	1,142	1,176	1,211	1,248	1,285	1,324	1,363	1,404	1,446	1,490	1,534	1,581	1,628
TOTAL		MMT	1,537	1,583	1,632	1,682	1,734	1,788	1,843	1,901	1,961	2,023	2,088	2,155	2,224	2,296	2,371	2,449	2,530	2,615
CO2 Emission		Mt-CO2	4.69	4.84	4.99	5.14	5.30	5.46	5.63	5.81	5.99	6.18	6.38	6.58	6.79	7.02	7.24	7.48	7.73	7.99

Alternative Scenario 1

Sector	Unit	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Industrial	MMT	189	198	208	216	224	232	241	250	259	270	280	291	302	313	323	334	344	353
Residential	MMT	342	348	355	357	360	363	365	368	371	373	375	377	377	376	373	369	363	354
Commercial	MMT	20	22	25	27	29	32	35	38	43	47	51	56	62	67	74	81	88	96
Agliculture	MMT	985	1,014	1,045	1,069	1,094	1,119	1,145	1,171	1,198	1,227	1,256	1,285	1,313	1,340	1,366	1,390	1,413	1,433
Total	MMT	1,537	1,583	1,632	1,669	1,707	1,746	1,786	1,827	1,870	1,917	1,963	2,009	2,053	2,096	2,136	2,174	2,207	2,236
(scenario assumption)																			
Industiral reduction ratio	%	0.0%	0.0%	0.0%	1.1%	2.1%	3.2%	4.2%	5.3%	6.3%	7.0%	7.8%	8.7%	9.7%	10.9%	12.1%	13.5%	15.1%	16.8%
Residential reduction ratio	%	0.0%	0.0%	0.0%	1.0%	1.9%	2.9%	3.8%	4.8%	5.8%	6.7%	7.8%	9.1%	10.7%	12.4%	14.5%	16.9%	19.8%	23.0%
Commercial reduction ratio	%	0.0%	0.0%	0.0%	0.3%	1.9%	2.9%	3.8%	4.8%	2.0%	2.3%	2.6%	2.9%	3.3%	3.7%	4.2%	4.7%	5.3%	6.0%
Agriculture reduction ratio	%	0.0%	0.0%	0.0%	0.7%	1.3%	2.0%	2.7%	3.3%	4.0%	4.5%	5.1%	5.8%	6.5%	7.4%	8.3%	9.4%	10.6%	12.0%
CO2 Emission	Mt-CO2	4.69	4.84	4.99	5.10	5.21	5.33	5.45	5.58	5.71	5.86	6.00	6.14	6.27	6.40	6.53	6.64	6.74	6.83

Alternative Scenario 2

Sector	Unit	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Industrial	MMT	189	198	208	214	221	227	234	241	248	257	267	277	287	297	307	316	326	335
Residential	MMT	342	348	355	352	349	347	344	340	337	338	339	339	339	338	337	335	331	327
Commercial	MMT	20	22	25	27	29	32	35	38	41	45	49	54	59	65	71	77	84	92
Agliculture	MMT	985	1,014	1,045	1,058	1,072	1,085	1,098	1,110	1,123	1,146	1,169	1,192	1,213	1,234	1,253	1,271	1,288	1,302
Total	MMT	1,537	1,583	1,632	1,651	1,671	1,690	1,710	1,729	1,749	1,787	1,825	1,862	1,898	1,934	1,968	2,000	2,030	2,057
(scenario assumption)																			
Industiral reduction ratio	%	0.0%	0.0%	0.0%	1.8%	3.5%	5.3%	7.0%	8.8%	10.5%	11.3%	12.2%	13.2%	14.3%	15.4%	16.7%	18.0%	19.4%	21.0%
Residential reduction ratio	%	0.0%	0.0%	0.0%	2.4%	4.8%	7.2%	9.6%	12.0%	14.4%	15.6%	16.8%	18.1%	19.6%	21.2%	22.9%	24.7%	26.7%	28.8%
Commercial reduction ratio	%	0.0%	0.0%	0.0%	0.8%	1.7%	2.5%	3.3%	4.2%	5.0%	5.4%	5.8%	6.3%	6.8%	7.3%	7.9%	8.6%	9.3%	10.0%
Agriculture reduction ratio	%	0.0%	0.0%	0.0%	1.7%	3.3%	5.0%	6.7%	8.3%	10.0%	10.8%	11.7%	12.6%	13.6%	14.7%	15.9%	17.1%	18.5%	20.0%
CO2 Emission	Mt-CO2	4.69	4.84	4.99	5.04	5.10	5.16	5.22	5.28	5.34	5.46	5.57	5.69	5.80	5.91	6.01	6.11	6.20	6.29

4. Forecast of Coal Consumption (1,000 TOE) (uo to 2030)※Derived from industrial and service sector's nominal GDP

Business As Usual (BAU) Case

Sector	Growth	Unit	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Industrial	4.88	kTOE	666	698	733	768	806	845	886	929	975	1,022	1,072	1,124	1,179	1,237	1,297	1,360	1,426	1,496
CO2 Emission		Mt-CO2	2.68	2.81	2.95	3.10	3.25	3.41	3.57	3.75	3.93	4.12	4.32	4.53	4.75	4.98	5.23	5.48	5.75	6.03

Alternative Scenario 1

Sector	Unit	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Industrial	kTOE	666	698	733	760	789	818	849	881	913	950	988	1,026	1,064	1,102	1,140	1,176	1,211	1,245
(scenario assumption)																			
Industiral reduction ratio	%	0.0%	0.0%	0.0%	1.1%	2.1%	3.2%	4.2%	5.3%	6.3%	7.0%	7.8%	8.7%	9.7%	10.9%	12.1%	13.5%	15.1%	16.8%
CO2 Emission	Mt-CO2	2.68	2.81	2.95	3.06	3.18	3.30	3.42	3.55	3.68	3.83	3.98	4.13	4.29	4.44	4.59	4.74	4.88	5.02

Alternative Scenario 2

Sector	Unit	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Industrial	kTOE	666	698	733	755	777	801	824	848	872	906	941	976	1,011	1,046	1,081	1,115	1,149	1,182
(scenario assumption)																			
Industiral reduction ratio	%	0.0%	0.0%	0.0%	1.8%	3.5%	5.3%	7.0%	8.8%	10.5%	11.3%	12.2%	13.2%	14.3%	15.4%	16.7%	18.0%	19.4%	21.0%
CO2 Emission	Mt-CO2	2.68	2.81	2.95	3.04	3.13	3.23	3.32	3.42	3.52	3.65	3.79	3.93	4.07	4.21	4.36	4.49	4.63	4.76

5. Forecast of CO2 Emission (up to 2030)

Business As Usual (BAU) Case

		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Electricity	Mt-CO2	24.00	26.06	28.31	30.76	33.43	36.34	39.52	43.00	46.79	50.93	55.45	60.39	65.79	71.70	78.16	85.22	92.95	101.42
Natural gas	Mt-CO2	28.09	29.48	30.95	32.53	34.22	36.02	37.96	40.03	42.25	44.63	47.18	49.93	52.88	56.06	59.48	63.15	67.12	71.39
Oil	Mt-CO2	4.69	4.84	4.99	5.14	5.30	5.46	5.63	5.81	5.99	6.18	6.38	6.58	6.79	7.02	7.24	7.48	7.73	7.99
Coal	Mt-CO2	2.68	2.81	2.95	3.10	3.25	3.41	3.57	3.75	3.93	4.12	4.32	4.53	4.75	4.98	5.23	5.48	5.75	6.03
Total	Mt-CO2	59.48	63.19	67.20	71.52	76.19	81.23	86.68	92.58	98.95	105.85	113.33	121.43	130.22	139.75	150.10	161.34	173.55	186.83

Alternative Scenario 1

		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Electricity	Mt-CO2	24.00	26.06	28.31	30.48	32.77	35.27	37.97	40.88	44.23	47.75	51.51	55.50	59.73	64.17	68.81	73.62	78.55	83.53
Natural gas	Mt-CO2	28.09	29.48	30.95	32.10	33.31	34.58	35.93	37.36	38.87	40.46	42.15	43.94	45.83	47.84	49.96	52.21	54.59	57.11
Oil	Mt-CO2	4.69	4.84	4.99	5.07	5.16	5.24	5.33	5.42	5.51	5.60	5.70	5.79	5.89	5.99	6.09	6.19	6.29	6.39
Coal	Mt-CO2	2.68	2.81	2.95	3.05	3.16	3.27	3.38	3.50	3.61	3.73	3.86	3.99	4.12	4.25	4.39	4.53	4.68	4.82
Total	Mt-CO2	59.48	63.19	67.20	70.70	74.40	78.37	82.61	87.15	92.22	97.55	103.22	109.22	115.56	122.24	129.24	136.54	144.10	151.85

Alternative Scenario 2

		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Electricity	Mt-CO2	24.00	26.06	28.31	30.15	32.12	34.21	36.44	38.82	41.35	44.56	47.98	51.64	55.53	59.66	64.04	68.66	73.51	78.59
Natural gas	Mt-CO2	28.09	29.48	30.95	32.08	33.26	34.51	35.83	37.22	38.70	40.25	41.90	43.64	45.48	47.43	49.48	51.66	53.96	56.40
Oil	Mt-CO2	4.69	4.84	4.99	5.07	5.16	5.24	5.33	5.42	5.51	5.60	5.70	5.79	5.89	5.99	6.09	6.19	6.29	6.39
Coal	Mt-CO2	2.68	2.81	2.95	3.05	3.16	3.27	3.38	3.50	3.61	3.73	3.86	3.99	4.12	4.25	4.39	4.53	4.68	4.82
Total	Mt-CO2	59.48	63.19	67.20	70.35	73.69	77.23	80.99	84.96	89.17	94.15	99.44	105.06	111.02	117.33	124.00	131.03	138.44	146.20

[Emission Factor]

as of 2030

	MW	%	kcal/kWh	al/kg-CO2	-CO2/kWh		
Hydro & RE	1,941	5.02			0		
Gas	8,854	22.89	656.11	0.000235	0.15418		
Oil	2,240	5.79	165.99	0.000307	0.05096		
Coal	19,650	50.79	1,456.12	0.000403	0.58682		0.02377
Power Import	2,000	5.17			0		
Nuclear	4,000	10.34			0		
Total	38,685	100.00			0.792	0.79	

(source: PSMP2010, JICA Expert revised)

as of 2013

	%	kcal/kWh	ן-CO2/kcal	-CO2/kWh	
Hydro & RE	1.39			0	
Gas	72.42	2076.04	0.000235	0.48787	0.48787
HFO	15.44	424.61	0.000307	0.1304	0.1304
HSD	2.91	83.42	0.000310	0.02586	0.02586
Coal	2.46	70.52	0.000403	0.02842	0.02842
Power Import	5.36			0	
Total	99.98			0.673	0.67