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

Energy Efficiency and Conservation Master Plan up to 2030

Sustainable and Renewable Energy Development Authority
(SREDA)

and

Power Division
Ministry of Power,Energy and Mineral Resources
Government of the People's Republic of Bangladesh

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Japan International Cooperation Agency
Electric Power Development Co., Ltd

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ABBREVIATION

Abbreviation	Meaning
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
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
BPC	Bangladesh Petroleum Corporation
BPDB	Bangladesh Power Development 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
CBM	Condition Based Maintenance
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
DB	Data Base

Abbreviation	Meaning
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 &Conservation
EER	Energy Efficiency Ratio
EGCB	Electricity Generation Company of Bangladesh
EIB	European Investment Bank
EM	Energy Manager
EMS	Energy Management System
ERD	Economic Relation Division (Ministry of Finance)
ESCO	Energy Service Company
FS	Feasibility Study
FY	Financial Year
GBG	Green Building Guideline
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (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
HFO	Heavy Fuel Oil
HR	Human Resource
HSD	High Speed Diesel
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

Abbreviation	Meaning
JERI	Japan Economic Research Institute Inc.
JICA	Japan International Cooperation Agency
J-POWER	Electric Power Development Co., Ltd.
kg oe	kg of oil equivalent
KPI	Key Performance Indicators
ktoe	kilo ton of oil equivalent
LDC	Least Developed Country
LGED	Local Government Engineering Department
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)
MGI	McKinsey Global Institute
MIC	Middle Income Country
MOA	Ministry of Agriculture
MOC	Ministry of Commerce
MOE	Ministry of Education
MOEF	Ministry of Environment and Forest
MOF	Ministry of Finance
MOHPW	Ministry of Housing & Public Works
MOI	Ministry of Industry, Ministry of Information
MOT	Ministry of Transportation
MPEMR	Ministry of Power, Energy and Mineral Resources
MW	Megawatt
NBFI	Non-bank Financial Institution
NBNBC	New Bangladesh National Building Code
NCTB	The National Curriculum and Text Book Board
NGO	Non-government Organization
NPO	Non-profitable 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
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

Abbreviation	Meaning
RE	Renewable Energy
REB	Rural Electrification Board
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
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

TERMS AND DEFINITION

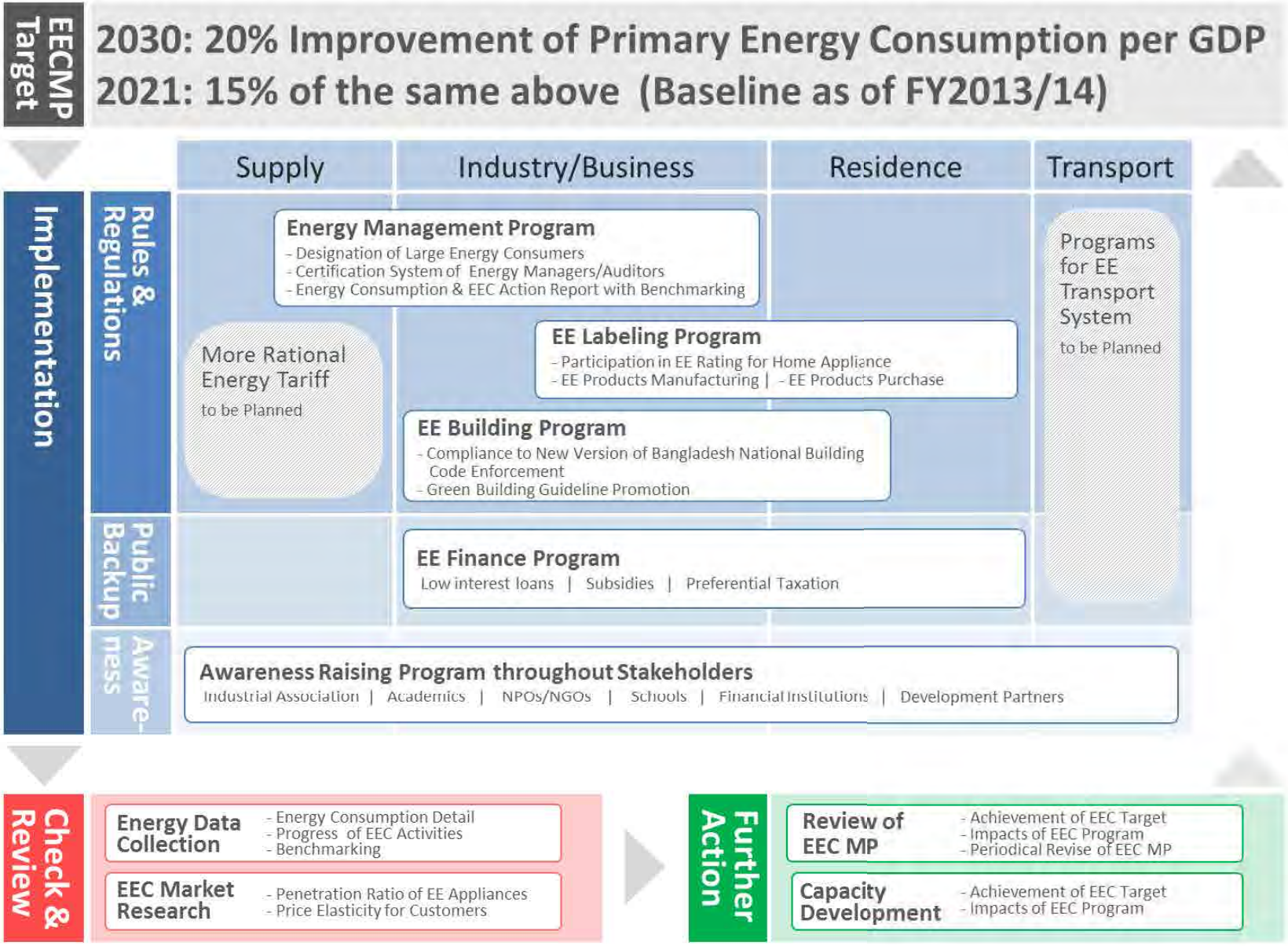
Term		Meaning
Policy	EE&C policy	The general expression of EE&C policy, which includes EE&C programs and other measures, projects and systems for EE&C.
	EE&C program	The programs for EE&C implementation, which should be applied and is being organized.
	EE&C measure	The measure for EE&C, such as heat recovery, EE equipment, heat insulation, energy management, etc.
	EE&C project	The project for EE&C, in which one or multiple EE&C measures are introduced.
Energy	Primary energy	Energy form that is found in nature such as coal, oil, natural gas solar, and wind.
	Secondary Energy	The energy that has been converted from a primary form, either renewable or non-renewable energy, into another energy form, such as gasoline or electricity for distribution and use.
	Commercial energy	The energy such as coal, gas, electricity, etc., which are sold by energy suppliers to energy consumers.
	Non-commercial energy	The energy such as biomass, which is privately produced and consumed.
Party, Sector	Party	Groups of stakeholders such as individuals, business operators, consumers, governments, NGOs, etc.
	Sector	The categorized group of energy consumers, such as industrial sector, business sector, residence, transportation and utility (energy supply).
	Commercial sector	The group of energy consumers, which mainly use energy at the buildings, where the business operators use for their business, such as office, shop, school, theater, hall, airport, etc. The sector includes public and also commercial (private) sectors.
	Transportation Sector	The group of energy consumers, which mainly use energy for transportation vehicles such as car, train, ship and aircraft.
	Residential sector	The group of energy consumers, which mainly use energy at residence for household purpose.
	Energy supply side	The group of energy consumers, which mainly use energy for energy supply, converting or processing the energy, such as electricity supplier. The sector includes public and private sectors.
	Public sector and private sector	The terms are used only when the explanations distinguishing public (government) establishments and private (commercial) establishments are necessary.

Energy Efficiency and Conservation Master Plan

Foreword

Energy has become one of the most important factors for better economic growth and people's life in our country. After decades of dependency on domestic natural gas, we find ourselves not equipped with sufficient energy resources in our land, and will gradually rely on imported fuels. Also, we are well aware that the use of fossil energy increases Greenhouse Gas emission, which accelerates global warming and causes climate change, and suffers our country by natural calamities.

Energy efficiency and conservation is a cross-cutting issue for all the people. We hereby issue the Energy Efficiency and Conservation Master Plan (EECMP), and declare our unyielding commitment of its implementation.


EECMP Target
2030: 20% Improvement of Primary Energy Consumption per GDP
2021: 15% of the same above (Baseline as of FY2013/14)
Implementation
Rules & Regulations
Public Backup
Awareness
Supply
Industry/Business
Residence
Transport
Energy Management Program
- Designation of Large Energy Consumers
- Certification System of Energy Managers/Auditors
- Energy Consumption & EEC Action Report with Benchmarking
More Rational Energy Tariff
to be Planned
EE Labeling Program
- Participation in EE Rating for Home Appliance
- EE Products Manufacturing | - EE Products Purchase
EE Building Program
- Compliance to New Version of Bangladesh National Building Code Enforcement
- Green Building Guideline Promotion
Programs for EE Transport System
to be Planned
EE Finance Program
Low interest loans | Subsidies | Preferential Taxation
Awareness Raising Program throughout Stakeholders
Industrial Association | Academics | NPOs/NGOs | Schools | Financial Institutions | Development Partners
Check & Review
Energy Data Collection
- Energy Consumption Detail
- Progress of EEC Activities
- Benchmarking
EEC Market Research
- Penetration Ratio of EE Appliances
- Price Elasticity for Customers
Further Action
Review of EEC MP
- Achievement of EEC Target
- Impacts of EEC Program
- Periodical Revise of EEC MP
Capacity Development
- Achievement of EEC Target
- Impacts of EEC Program

Executive Summary

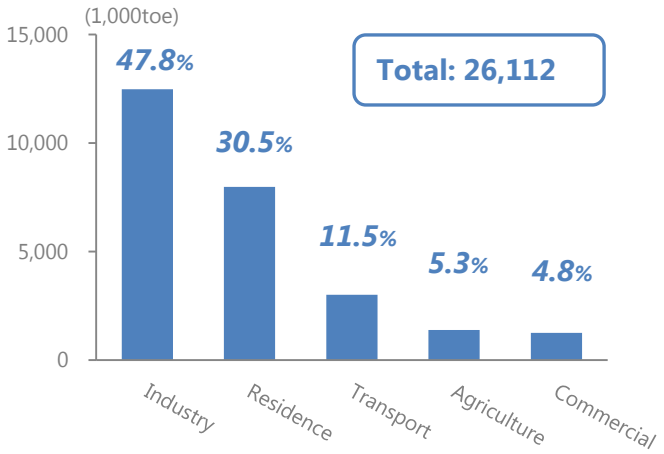
1. Background

1.1 Energy Demand

Bangladesh is a densely populated country with about 161 million people living in 147,570 square kilometers of land. In order to maintain a sustainable GDP growth of 7%/year up to 2020 and beyond, the Government of Bangladesh (GOB) needs to meet the essential energy needs of the people and industries. For this purpose, demand-side energy management is just as important as supply-side infrastructure development. The Sustainable & Renewable Energy Development Authority (SREDA) was thus established by Bangladesh Parliament in May 2012 as a national nodal organization for promoting demand-side energy efficiency and conservation (EE&C) in the country.

A rapidly growing country like our country needs a huge amount of energy to feed its large growth appetite. In the past decade, primary energy consumption increased over 100% and this trend will sure to be continued. We have no room for wasting energy.

Besides the latest sector-wise energy consumption (industrial, residential, transport, agriculture and commercial) is shown in Figure 1-1: industry has the biggest share at 47.8%, followed by residence and transportation at 30.5% and 11.5%, respectively.



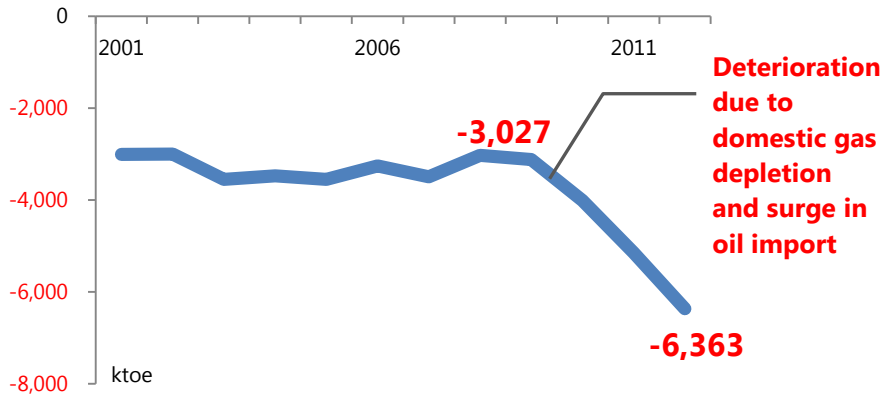
Notes:
1. Primary energy basis: excluding biomass
2. Electricity: 2,867kcal/kWh (thermal efficiency 30% basis

Source: Compiled by JICA Project Team based on the following data; Electricity: 2013-14, Power Cell, Power Division, Ministry of Power, Energy and Mineral Resources | Gas: 2013-14, MIS of Petrobangla, Oil: 2012-13, BPC, | Coal:2012, IEA

Figure 1-1 Primary Energy Consumption by Sector (as of 2013-14)

From the macro point of view, the amount of national energy production stands at 27,187 ktoe, while the amount of primary energy use was 33,550 ktoe, including imported fuel[1]. As shown in Figure 1-2, this gap between national energy production and the amount of primary energy use is becoming larger in the last few years.

[1] IEA country statistics

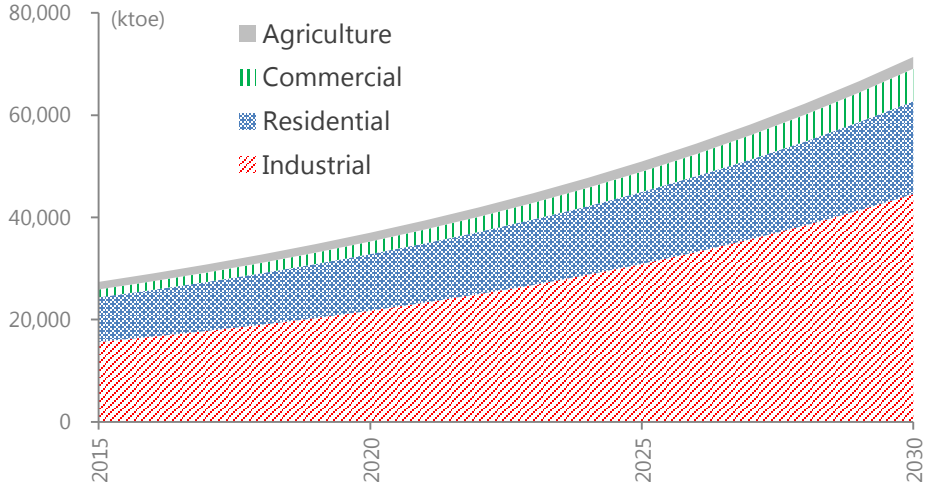


Note: Grid electricity 1kWh-= 2,867kcal (efficiency 30%) basis, excluding biomass

Source: Compiled by JICA Project Team, based on IEA country statistics

Figure 1-2 Gap between National Energy Production and Primary Energy Use (ktoe)

It is estimated that the primary energy consumption (excluding transportation and biomass) will increase approximately three-fold from 27,500 ktoe in 2015 to 71,600 ktoe in 2030 as shown in Figure 1-3. The composition of sector-wise share will not see a significant change; the consumption in industrial sector will remain nearly half.



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

Figure 1-3 Forecast of Primary Energy Consumption in 2030 (BAU Case, Excluding Transportation and Biomass)

1.2 Energy Supply

Our country has been able to exploit its abundant natural gas reserves. Three-quarters of its energy supply depends on natural gas. It is anticipated, however, that the gas supply will reach its peak in 2018 and gradually decrease thereafter. Therefore, the country cannot build another gas fired power plants, but instead resort to other natural resources for power generation, such as oil, LNG and coal. The Government plans to develop the Matarbari Island area to build ports and facilities, which allow imports of coals and liquefied natural gas (LNG) for power generations from after 2021 and 2022, respectively. The development of other type of power

generation (such as nuclear and hydro power) awaits negotiation with partner countries, and seems not able to start operation before 2030.

1.3 Energy Balance in Bangladesh

Our country's primary energy supply is 33,172 ktoe, of which 55% is dependent on domestic natural gas, followed by 27% of biomass & waste in rural area and 15% of imported oil. On the demand side, out of 24,445 ktoe final consumption, the industrial sector uses 24% and residential sector (excluding biomass & waste) 15%, as a secondary energy basis.

1.4 Bangladesh's Vulnerability for Climate Change

Our country is vulnerable for sea level rise, high tide wave and river flood by cyclone potentially caused by the climate change through global greenhouse gas (GHG) emission by fossil fuel consumption. Our EE&C implementation is not only for the economic benefit but also closely links to protecting the country from such disasters.

1.5 Necessity of EE&C Policy and Implementation

Energy Efficiency (EE) means high competitiveness; it means producing more with less energy. Thus earned "energy savings" can be wisely reinvested. Business establishments can reinvest them to expand their businesses. The households can reinvest them for their children's' education and health cares. The Government can invest less in energy subsidies and more in industrial development. After all, our country can grow up more strongly and rapidly.

EE is about national energy security; the Government can reduce import of expensive fuels, which is expected to increase in early 2020's, and improve the international balance of payments.

There is lack of urgency among the general public and industries to save energy under the current situation, where GOB highly subsidizes energy and power sector to lower the costs of fuel and electricity prices for the household and industries. Nevertheless, people and entrepreneurs are wise enough to know the importance of energy saving once they find out the magnitude of economic benefits they can earn, even under the current low energy prices.

It is important for all of us, therefore, to facilitate the installment, execution and proliferation of EE&C Programs as well as to create the momentum to promote energy saving activities among all the general public through EE&C awareness-raising activities.

2. Master Plan

2.1 Objective of Energy Efficiency and Conservation Master Plan

2.1.1 Structure of EE&C Planning and Implementation

The Energy Efficiency & Conservation master Plan (EECMP) is a supreme plan of Bangladesh's initiative on energy efficiency and conservation, of which preparation requirement is stipulated in the Energy Efficiency and Conservation Rules (2014). The Plan declares our country's unyielding commitment for EE&C implementation to our people and to the world. Under the EECMP, all the policies, programs, legal documents (Act, Rules, Regulations, Circulars or Standards etc.) and frameworks are to be established. Figure 2-1 shows the basic structure of EE&C planning and implementation. In EECMP, we clearly indicate Roadmap up to 2030 with Action Plan, consisting of the outlines of legal, institutional and operational frameworks for the effective implementation of EE&C initiatives.

Figure 2-1 Structure of EE&C Planning and Implementation

2.1.2 Cross-cutting EE&C Policies and Actions

EE&C actions are to be taken by all the people and establishments, including governmental organizations and private sectors. EECMP shows a systematic structure of EE&C policies/programs and actions carried out by ourselves. More elaborated plan is to be implemented through cross-cutting discussions among the related stakeholders.

2.1.3 EE&C Potential

EE&C potential is defined as an expected amount or ratio of energy reduction, gained by introducing more effective energy management, EE equipment, insulation and solar control for buildings nationwide. Through the researches, on-site surveys and interviews, EE&C potentials by sector were estimated as follows.

(1) Industrial Sector

Manufacturing industries in our country are not efficient in energy use, because of the continuous usage of old/ mal-maintained machines and poor energy management. We estimated that, through energy intensity comparison and actual on-site energy audits, the accumulating EE&C potential in industrial sub-sectors amount to around 21% of the entire industrial sector consumption. Considering the fact that about 50% of national primary energy is consumed in the industrial sector, the potential economic impact of EE&C measures is massive: almost 10.5% of the total energy consumption in the country can be reduced.

(2) Residential Sector

If all the existing home appliances in residences are to be replaced by higher efficiency products (as of today), huge energy reduction can be achieved. It is estimated that EE&C potential is 28.8% in the total energy consumption in the residential sector. Considering the fact that about 30% of national primary energy is consumed in the residential sector, the potential economic impact of EE&C measures is massive: almost 8.6% of the total energy consumption in the country can be reduced.

(3) Commercial Sector (Buildings)

Electricity is the main mode of energy in commercial buildings. In detail, nearly 50% of the total energy is consumed by ACs and 10-30% by lighting systems. 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%.

(4) Agricultural Sector

Electricity (incl. 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%.

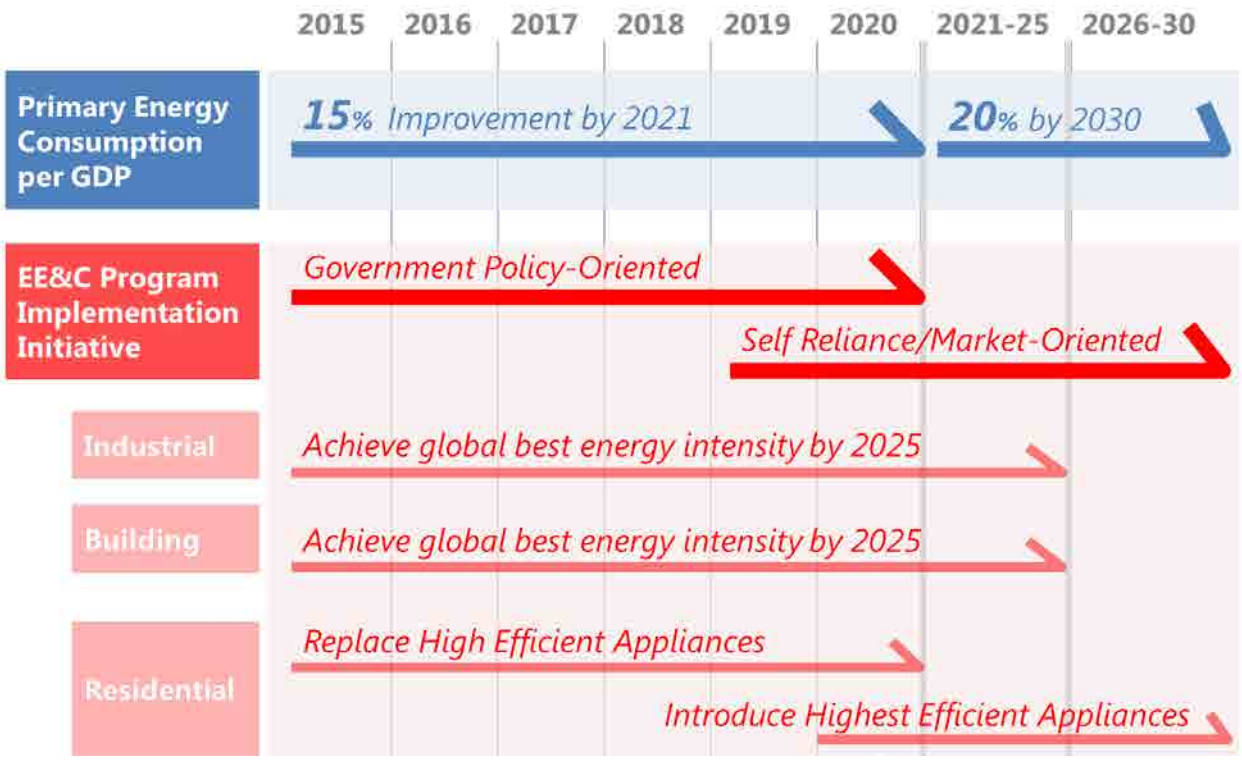
2.2 Toward "Self-Reliant EE&C Society": Target and Implementation Roadmap

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 our country. 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 our country. Energy consumption per GDP can consider both energy efficiency and national economic growth. In this EECMP, therefore we apply “primary energy consumption per GDP” as an indicator to set EE&C target and evaluate future national energy efficiency.

While identifying a huge EE&C potential, we must 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. Here 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, respectively 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)



And in order to achieve the above mentioned target in 2021 and 2030, we must take immediate actions under the leadership of the Government.

3. Action Plan

3.1 Overview

The Action Plan, containing the EE&C policies, programs, frameworks and organization structure, is prepared to show a practical methodology to achieve and accomplish the targets set in EECMP.

3.2 Roles and Responsibilities

EE&C implementation is a multi-sector issue, which should be tackled with the participation of all interested parties including the people and private/public establishments. Our EE&C activities are interconnected with each other. Some organizations have roles and responsibilities to support and enforce rules, and/or EE&C awareness and dissemination. Table 3-1 shows major roles and responsibilities of the participating parties.

Table 3-1 Roles and Responsibilities of Participating Parties

Party	Roles and Responsibilities
MPEMR	■ Responsible ministry for EE&C policy planning and implementation ■ Overall planning and development of electricity, gas and energy sector
SREDA	■ Implementing body to promote EE&C nationwide ■ Multi-sector / cross-cutting coordination of EE&C policies among all governmental organizations and non-governmental organizations ■ Nationwide monitoring of energy consumption and EE&C implementation ■ Reporting energy consumption status to the people
Local Governments	■ Administration of New version of Bangladesh National Building Code (BNBC [Revised]) and Green Building Guideline (GBG) ■ Initiatives on EE&C activities in office, projects and own procurement
Utility Companies (energy supplier)	■ Energy conservation improvement in plants ■ Transmission efficiency increase in supply system ■ Functional tariff system formulation/introduction for EE&C incentives
Establishments, People and Society	■ Compliance of EE&C Rules and regulations ■ Preparedness / acceptance for future energy/power price increase and risks
Energy Experts, Academics and Researchers (including those at labs)	■ Leading EE&C implementation initiative ■ Network/community development among energy experts
Educational Institutions	■ Awareness raising for students

3.3 EE&C Programs

Action Plan for the major EE&C programs is summarized in Table 3-2. Necessity of the programs, program outline and implementation methodology, stakeholders' roles and responsibilities, roadmap and expecting outcomes are introduced. These programs have been introduced in the advanced countries, as well as in our neighboring countries. EE&C programs for transportation and energy supply sectors and the issue of energy tariffs are not included in EECMP, and policies/programs on these remaining fields will be studied and revised EECMP will be issued in the near future.

Here, Energy Management Program is mainly focused on the promotion of energy efficiency in the industrial sector, EE Labeling Program in residential sector and EE Building Program in buildings. Other EE&C programs (such as those of finance and data collections) concern all industrial, residential and commercial sectors.

Table 3-2 Summary of EE&C Programs in Action Plan

Program	Target	Methodology
Energy Management Program (EMP)	Large Industrial Energy Consumers	■ Large energy consumer designation ■ Energy Manager, Certified Energy Auditor and Accredited Energy Auditor certification with qualification and examination system ■ Energy audit (mandatory/voluntary) ■ Energy consumption reporting (mandatory) ■ Benchmarking
EE Labeling Program (EELP)	Residential Consumers	■ Label certification / Laboratory accreditation system ■ Standardization of EE measurement method and Star Label Rating criteria ■ Star Label Standardization (Unification) ■ Participation of manufactures, importers and retail shops (mandatory/voluntary) ■ MEPS (Minimum Energy Performance Standard)
EE Building Program (EEBP)	Buildings	■ New version of BNBC [Revised] Implementation ■ GBG development ■ Manual and assessment system introduction
EE&C Finance Incentive Program	Private Companies	■ Low-interest loan for EE&C investment ■ Preferential taxation on high efficiency equipment/appliances and/or EE&C investment ■ Subsidy for EE&C investment ■ Other incentive mechanisms
Government's Own Initiatives	Government	■ Green Purchase Program for Eco-friendly public procurement ■ Obtain ISO14001 and 50001 certification
Energy Consumption Data Collection	Government	■ Energy consumption data by fuel ■ Energy consumption data by sector and sub-sector ■ Energy intensity data
Global Warming Countermeasure	All	■ Formulation and quantification of national carbon market ■ Carbon abatement project as capacity development ■ Awareness raising

3.4 Monitoring and Review of EE&C Programs

3.4.1 Monitoring and Data Collection

Periodical monitoring and data collection of indicators on the energy consumption in various sectors are key factors of success in EE&C implementation. The web-based information collecting mechanism proposed under this EECMP will ensure a smooth data accumulation which enables appropriate PDCA (Plan-Do-Check-Act) cycle of the entire EE&C policies.

3.4.2 Review of EECMP

All the data are maintained by SREDA as a regulatory authority for EE&C initiative. SREDA is mandated to analyze the data in order to review the progress of EECMP and its subordinate programs. The annual reporting is conducted as the follow-up of EECMP to the Joint Coordination Committee, which is chaired by the Chairman of SREDA with participation from all the relevant ministries/agencies. Results of the review will be reflected in details in Action Plan. The annual report will be uploaded on SREDA website for disclosure to the public.

3.4.3 Revision of EECMP

EECMP will be periodically revised along with the progress of EE&C initiatives in accordance with the development of EE&C programs. The Government intends to make the next revision in five years: i.e., in the year 2020.

4. Economic Analysis

4.1 Overview

Economic viability of each EE&C measure has to be verified by the cost-benefit analysis; clarifying and comparing its costs and benefits. Although energy consumption reduction is the primary and direct benefit of EE&C measures, secondary and indirect benefit should, in some cases, be taken into consideration in order to justify the costs involved. From the viewpoint of effective allocation of limited resources, the Government will compare candidate EE&C measures and projects according to their cost effectiveness (or costs per unit of energy saved), since the Government has a responsibility in prioritizing allocation of limited resources to economically viable projects and to avoid implementation of projects with less economic values.

4.2 Economic Impact of EE&C Programs as a Whole

By achieving the target of 20% improvement of primary energy consumption per GDP, a total of approx. 66 Mtoe (or 78 billion m3 of gas equivalent) is expected to be saved within the 15 years between 2016 and 2030. The total energy savings in monetary terms will amount to approx. BDT 530 billion in the period or an annual average of BDT 35 billion, at the current weighted average natural gas price[2]. The energy intensity in 2030 will be improved by 20% compared to the 2013 level and the energy consumption in 2030 will be reduced by 17% (or by 12 Mtoe) compared with the BAU case.

[2] Based on the recent gas tariff proposal, weighted average tariff is calculated as 195BDT/MCF, raised from the current 140.6BDT/MCF. 195BDT/MCF is equal to 6.8BDT/m3 (1MCF = 28.3m3)

4.3 Cost Effectiveness Analysis of EE&C Programs

Energy-saving activities promoted under EECMP will directly affect power supply through reduced power demand. If the power demand can be gradually reduced in the period between 2015 and 2030 to reach 20% reduction in 2030 compared with BAU (i.e., a total of 42 GW reduction), power supply can be saved by 48 GW, which implies that the necessary development of additional power supply capacity can also be reduced by 8 GW from 27 GW to 19 GW. As a result, the amount of imports of expensive fuels for power generation will decrease remarkably: The total energy savings would amount to BDT 2.3 trillion (or an annual average of BDT 135 billion), which is equivalent of 6% of national budget and 1% of GDP (2013).

5. Capacity Development and Awareness Raising

For successful implementation of EE&C initiatives, all the stakeholders such as governmental organizations, private sectors and energy experts must accurately understand the urgency and necessity of EE&C. Close cooperation/collaboration among them is essential as well. Thus, the Government will promote the provision of EE&C awareness raising and information dissemination programs.

The Government will initially lead and take the primary responsibility for the capacity development and awareness raising on the EE&C policies/programs for all the stakeholders. Considering the importance of EE&C for our country, however, such roles will also be taken by relevant private sectors, NPO/NGO and individuals in the long run.

The final goal is for all the people and the establishments to take voluntary EE&C actions.

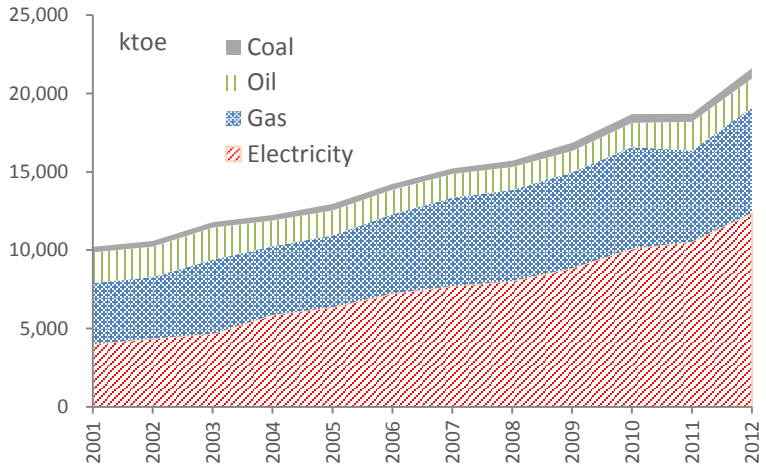
Chapter 1 Introduction

1.1 Background

1.1.1 Energy Demand

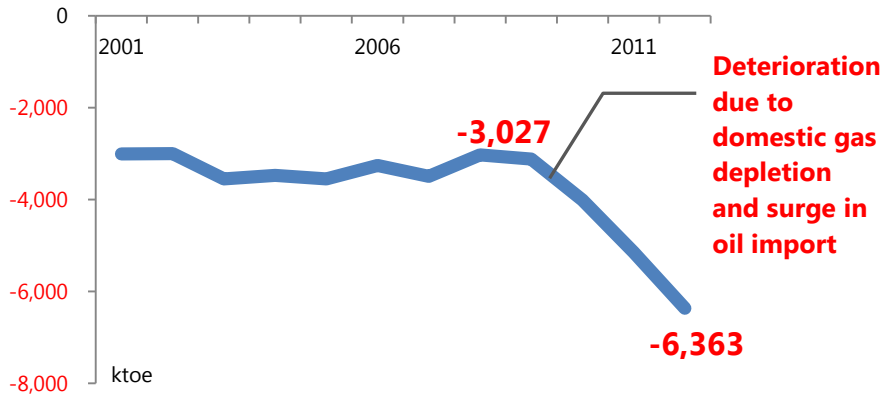
(1) Overall

Bangladesh is one of the lowest among the world in the primary energy consumption per capita. However, from the macro point of view, primary energy consumption has been increasing steadily, as shown in Figure 1.1-1. And the amount of national energy production stands at 27,187 ktoe, while the amount of primary energy use was 33,550 ktoe including imported fuel[3]. As shown in Figure 1.1-2, this gap between national energy production and the amount of primary energy use is becoming larger in the last few years. The risk of further deterioration is foreseeable as the country's industrialization accelerates. Therefore, it is an utmost importance for the Government to take leadership in controlling the energy use by implementing appropriate EE&C plan, programs and measures and therewith promote energy efficiency in the entire economy.



Source: Compiled by JICA Project Team, based on IEA data, excluding transportation and biomass electricity
1kWh=2,867kcal thermal efficiency 30% basis

Figure 1.1-1 Trend of Primary Energy Consumption by End-use



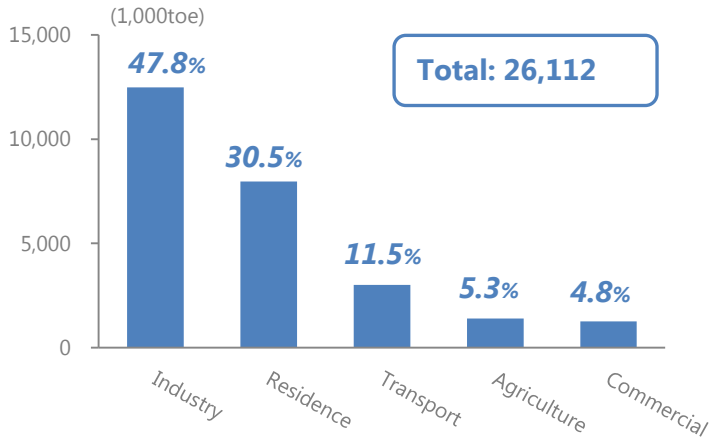
Note: Grid electricity 1kWh-= 2,867kcal (efficiency 30%) basis, excluding biomass
Source: Compiled by JICA Project Team, based on IEA country statistics

Figure 1.1-2 Gap between National Energy Production and Primary Energy Use (ktoe)

[3] IEA country statistics

(2) Energy Consumption by Sector

Our country's energy consumption by sector (industrial, transportation, commercial and residential sectors) is shown in Figure 1.1-3. The largest energy consuming sector is industry, followed by residential and transportation sectors.



Notes:
1. Primary energy basis: excluding biomass
2. Electricity: 2,867kcal/kWh (thermal efficiency 30% basis)

Source: Compiled by JICA Project Team based on the following data; Electricity: 2013-14, Power Cell, Power Division, Ministry of Power, Energy and Mineral Resources | Gas: 2013-14, MIS of Patrobangla, Oil: 2012-13, BPC, | Coal:2012, IEA

Figure 1.1-3 Primary Energy Consumption by Sector

(3) Energy Consumption by Energy Type and Sector

Gas and petroleum are the main sources of primary energy to meet our energy demand. Of the total gas consumption, the shares of industrial and residential sector are 56.3% and 29.3%, respectively. As for the shares in total petroleum (oil) consumption, transportation sector has the largest share (59.8%), followed by agriculture (25.8%) and residential sectors (9.0%, in the form of kerosene oil). (See Table1.1-1) Besides electricity consumption by sector is shown in Table 1.1-2. Residential and industrial sectors occupy the largest shares.

Table 1.1-1 Gas and Petroleum Use

	Industry	Transport	Residence	Commercial	Agriculture
Gas	56.3%	11.6%	29.3%	2.6%	0.2%

Excluding Grid and captive power

	Industry	Transport	Residence	Commercial	Agriculture
Oil	4.9%	59.8%	9.0%	0.5%	25.8%

Excluding power

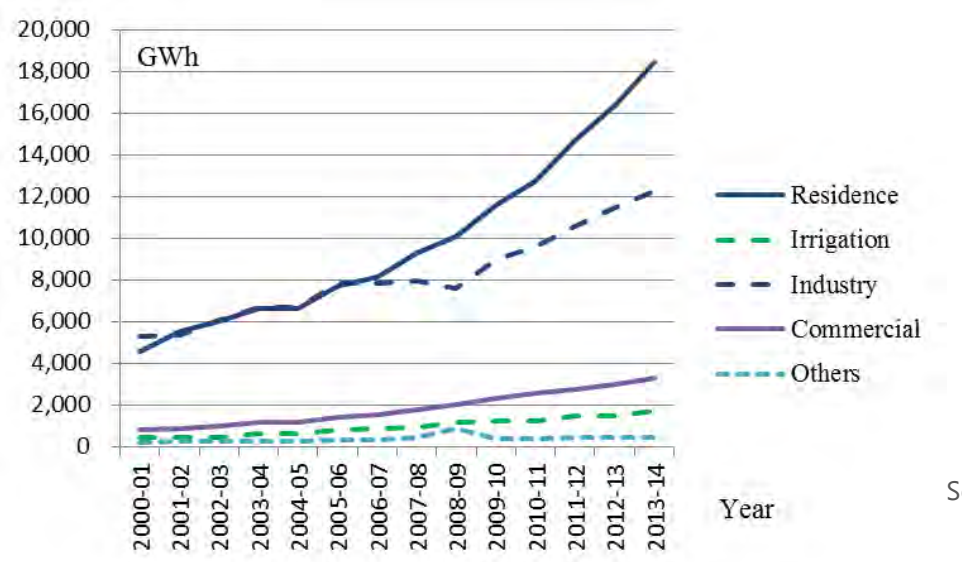
Source: Gas MIS of Patrobangla, 2013-2014, Petroleum BPC, 2012-2013

Table 1.1-2 Grid Electricity Consumption by Sector

	Industry	Transport	Residence	Commercial	Agriculture
Electricity	34.3%	0.0%	51.0%	9.9%	4.8%

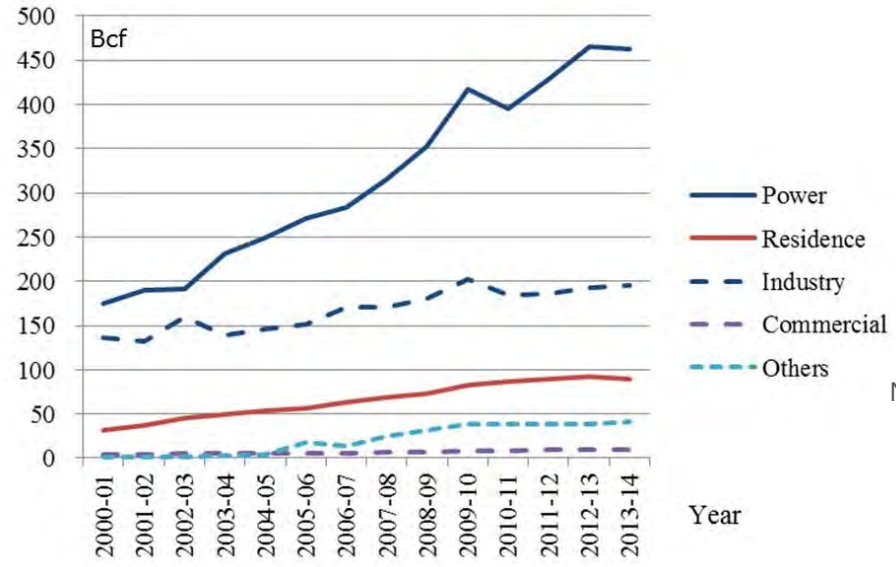
Source: Power Cell, Power Division, MPEMR, 2013-14

Energy supply companies (energy and power suppliers) and industrial sectors are the main consumers of energy and responsible for the increase of primary energy consumption as shown in Figure 1.1-4 and 1.1-5.



Source: System Planning Directorate, BPDB

Figure 1.1-4 Trend of Consumption of Grid Electricity by Sector

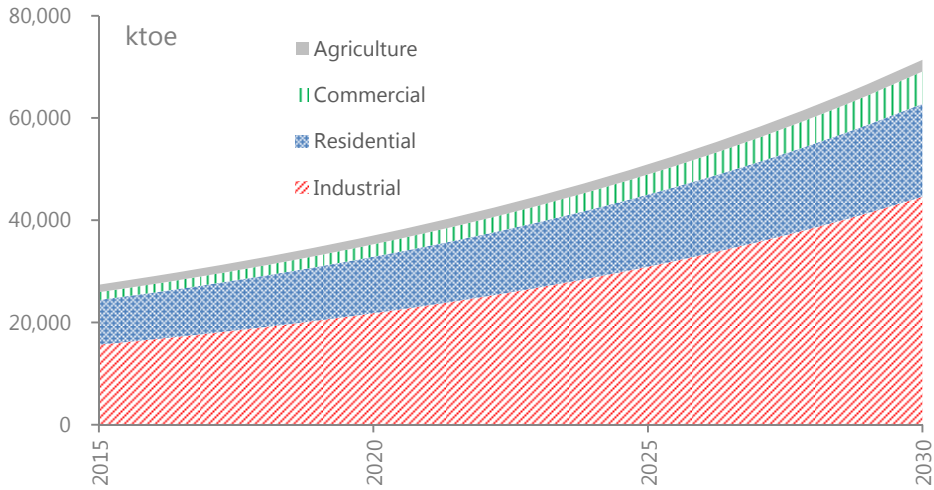


Note: Power includes captive, others includes tea estate, brick field and CNG
Source: Source: Petrobangla database

Figure 1.1-5 Trend of Natural Gas Consumption by Sector

(4) Energy Consumption Forecast for 2030

Figure 1.1-6 shows the forecast of primary energy consumption by sector up to 2030. Primary energy consumption in 2030 will be around three times as that of 2013-14.



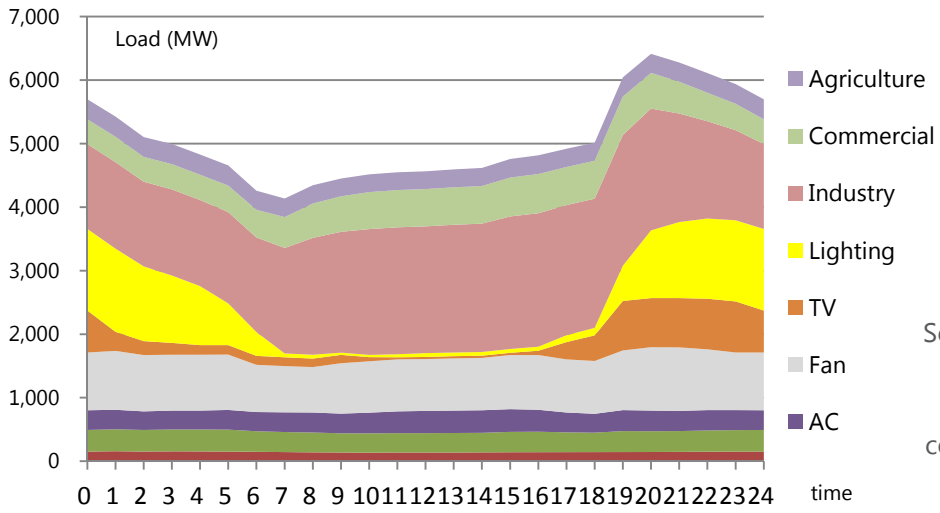
Source: Compiled by JICA Project Team, based on the present energy consumption data and forecast of future growth rate by sub-sector derived from UNFCCC Second National Communications, Oct. 2012

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Industrial	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	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	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	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 (BAU)	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	184	183	181	180	178	177	177	176	175	175	174	174	174	174	174	174

Figure 1.1-6 Primary Energy Consumption Forecast for 2030 (BAU Case)

(5) Daily Electricity Load Curve

Electricity daily load curve fluctuates by season and by day of the week. However throughout the year, the peak appears in the evening. Lighting, TV and other electric appliances in the residential sector may cause the evening peak as shown in Figure 1.1-7. Therefore, electricity saving in the evening is the most effective action to reduce the use of limited electricity supply capacity.



Source: Compiled by JICA Project Team, based on BPDB's data, hourly consumption pattern was estimated by the Team

Figure 1.1-7 Estimated Breakdown of Grid Electricity Daily Load Curve (31 May 2014)

1.1.2 Energy Supply

(1) Overall

Bangladesh to date has been able to exploit its abundant natural gas reserves. As shown in Figure 1.1-8. Around third quarters of its energy supply depended on natural gas.

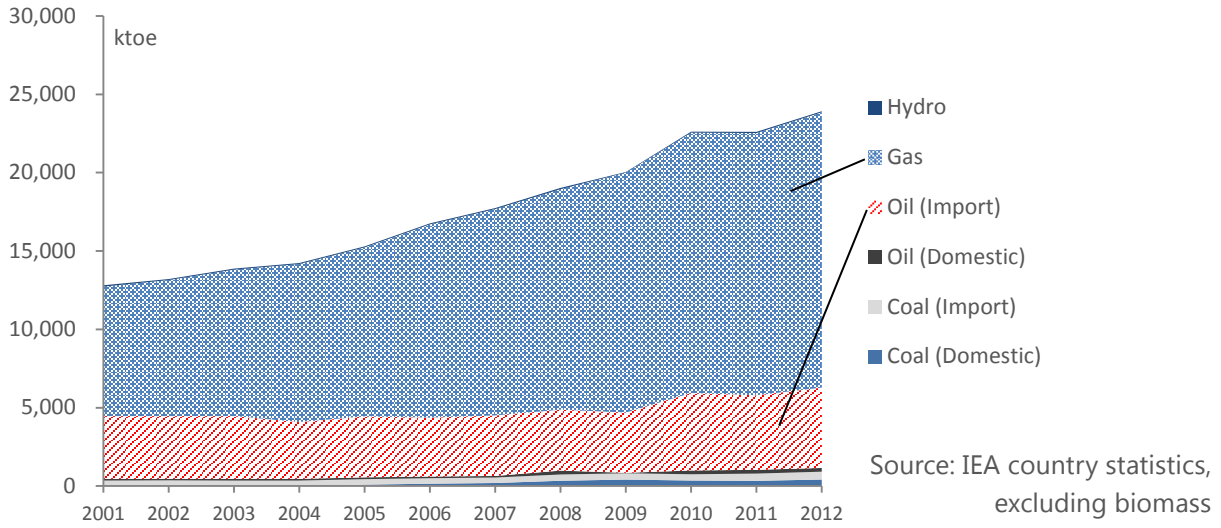


Figure 1.1-8 Trend of Source of Energy Supply

(2) Electricity Supply Trend

The peak load deficit (shortage) has resulted in regular load shedding (cut) during the peak hours. Electricity demand is growing at over 10% per year, owing to rapid population growth, industrialization, expansion in grid connection and increase in the use of electrical appliances. Due to this rapid increase in power demand, the present peak load deficit (shortage) is becoming even larger than those in the earlier decades. (Final Energy Efficiency Technical Report-Bangladesh (Revised), ADB RETA 8025, September 2012)

(3) Electricity Generation Fuel Mix

Table 1.1-3 shows the present fuel mix used for electricity generation in our country. As noted, electricity strongly relies on fossil fuels.

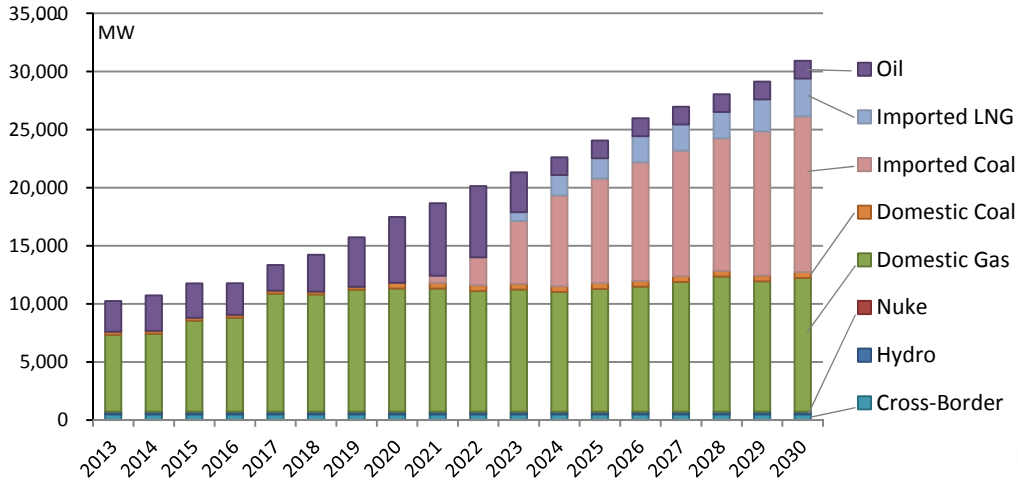
Table 1.1-3 Electricity Generation Fuel Mix (2013-14)

Total	Type	Share
Electricity generation: 42,195 GWh	Hydro	1.39%
	Gas	72.42%
	HFO	15.44%
	HSD	2.91%
	Coal	2.46%
	Import from India	5.37%

Source: System Planning Directorate, MPEMR

(4) Electricity Supply Expansion Plan

It is anticipated that the gas supply will reach its peak in 2018 and gradually decrease thereafter. Therefore, the country cannot build another gas fired power plants, but instead resort to other natural resources for power generation, such as oil, LNG and coal, as shown in Figure 1.1-9. The Government plans to develop the Matarbari Island area to build ports and facilities which allow imports of coal and liquefied natural gas (LNG) for power generations from after 2021, respectively. The development of other type of power generation (such as nuclear and hydro power generation) awaits negotiation with partner countries, and seems not able to start operation before 2030. The Government has prepared Power System Master Plan 2010 (PSMP) to improve and expand electricity supply as shown in Table 1.1-4.



Source: Estimation of JICA expert revising the forecast in JICA Power Supply Master Plan, 2010

Figure 1.1-9 Forecast of Transformation of Power Generation Resources

Table 1.1-4 Electricity Supply Expansion Plan

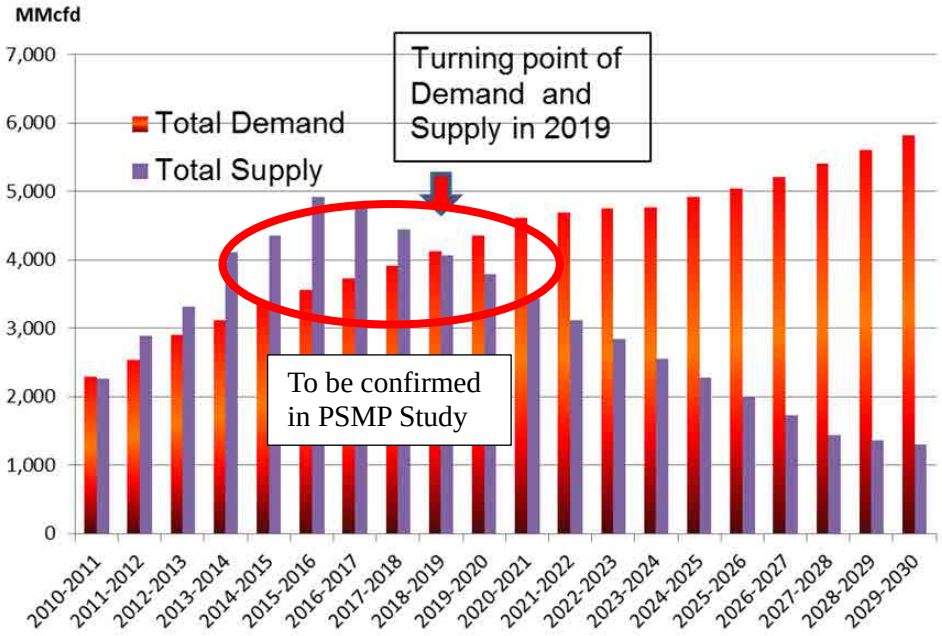
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Domestic Gas	4,291	4,821	4,775	5,715	7,317	9,379	9,829	10,699	11,449	11,449
Domestic Coal	200	200	200	200	450	450	450	450	450	1,650
Imported Oil (HFO, HSD)	411	1,918	2,898	3,083	3,174	2,623	2,623	1,409	1,409	1,609
Hydro	230	230	230	341	341	341	341	341	841	841
Cross-Border	0	0	0	500	500	500	500	500	500	500
Imported Coal	0	0	0	0	0	0	1,200	3,000	3,600	3,600
Imported LNG	0					0	0	0	0	0
Nuclear	0	0	0	0	0	0	0	0	1,000	1,000
Total	5,132	7,169	8,103	9,839	11,782	13,293	14,943	16,399	19,249	20,649

2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
12,163	12,163	11,865	11,558	11,370	10,771	10,442	10,267	9,907	9,032	8,854
1,650	2,250	2,850	3,450	4,650	4,650	5,250	6,250	8,250	10,250	11,250
1,755	1,855	1,955	2,055	2,055	2,155	2,355	2,455	2,555	2,240	2,240
841	941	941	1,941	1,941	1,941	1,941	1,941	1,941	1,941	1,941
500	1,000	1,750	1,750	1,750	2,000	2,000	2,000	2,000	2,000	2,000
3,600	3,600	3,600	4,200	4,200	4,200	5,400	6,600	6,600	7,800	8,400
0	0	0	0	0	0	0	0	0	0	0
2,000	2,000	2,000	2,000	3,000	4,000	4,000	4,000	4,000	4,000	4,000
22,509	23,809	24,961	26,954	28,966	29,717	31,388	33,513	35,253	37,263	38,685

Source: PSMP 2010, MPEMR to be reviewed in PSMP in 2015

(5) Natural Gas Production

Domestic gas supply will increase in the next few years, however it is estimated that it will soon reach the peak production and then decline and the demand will exceed the supply as shown in Figure 1.1-10. This means, we will have to import natural gas from abroad.



Source: Compiled by JICA Project Team based on the data from

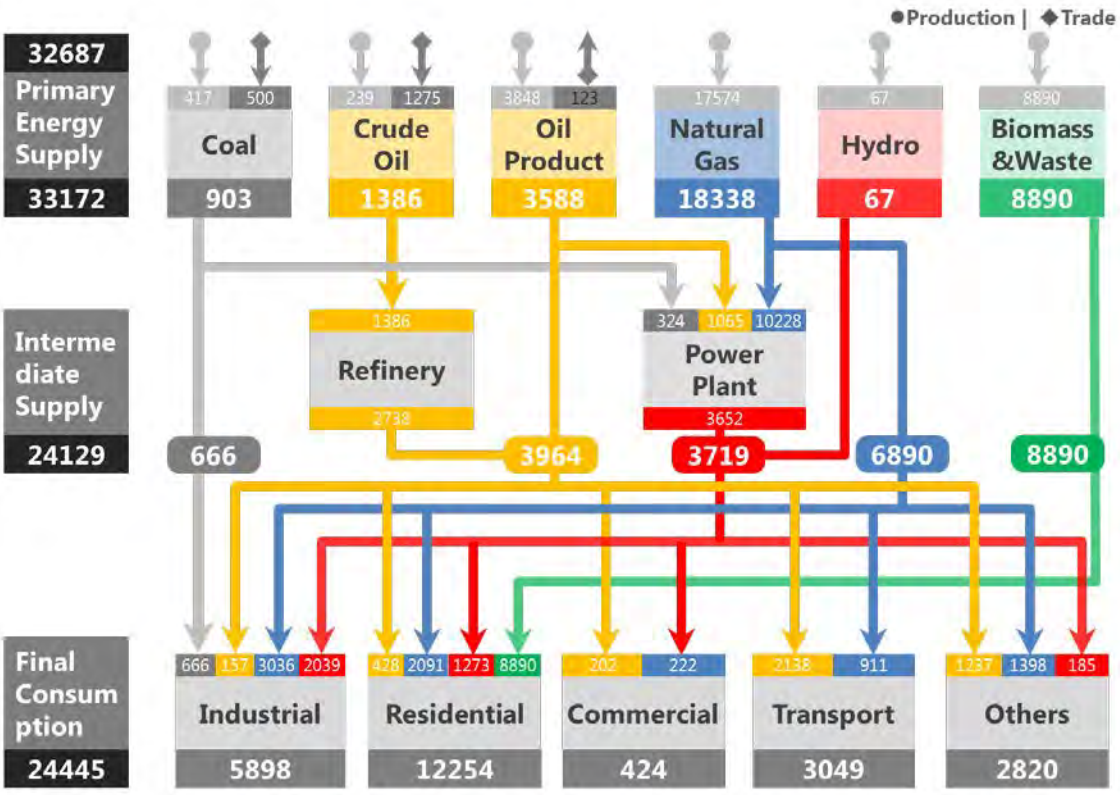
Data collection survey on Bangladesh natural gas sector", 2012, JICA

Figure 1.1-10 Domestic Natural Gas Production and Demand

It is expected that in the EE&C scenario (20% energy efficiency improvement by 2030), the electricity demand in 2030 will be reduced by approx. 7GW compared to the BAU case and cumulative power demand reduction in the period between 2015 and 2030 will amount to 42 GW, with an additional power generation capacity development of 8 GW saved. This will lead to the decrease in the amount of fuel imports for power generation, resulting in a cumulative savings of DBT 2.3trillion (or an annual average of DBT 135billion) from 2015 to 2030. This average annual savings are equivalent of 6% of national budget and 1% of GDP (2013).

(6) Energy Balance in Bangladesh

Figure 1.1-11 shows the energy balance of Bangladesh in 2012, based on the data from International Energy Agency (IEA). Our primary energy supply is 33,172 ktoe, of which 55% is dependent on domestic natural gas, followed by 27% of biomass & waste in rural area and 15% of imported oil. On the demand side, out of 24,445 ktoe final consumption, the industrial sector uses 24% and residential sector (excluding biomass & waste) 15%.



Source: Compiled by JICA Project Team based on IEA country statistics (2012 data)

Figure 1.1-11 Energy Balance in Bangladesh (2012)

1.1.3 Global Warming and Our Country's Vulnerability for Climate Change

(1) Global Warming Issues

Release of CO_2 to the atmosphere, mainly due to the burning of fossil fuels is the major driver of Global Warming. The consequence of such warming is being anticipated as a very serious global issue for several decades and has started to raise global awareness mainly after the United Nations Conference on the Human Environment, hold at Stockholm from 5 to 16 June 1972.

Since 1988, United Nations created a technical unit, called as the Intergovernmental Panel on Climate Change (IPCC) to study, analyze and make recommendations on how to mitigate global warming, how to adapt human society to live in a warming world, and finally how to precisely understand all scientific aspects of climate.

Nowadays significant number of scientific work, dealing with Climate Change, has been produced and are available as free literature, five very complete assessments, covering Climate Change science, Climate Change adaptation and Climate Change mitigation had been officially produced by the UN designated body (IPCC), and several national and international policies are implemented, mostly to mitigate Climate Change. Unfortunately, as reported in the freshest IPCC report[4], published in early 2014, the world is still following an unsustainable path, regarding the Global Warming issue. In the decade of 2001-2010, CO_2eq emissions have grown faster than in all the previous decades where emission data are

[4] The Fifth Assessment Report – Working Group III - Mitigation

available. Keeping the present trend, by the year 2100, average global temperature shall be around 4ºC above pre-industrial figure, which is by far above globally agreed pledges set at the Cancun Conference of the Parties, which requires global temperature should not increase by more than 2ºC, above the pre-industrial average, in any date in the future.

Some of the most relevant international action plans, like the Kyoto Protocol, which had its first committed period concluded by the end of 2012, achieved some partial success on GHG mitigation, but shall achieve more modest results under the second period, which are presently in effect. Future international and/or national agreements on a more ample action plan has been agreed, by all participants of the UNFCCC[5] , to be set until the end of 2015, and become effective by 2020. Huge expectations exist that in the COP[6] to be held in Paris, at the end of 2015, the new agreement will be finalized.

In the meantime, it is notorious the Government, the society, and the major establishments concern with the Climate Change issue, and a plan like this one, being elaborated for our country, should take into account such issue.

In reality, EECMP, is naturally aligned with Climate Change mitigation, since one of the five mitigation options[7], identified by IPCC, is energy efficiency either when using or producing it. What has to be considered in the EECMP is how to manage potential conflicts due the higher cost of clean technologies when compared with traditional ones. Such costs include investment and operational expenses, as well as indirect costs due social and environment improvements, usually associated with the practice of clean technologies. When performing the full cost evaluation, it is necessary to add investment cost, which probably occurs immediately, with operational, social and environmental costs distributed during many years, during the full life of the project.

Furthermore, political and strategic consideration must be included, on top of cost evaluation, for the final decision when embracing a project. The political aspect includes items like the prestige of the country regarding its action on minimizing a global issue, as is the case for Global Warming, the reaction of its population to certain technology or policy and, the possibility of receiving financial reward, from the international community. Strategic decisions shall consider the relevance of a new technology regarding the economic contribution for the country development, through creation of new jobs and activities in the country.

In conclusion, it is transparent from the above discussion that all suggested actions must include Climate Change impact analysis, even for countries where the GHG emissions are small compared with the major emitter countries, and that are well recognized internationally as deserving further supply of energy to guarantee its development to reasonable pattern, as is our country's case.

[5] UNFCCC = United Nations Framework Convention on Climate Change

[6] COP = Conference of the Parties is the supreme forum for decisions regarding actions between the more than 190 countries and parties signatories of the UNFCCC.

[7] The other 4 are: Decarbonisation of fossil fuels, Biological carbon sequestration, More use of renewable energy resources, and Reducing other greenhouse gases from industry, agriculture, waste management

(2) What is Impact of the Global Warming?


Sea level rise, caused by melt of glacier and thermal expansion

Rare animals which can live only in specific climate condition may be eradicated

Prevalent area of tropical epidemics such as malaria will expand


Climate change will bring desertification, high tide and wave

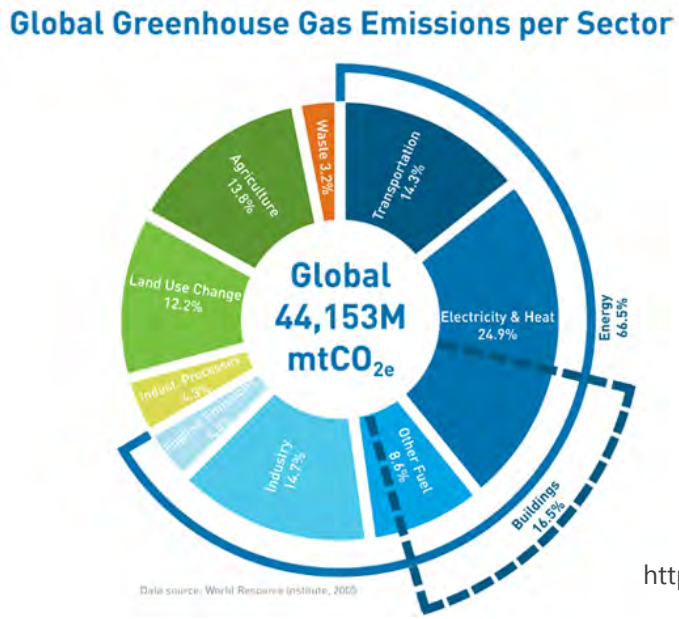
Not only the climate change, but also noxious insects increase brings agricultural damage and cause scarcity

Source: JCCCA (Japan Center for Climate Change Actions) http://www.jccca.org/english/

Figure 1.1-12 Impact of Global Warming

(3) GHG (CO_2) Emission in the World

70% of GHG in the world comes from energy consumption. Therefore, EE&C will mostly contribute global warming countermeasure.



Source: http://greenblog.typepad.com/d41e/global/

Figure 1.1-13 GHG (CO2) emission in the world

1.1.4 Necessity of EE&C Implementation and Policy/Program Establishment

There is lack of urgency among the public and industries to save energy under the current situation where GOB highly subsidizes energy and power sector to lower the costs of fuel and electricity prices for the household and industries. Nevertheless, people and entrepreneurs are wise enough to know the importance of energy saving once they find out the magnitude of economic benefits they can earn, even under the current low energy prices.

It is important for the Government, therefore, to facilitate the installment, execution and proliferation of EE&C Programs as well as to create the momentum to promote energy saving activities among all the general public through EE awareness-raising activities.

Under this EECMP, three EE&C programs will be promoted, namely, Energy Management Program, EE Labeling Program and EE Buildings Program, which will be targeted at large energy consuming establishments and equipment in the industrial, residential and commercial sectors. During the period between 2015 and 2030, a total of 4.4Mtoe/ year or an energy saving of over BDT 35 billion/year based on end user energy prices can be achieved through the adoption and implementation of the three EE&C Programs.

In addition, the Government considers it important to provide EE Finance Program to raise EE awareness among the power end users and boost their investments in EE products. Financial incentives such as loan interest loans, subsides and preferential tax will be provided to lessen the financial burden (initial cots) of end users who will purchase high energy efficient electric appliances and industrial equipment.

1.2 Objective of Energy Efficiency and Conservation Master Plan

EECMP was drafted to realize the following objectives.

(1) National plan under EE&C Rules

EECMP is the supreme plan of national policies on EE&C. Issue of EECMP is indicated in EE&C Rules (2014).

(2) Our Country's Commitment on EE&C Implementation

EECMP shows our country's commitment for EE&C implementation, declaring it to the people and also to the world. Therefore, clear EE&C targets and roles and responsibilities of all parties are presented.

(3) EE&C Awareness and Dissemination Tool

EECMP should be read by not only government people, but also widely by all the people and establishments in our country. For this purpose, the contents are written in easy terms with explanations. The EECMP can be used as a text book of EE&C.

(4) Sorting of Cross-cutting EE&C Policies/Programs and Actions

EE&C actions are to be taken by all the people and establishments, including governmental organization, individuals, NPO/NGO and other establishments relating to each other. EECMP shows a systematic structure of EE&C policies/programs and actions and a sorting of cross-cutting EE&C policies/programs and actions.

1.3 Existing Policies on Energy Supply and Energy use Including Acts, Rules, Regulations, Standards, Guidelines and Projects

1.3.1 Overview of Policies Issued

MPEMR, which is the authority to deal with the issues on energy, has issued plans and regulations as shown in Table 1.3-1.

Table 1.3-1 Plans and Regulations Issued by MPEMR

Name of plan/ regulation	Issued by
Sustainable and Renewable Energy Development Authority Act, 01 (Act No. 48 of 2012)	10 Dec. 2012
Energy Efficiency and Conservation Rules	Initial Draft 22 October 2012
Interim Action Plan for Improvement of Energy Efficiency & Conservation (2012-2016)	Final Draft 14 Oct. 2012
Action Plan for Energy Efficiency and Conservation	Power Division, MPEMR,
The Electricity Act	1910 (under revision)
The National Energy Policy	1996 (under revision)
Policy Guidelines for the Enhancement of Private Participation in the Power Sector 2008	2008
Renewable Energy Policy of Bangladesh	2008 (under revision)
Power System Master plan-2010	2010
Gas Act 2010	2010

Other governmental organizations also have issued plans and regulations relating to energy and EE&C as shown in Table 1.3-2.

Table 1.3-2 Plans and Regulations Issued by Other Governmental Organizations

Name	Issued by, date
Environment Conservation Rules (ECR) 1997	1997
Bangladesh Energy Regulatory Commission Act 2003	2003
Bangladesh Climate Change Strategy and Action Plan 2009	2009
Sixth Five-year Plan (2011-15)	2010
BSTI Ordinance	BSTI
GHG emission	MOEF
National Building Code	MOHPW

1.3.2 On-going EE&C Programs and Projects

In accordance with the EE&C plans and regulations mentioned above, several programs and projects are on-going as listed in Table 1.3-3:

Table 1.3-3 On-going Programs and Projects

Name of program/project
National Building Code
Text Book Curriculum of schools, madrasas and colleges
CFL, T- 5 tube light, electronic ballast
Free CFL Distribution program
Energy Star Labeling Program (fan, AC, refrigerator, CFL bulb, ballast and electric motors)
Efficient Rice husk Parboiling Program
Improved Cook Stove Program
Improving Kiln Efficiency in the Brick Manufacturing Industry
Electricity Week program
Energy audits by Energy Audit Cell under Electrical Advisor and Chief Electrical Inspector

1.4 Stakeholder's Participation in EE&C Planning and Policy Making

Nobody can live without energy, and all of us have responsibility on energy use. In order to mobilize EE&C activities nationwide, EE&C policies and programs should be prepared getting as much as opinions and ideas from all concerned stakeholders and building a consensus among them; such as governmental organizations, individuals, establishments, residences, schools and industries,.

It is important to hold not only governmental officials meetings but also open discussion meetings inviting related stakeholders, including those from private sectors. Such manner will shorten the time for wider dissemination of the EE&C plans and regulations to the people and businesses.

For that purpose, the Joint Coordination Committee (JCC), committees and working groups (WGs) for specified EE&C programs, as shown in Figure 1.4-1, have been held with the presence of invited stakeholders' representatives. These committees and WGs are expected to be held in the monitoring and reviewing stage, after the programs implementation. Moreover open seminars to discuss EE&C measures for wider participants are also effective to raise people's awareness.

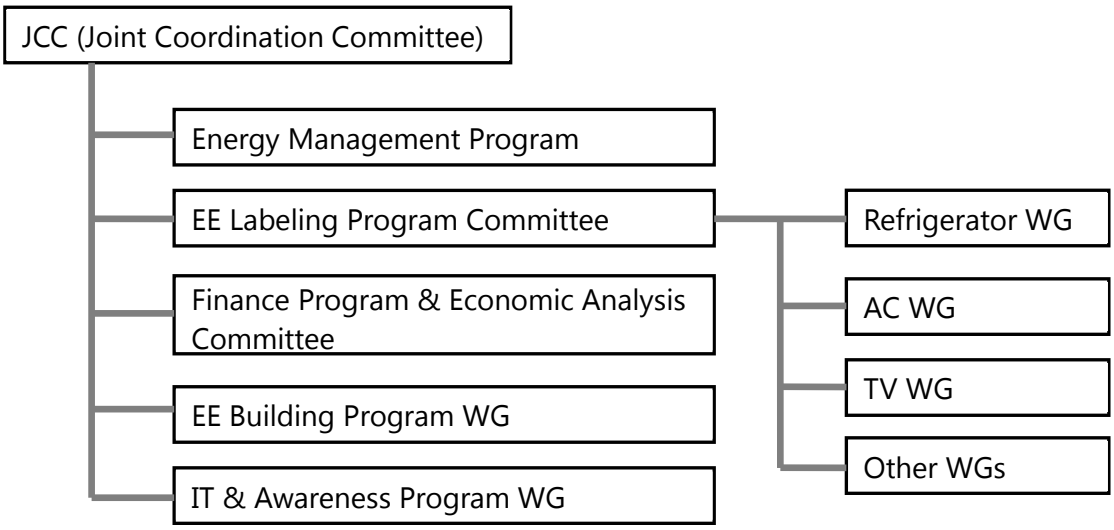


Figure 1.4-1 Structure of JCC, Committees and WGs

1st Seminar (19 Feb. 2014) 1st Energy Management Program Committee (18 May, 2014)

Figure 1.4-2 Scenes of a Seminar and a Committee

1.5 Reference: Energy Conversion, Primary Energy and Secondary Energy

Table 1.5-1 shows energy conversion factors for grid electricity, crude oil and major units to measure heat quantity. The energy balance is mainly checked and discussed not on the secondary but the primary energy[8] basis. The conversion ratio from the secondary to primary energy is calculated by considering the average conversion efficiency All types of energy (gas, electricity, coal and petroleum) must be discussed on the primary energy basis by converting energy units into tons of oil (toe) equivalent. Table 1.5-2 shows the primary energy conversion factors. Grid electricity heat value is based on end-users' thermal efficiency: 36% (at plant) minus 6% (transmission and distribution loss) = 30%

The table will be reviewed by SREDA from time to time or as and when required.

[8] Primary energy is a natural energy; such as fossil, hydro, solar and geo-thermal energy. Besides secondary energy is an artificially converted energy; such as electricity, gasoline etc.

Table 1.5-1 Heat Value Table (Primary Energy Basis) (Draft)

	MJ ($MJ=10^6J$)	kWh	kcal	kilo liter crude oil equivalent (kl)	ton of oil equivalent (toe)	British thermal unit (BTU)
MJ	1	0.278	239	0.0258×10^{-3}	0.0239×10^{-3}	948
kWh (Grid electricity)	12.0	1	2,867[9]	0.31×10^{-3}	0.2867×10^{-3}	11,370
kcal	0.00419	0.00116	1	1.08×10^{-7}	1×10^{-7}	3.97
kilo liter equivalent crude oil	3.87×10^{4}	1.08×10^{4}	9.25×10^{6}	1	0.925	3.67×10^{7}
ton equivalent oil	4.19×10^{4}	1.16×10^{4}	1×10^{-7}	1.08	1	3.97×10^{7}
British thermal unit	0.00106	2.93×10^{-4}	0.252	2.72×10^{-8}	2.52×10^{-8}	1

Table 1.5-2 Primary Energy Conversion Factors (Draft)

Type of Energy Source		Unit	Conversion factor		Heat value	
			Numeric	Unit	Quantity	Heat value
Fuel and Heat[10]	Petrol/ octane	kL	0.8295	toe/kL	10,900	Mcal/ton
	Naphtha	kL	0.7521	toe/kL	10,900	Mcal/ton
	Kerosene	kL	0.8248	toe/kL	10,500	Mcal/ton
	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[11]	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

[9] Confirmed in the 2nd EM Committee based on the data from MPEMR: 860/0.30=2,867

[10] Tentatively derived from Japanese conversion factor, and to be revised to Bangladesh ones

[11] Source: JICA Power Supply Master Plan 2010

Chapter 2 Master Plan

2.1 Master Plan

2.1.1 Overview

Energy Efficiency & Conservation Master Plan (EECMP) is positioned at the summit of all national documents on EE&C plan, regulation and implementation. Figure 2.1-1 shows the basic structure and relation of the policy documents, organization and action plans. We must note that rules and acts are not placed at the summit, but supporting EECMP.

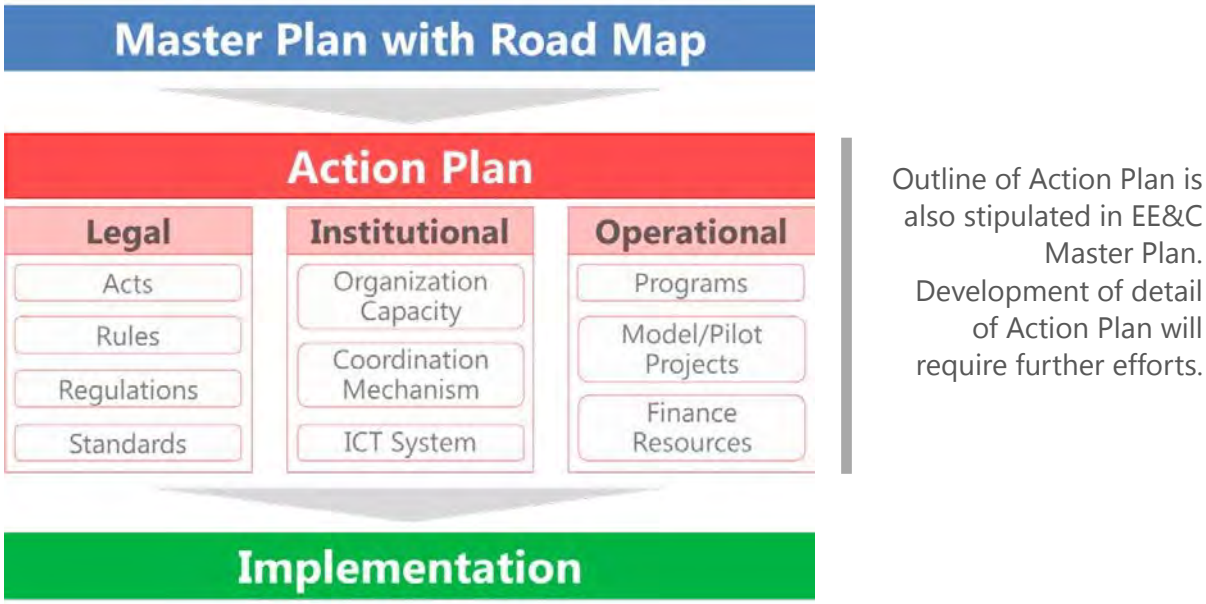


Figure 2.1-1 Structure of EE&C Planning and Implementation

EECMP, roadmap up to 2030 and action plans are described. Action plans consist of the basic methodology of EE&C policy implementation, frameworks of programs, outline of standards, rules and regulations, optimum organizational structures.

2.1.2 Scope of Plan

Originally, EECMP should be formulated, covering all energy consuming sectors in the country. However, in this EECMP, industry, commercial and residential sectors are focused and the transportation sector, utilities (energy supply sector) and energy tariff are not included. These remaining areas will be studied and properly addressed in the next version of EECMP. (See Table 2.1-1)

Table 2.1-1 Remaining Areas in EECMP

Plan	Major issue	Planner	Issue schedule
Transportation	■ Penetration of high efficiency vehicle ■ Mass transportation system in urban area	MOT (Ministry of Transportation)	TBD
Utilities	■ High efficiency generation ■ Transmission loss reduction, power factor improvement ■ Energy management at energy supply plants	Power Division, MPEMR BERC	2015
Energy tariff	■ Subsidy reduction ■ TOU (Time of Use) ■ Measurement charge (provision of meters)	MPEMR	TBD

2.1.3 EE&C Potential

(1) How to Grasp EE&C Potential?

Before starting EE&C action and/or setting EE&C targets, we must know how we are wasting energy or how much EE&C potential we have. Table 2.1-2 shows the comparison between "Without EE&C" and "With EE&C" case in industrial, commercial and residential sectors. The comparison can be evaluated based on indicators shown in Table 2.1-2

Table 2.1-2 Comparison between Without EE&C Case and With EE&C Case

Item	Without EE&C	With EE&C	Indicator
Production	Inefficient process	Efficient process	Unit energy cost
Lighting	Incandescent lamp	Fluorescent lamp, LED	Lumen/watt
AC	Window type	Split type, inverter type	COP, EER
Thermal power generation	Conventional	Combined cycle, Co-generation	Thermal efficiency
Car	Heavy car	Hybrid car	Fuel efficiency
Life style	Sleep with lights on	Sleep with lights off	Household's electricity charge

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 in Industrial Sector

The manufacturing industries in our country are not yet efficient in energy use due to old and poorly-maintained machines and poor energy management. Table 2.1-3 shows examples of energy intensity comparison between our country and Japan, where almost all industrial production has the best energy intensity in the world.

Table 2.1-3 Comparison of Industrial Energy Intensities

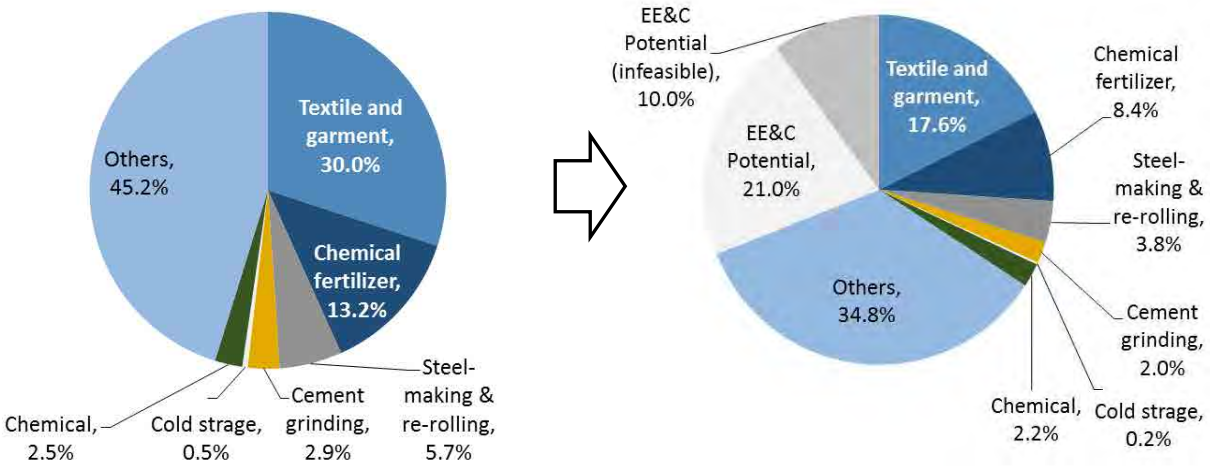
Sub-sectors	Criteria: energy intensity (kgoe/ton)		
	Japanese criteria	Best practice data of energy audit in Bangladesh	
Chemical fertilizer (Urea)	(750)	1,700	Average values of BCIC + KFCO in 2012-2014
Steel-making and re-rolling	130 (Arc furnace)	212 (Induction furnace)	Products: Bar steel
Re-rolling	50	64	Products: Bar steel
Cement kiln +mill	93	130	Material crushing + Rotary kiln + grinding
Cement mill	15	16 (Vertical-Roller mill)	23 (Ball mill)
Print paper	204	210	
Board paper	118		
Soda chemical	82	300	Caustic soda (NaOH)

With regard to EE&C potential in the industrial sub-sectors, through energy intensity comparison and actual on-site energy audits, we found that our country has a large EE&C potential as shown in Table 2.1-4 and Figure 2.1-2. The EE&C potential is estimated to be around 21% of the entire sector consumption, excluding infeasible EE&C potential. Considering that about 50% of the national primary energy is consumed in industrial sector, the potential impact of EE&C measures on the economy is massive: it is expected that the national primary energy consumption can be reduced by almost 10%.

Table 2.1-4 EE&C Potential by Industrial Sub-sector

Sub-sector and item	Energy consumption (1000toe/y)	EE&C potential (1000toe/y)
Textile and garment ■ Adoption/improvement of: spinning machine, air Jet Loom (Weaving machine), sewing machine, efficient lighting (HF TFL and LED lamp), gas engine waste heat recovery, gas turbine cogeneration, steam boiler waste heat recovery, steam boiler combustion control, once-through steam boiler, high efficient stenters, etc.	3,740	1,159
Chemical fertilizer ■ Replacement of the old plants with 3rd generation technology plants ■ Waste heat recovery technology and rehabilitation in 4 plants	1,646.3	431

Sub-sector and item	Energy consumption (1000toe/y)	EE&C potential (1000toe/y)
Steel-making & re-rolling ■ Reheating furnace: re-generative burner, combustion control unit, waste heat recovery, heat insulation with ceramic fiber ■ Replacement of induction furnace with arc furnaces	707	156
Cement grinding ■ Replacement with vertical roller mill	358	75
Cold strage ■ Renewal of gas compressor	60	31
Chemical ■ Improvement of caustic soda electrolytic process	310	5
Others	5,626	482
Energy management in all sub-sectors ■ Enforcement of energy management: DCs, EM, Energy audit		1281
Total	12,447	3,620 (-31%) Including Infeasible(10%)



A: Present Energy Consumption B: EE&C Case Energy Consumption

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

Figure 2.1-2 Industrial Sector's EE&C Potential

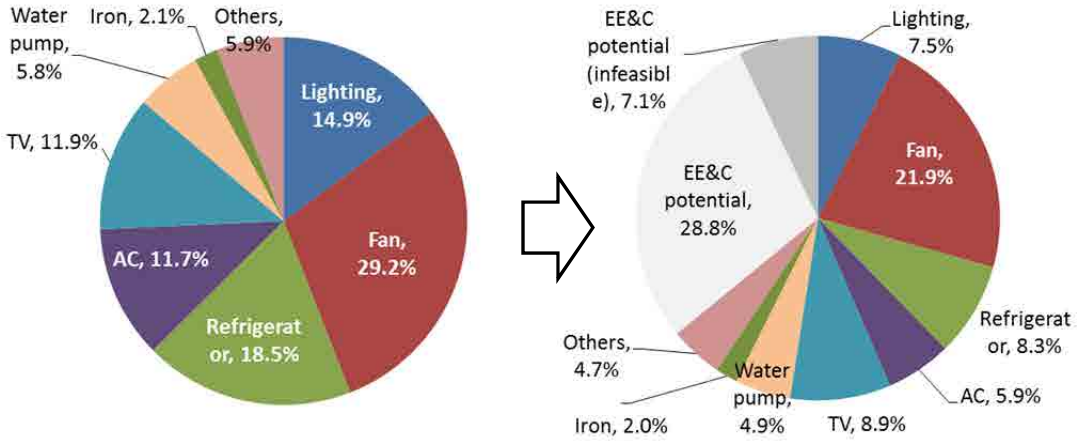
(3) EE&C potential in Residential Sector

Energy efficient type products are available at the home electric appliance shops; however, their sales shares are still minor in the present market. If all existing home electric appliances in residences are replaced with the highest efficiency type products, a huge scale of energy consumption reduction can be achieved. Table 2.1-5 shows a rough estimation of energy consumption reduction rates (EE rate) by appliance based on the current EE technologies; and Figure 2.1-3 shows the present electricity consumption by home appliance (A) and EE case electricity consumption (B) using the EE rates given in Table 2.1-5. The total EE&C potential in the residential sector is estimated to be around 28.8%, excluding infeasible potential. Considering that about 30% of the national primary energy is consumed in

residential sector, the potential impact of EE&C measures on the economy is massive: it is expected that the national primary energy consumption can be reduced by almost 9%.

Table 2.1-5 EE Rate and EE&C Potential of Home Appliances

Appliance	EE Technology	Currently Energy Consumption (GWh/year)	EE Rate	EE&C Potential (GWh/year)
Lighting equipment	LED, high frequency FL	3,724	-50%	1,862
Fans	High efficiency motor	6,181	-25%	1,545
Refrigerators /freezers	Variable speed compressor, high performance heat insulation	2,299	-55%	1,264
ACs	High COP with large heat exchanging coil and variable speed compressor	2,237	-50%	1,119
TVs	LCD with LED back light	2,105	-25%	526
Water pumps	High efficiency motor	298	-15%	45
Irons	Thermostat	181	-5%	9
Others		546	-20%	109
Total		17,570	-35.9%	6,479



A: Present Electricity Consumption B: EE Case Electricity Consumption

Source; Surveyed data by JICA Project Team, EE potential is estimated by the Team

Figure 2.1-3 EE&C Potential of Home Appliances

”Others” include home appliances, such as micro wave ovens, personal computers, audios and home-automation appliances, the share of which is still small, but eventually will consume additional electricity. It is important to guide the people to choose energy efficient products when we buy new ones.

(4) EE&C Potential in Commercial Sector (Buildings)

Electricity is the main source of energy consumed within buildings. Around 50% of the total energy is consumed in air conditioning and from 10 to 30% is consumed in lighting. And expected energy-saving potentials under these two categories are as follows:

- Air conditioning: 50% by applying high efficient air conditioners (ACs) with inverter technology
- Lighting: 50% by applying high efficient lighting system, such as LED lamp, T5 florescent lamp with electronic ballast or utilizing sun 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 (incl. 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%.

2.1.4 Target for 2030

(1) Indicator to Evaluate EE&C Progress

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 our country. 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 our country. Energy consumption per GDP can consider both energy efficiency and national economic growth. In this EECMP, therefore we apply “primary energy consumption per GDP” as an indicator to set EE&C target and evaluate future national energy efficiency.

(2) Present Energy Consumption as the “Baseline”

Present energy consumption situation is summarized in Chapter1.1.1. A baseline, which indicates nationwide energy consumption, was fixed in order to set EE&C target. The baseline was set in energy intensity basis, which is calculated by “primary energy consumption and GDP in 2013-14” as shown in Table 2.1-6.

Table 2.1-6 GDP and Primary Energy Consumption in 2013-14

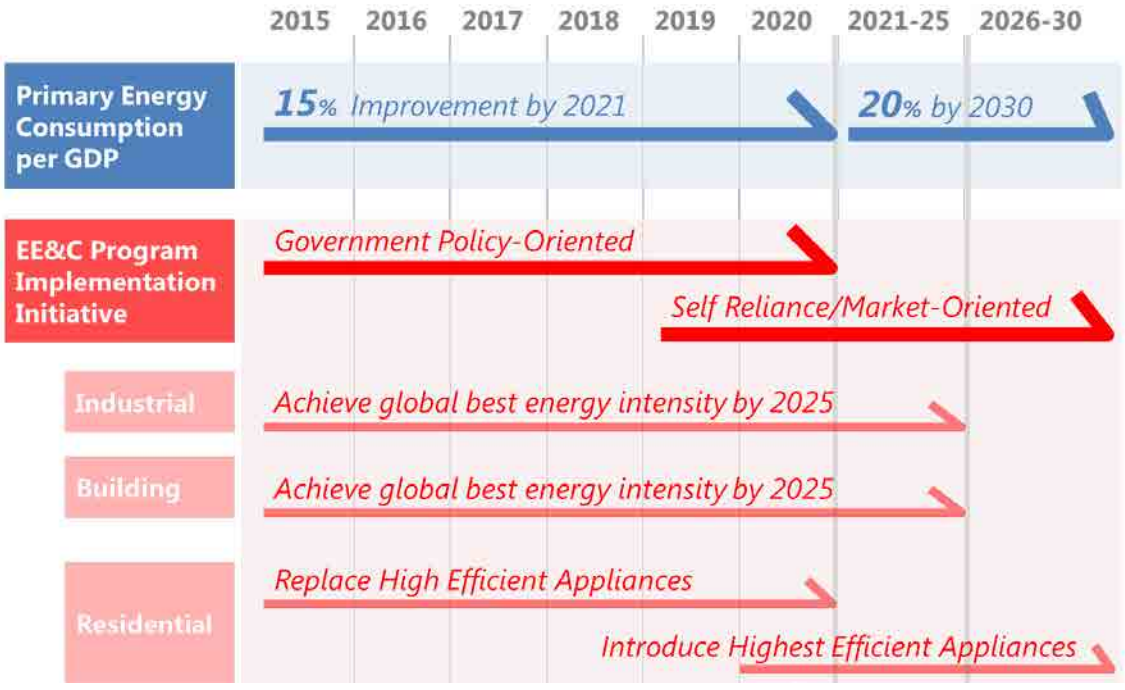
GDP in 2013-14 (billion DBT)	Final energy consumption in 2013-14 (primary energy basis, excluding transportation & biomass) (1,000toe)	Final energy consumption/ GDP (ktoe/ billion BDT)
0,380	24,562	2.37

Source: Compiled by JICA Project Team based on the following data sources:
GDP from WB website, energy consumption from mainly distribution companies' data
(Oil & coal: 2012-13 data)

(3) Target for2030

While identifying a huge EE&C potential, we 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 2013-14 level. Here in EECMP, EE&C target and roadmap are set as Table 2.1-7. The targets for 2021 and 2030 are set 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 2.1-7 EE&C Implementation Roadmap (2015-30)



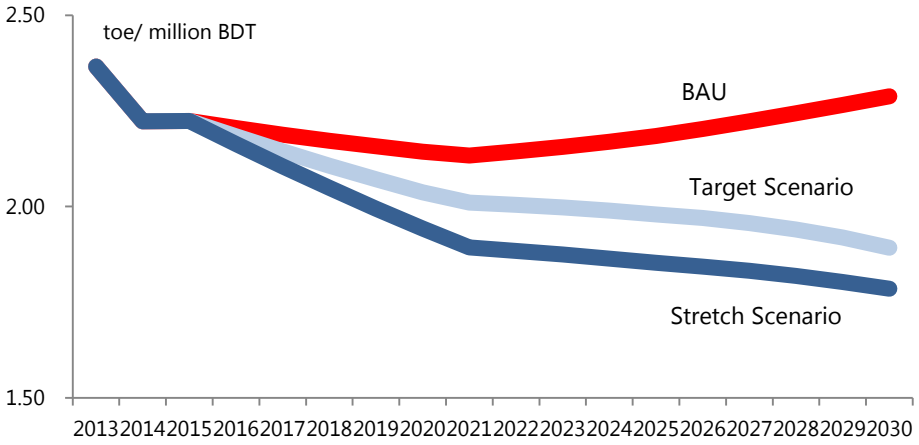
It is expected that the primary energy consumption per GDP will slightly decrease until 2021 and then gradually increase up to 2030. And in order to achieve the above mentioned target in 2021 and 2030, the following scenarios are to be recognized.

Table 2.1-8 shows the outline of investigated EE&C Scenarios

Figure 2.1-4 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 Table2.1-9.

Table 2.1-8 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 rates 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 rates 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 2.1-4 Future Scenarios of Primary Energy Consumption in 2030 (BAU Case, Excluding Transportation and Biomass)

Table 2.1-9 Efforts Needed to Achieve EE&C Target

Target Scenario

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

Stretch Scenario

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

2.1.5 Basic Policy of EE&C Programs to Meet Target

(1) Approaches to Be Considered

Although every member of this society is responsible for energy use, EE&C policies and programs may represent heavy burdens on some establishments and individuals. We have to take the following points into account:

- EE&C policies should be applied first on large energy consumers and eventually include small and medium sized enterprises (SMEs).
- The policies should start in a limited scope (narrow range) and expand to wide range, as administrative capacity buildings fostered.
- EE&C policies should start on a voluntary basis and will be shifted to a mandatory basis.
- EE&C policies should not be prioritized and enforced without providing basic regulations and measures for ensuring safety for, life, health and environment. For example, we recognize that pollution control in the industrial sector has not yet been carried out at sufficient level, but environmental equipment (water pollution control equipment) consumes energy. Thus, before applying mandatory energy efficiency label on home appliances, regulation for assuring safety and minimum performance should be provided.
- Keyword is not “reduction of energy,” but “rational energy use.” the people need more energy for better and convenient life
- Try all means to assure that correct EE&C goals will be set and achieved by all parties.

(2) EE&C Policy/Program Mix

An efficient EE&C policy/program mix is needed for achieving the EE&C target, as shown in Table 2.1-10. These policies and programs have been introduced in advanced countries and neighboring countries.

Table 2.1-10 EE&C Policy Mix

Policy/Program	Target	Methodology
Energy management by energy consumers	Large energy consumers	"Energy Management Program" includes: ■ Designation of large energy consumers ■ Certification of energy managers, certified energy auditors and accredited energy auditors, including their qualification and examinations ■ Mandatory/voluntary energy audits ■ Energy consumption reporting (mandatory) ■ Benchmarking The program will be administrated by the Government
Penetration of high efficiency home appliances/equipment in the market	Residences and commercial sector	"EE Labeling Program" includes: ■ Label certification system and laboratory accreditation system ■ Standardization of energy efficiency (EE) measurement method and star rating criteria ■ Unification and standardization of the EE labels ■ Mandatory/voluntary participation of manufacturers, importers and retail shops in the program ■ Issuance of MEPS (Minimum Energy Performance Standard) The program will be administrated by the Government in cooperation with testing institutes, etc.
Penetration of EE buildings	Buildings	Enforcement of "Bangladesh National Building Code (BNBC) [Revised]" includes: ■ Promotion of energy efficiency and conservation in buildings ■ Application to all new constructed buildings, including residential buildings The program will be administrated by the Government.
EE&C financing to the private sectors	Private sector EE&C investments	Provision of financial incentives for EE&C investments, such as: ■ Low interest loans for EE&C investment ■ Preferential taxation on EE&C investments including the purchases of high efficiency equipment/appliances ■ Subsidy for EE&C investments ■ Other incentive mechanisms The program will be carried out by the Government jointly with private financial institutions
Awareness raising	General public	The following method will be introduced: ■ EE&C awareness program on media, such as TV, publication, internet, etc. ■ Provision of EE&C tips and technologies ■ Intensive education maximizing motivation of educational institutions, and other administrative units etc.
	Students	■ Environmental education at schools

Policy/Program	Target	Methodology
Government's own initiatives on EE&C implementation	Government	The central and local governments will implement EE&C by their own initiatives. The following program will be developed: ■ "Green purchase program" which specify the eco-friendly products for governmental purchase ■ Obtaining of ISO14001 and 50001 certification by governmental organizations
Global warming countermeasure	All parties	■ Capacity development
Energy tariffs	Electricity companies and gas companies	Besides collecting the data on actual costs for energy supply, the following matters should be considered: ■ Incentives and motivations for effective EE&C implementation ■ Electricity supply peak load shift ■ Financial resources for EE&C implementation

2.2 Roadmap (from 2015 up to 2030)

Overall roadmap up to 2030 is shown in Table 2.2-1. We aim to accomplish the EE&C target, and realize the Self-reliant EE&C Society by 2030.

Table 2.2-1 Overall Roadmap

Fiscal year	2014−15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-25	2025-30
Economic growth	7% annual growth						Stable growth	
Primary energy Consumption per GDP	15% reduction						20% reduction	
EE&C implementation	Led by the government							
					Self-reliant EE&C			
Industrial production process	Catch up with the best energy intensity in the world							
Building energy use	Catch up with the best energy intensity in the world							
Residence	Deployment of high efficient appliance							
					Use the highest efficiency appliance			
EE&C targeting	Reduction of primary energy per GDP						Absolute value	

2.3 Monitoring and Review of Plan

2.3.1 Follow up Survey on Energy Consumption

We must establish energy consumption data collection mechanism, in order to monitor our country's energy consumption accurately. Table 2.3-1 and Table 2.3-2 show the data and collection intervals.

Table 2.3-1 Collection of Energy Consumption Data (Primary energy)

Type	Data	Recommended frequency
Oil	■ Domestic production ■ Import	Every year
Gas	■ Domestic production ■ Import	Every year
Coal	■ Domestic production ■ Import	Every year
Electricity (renewable)	■ Domestic production	Every year

Table 2.3-2 Collection of Energy Consumption Data (Secondary energy)

Type	Data	Recommended frequency
Electricity (grid)	■ Electricity supply (power generation and sales) ■ Fuel consumption	Every year
Electricity (off grid)	■ Generation ■ Fuel consumption	Every 3 years

The data on energy consumptions, energy intensity, GDP, population and industrial production will be attained as shown in Table 2.3-3.

Table 2.3-3 Collection of Data for Energy Intensity

Type	Data	Data source	Recommended frequency
Common data	■ Primary energy consumption ■ GDP ■ Population	Energy sector's sales data, World Bank and Bangladesh Bureau of Statistics	Every year
Industrial data	Energy consumption and industrial production of the following industrial sub sectors: ■ Chemical industries ■ Fertilizer industries ■ Cement Manufacturers ■ Steel and Re-rolling Mills ■ Brick Manufacturing ■ Rice mills ■ Cold Storage ■ Frozen Foods ■ Sugar Mills ■ Paper Mills ■ Jute Mills ■ Textile Mills ■ Garment Industry ■ Sanitary & Tile Merchants	Energy supply side's sales data and designated energy consumers reports	Every year

Type	Data	Data source	Recommended frequency
Buildings data	Number, floor area and use of buildings	National Building Code	Every year
	Energy consumption and floor area	Designated energy consumers	Every year
	Maintenance and conservation condition of buildings	Sample survey	Every 3 years
Residential data	Electricity consumption at households	Energy sector's sales data	Every year
	Electricity consumption by electric appliance	Sample survey	Every 3 years

2.3.2 Monitoring of EE&C Programs Implementation

Besides energy consumption data, indicators, which express EE&C programs implementation and achievement of the EE&C target will be collected as shown in Table 2.3-4.

Table 2.3-4 Monitoring for EE&C Programs Implementation

Program	Indicator	Data collection method	Recommended frequency
Energy Management Program	■ Number of designated energy consumers ■ Number of energy managers and auditors certification	DCs number, certification of EM, CEA and ACEA	Every year
EE Labeling Program	■ Penetration of EE label ■ Sales of labeled products ■ Energy efficiency	Market researches	Every 3 years
EE Building Program	■ Number, floor area and use of the buildings attending the building codes	Research by MOHPW	Every year
	■ Energy efficiency	Energy audits	Every 3 years
EE&C Finance Program	■ EE&C investment	Financial institutes	Every year

2.3.3 Report and Review of EE&C Master Plan

The monitoring data will be reported by the Government (SREDA).The report will be uploaded on the Government website.

JCC (Joint Coordination Committee), whose members consist of the governmental organizations and related stakeholders, will be held for the review of EECMP. Result of the review must be publicly disclosed on SREDA's website.

Chapter 3 Action Plan

3.1 Overview

EE&C action plan is prepared to describe practical methodology to achieve and accomplish the EE&C target fixed in EECMP, which contains EE&C programs framework and organization structure. The following points are taken into account:

- Distinction between plans and rules: Provision of rules (regulations) is one of the measures to realize the plan, which gives administrative power to the Government and/or clarifies roles and responsibilities of each party (stakeholder).
- Distinction between standards and rules: Rules have administrative power, but standards have no such power. Standard should be provided solely for defining terms and methodologies relating to EE&C programs.
- Universality, adaptability for future changes in social and technical conditions, including EE&C technology development and improvement.
- Document issuance approval processes, authority and responsibility of the governmental organizations in charge, and/or importance of the concerned document

3.2 Roles and Responsibilities of Participating Parties

3.2.1 Organization Structure for EE&C Implementation

EE&C implementation is a multi-sectoral issue and must be done by the participation of all the people and establishments in the country. EE&C activities by the parties are related with several organizations which have roles and responsibilities for support and enforcement of rules, and/or EE&C awareness as shown in Figure 3.2-1.

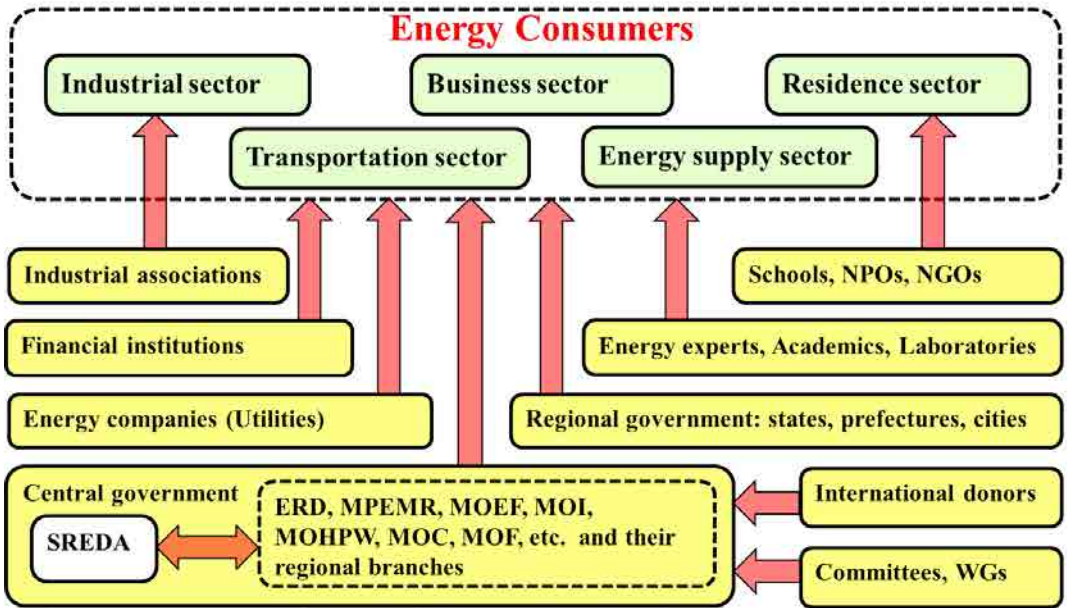


Figure 3.2-1 Organization Structure for EE&C Implementation

3.2.2 MPEMR

(1) Comprehensive Energy and EE&C Policy Implementation

The Ministry of Power, Energy and Mineral Resources (MPEMR), has a responsibility for the overall planning and development of the energy and electricity sector. The ministry has two separate divisions namely: (i) Power Division and (ii) Energy and Mineral Resources Division, each headed by a Secretary. The Power Division is responsible for the electricity sector including implementation of energy efficiency and renewable energy programs. The Energy and Mineral Resources Division is responsible for exploration and management of natural gas and mineral resources.

MPEMR also has a responsibility for EE&C on energy/electricity supply and energy tariff as the remaining part of EECMP.

(2) Multiple EE&C Policies

MPMR, in order to carry out its mandates, will formulate and implement multiple EE&C policies including voluntary, mandatory, financial and informational programs, in addition to environmental assessment and provision of infrastructure.

(3) Consideration of EE&C on Other Policies

MPEMR will consider EE&C, when formulating and implementing their policies even when the subjects are not concerned with energy or EE&C.

(4) Government's Own Initiative on EE&C Implementation

MPEMR will lead the Government's own initiatives on EE&C activities at its working places and in projects, in order to promote all parties' EE&C implementation.

3.2.3 SREDA

(1) Establishment of SREDA

Based on the recognition that efficient energy use in demand side is essential, the Government established the Sustainable and Renewable Energy Development Authority (SREDA) in 2012, which is the implementing agency for EE&C and renewable energy development under MPEMR.

(2) National Representative on EE&C Policies

SREDA's status is the national EE&C policy representative. It has the roles and responsibilities on the following activities.

- National information center of energy and EE&C
- Cross cutting (multi-sectoral) coordination of EE&C policies among all governmental organizations and also non-governmental organizations, including EE&C requirement into other governmental organizations' policies

- Formulation and implementation of its own EE&C policies, such as Energy Management Program, EE Labeling Program etc.
- Nationwide monitoring of energy consumption and EE&C implementation and its public disclosures
- Advocacy and awareness raising

(3) Relevant Activities on EE&C Implementation

Besides the above roles for the national representative, SREDA will have the following relevant actions:

- Conducting studies, researches, development and pilot demonstrations for all stakeholders
- Provide trainings for capacity development at institutional levels
- Providing advisory services to the private sector corporate bodies, government and non-governmental organizations
- Promote local and international experience sharing in the field of RE, EE&C for capacity development
- Manage its finances to promote innovative pilot projects in the country to enhance RE, EE&C coverage in the country
- Documentation and dissemination of results and information
- Strengthening consultancy services to establishments in the field of EE&C.
- Establish close cooperation with the private sector by creating linkages with appropriate personnel in different establishments at root level and top level. Inter-ministerial focal points
- Development of expertise for successive implementation of EE&C throughout the country

3.2.4 Other Governmental Organizations

(1) BERC

The Bangladesh Energy Regulatory Commission (BERC) was formulated under the Act of Parliament in March 2003, with the mandate to regulate the electricity, gas and petroleum sectors. Apart from the other activities, BERC is also empowered to ensure energy efficiency in generation, exploration, production, transmission and distribution levels of the related sectors.

BERC has the responsibility for formulating EE&C plan on electricity supply, which is not included in the EECMP.

(2) BSTI

The Bangladesh Standardization and Testing Institute (BSTI) has provided Bangladesh Standards (BDS) on energy efficiency (EE) measurement for the EE Labeling Program. It has the following roles and responsibility:

- Issuance of BDSs related to the EE Labeling Program
- Conduct of energy efficiency tests required for the EE Labeling Program

(3) Ministry of Industry and BAB

The Ministry of Industry (MOI) is the authority that administers the industrial sector, which join in the Energy Management Program, EE Labeling Program and other EE&C programs. MOI has the following roles and responsibilities:

- Cooperation in the enforcement of Energy Management Program with SREDA
- Cooperation in the enforcement of EE Labeling Program with SREDA, especially on encouraging appliance manufacturers participation on the program
- Coordination and monitoring of industrial associations on EE&C activities

Bangladesh Accreditation Board (BAB) belongs to MOI, and is an accreditation body for ISO 9000, 14001 and 50001, which have close relations with EE&C. BAB is expected to have the following roles and responsibilities:

- Accreditation of laboratories for energy efficiency measurement tests based on ISO17025, etc. for the EE Labeling Program
- Energy manager/auditor licensing system

(4) MOF and Governmental financial institutes

The Ministry of Finance (MOF) is responsible for making budgets for EE&C policy promotion activities. MOF allocates budgets to relevant ministries and governmental organizations which request for financial support. In order to promote EE/RE investments by private establishments, MOF provides on-lending programs through government financial institutions, namely, Bangladesh Bank (BB) and Infrastructure Development Corporation Ltd. (IDCOL). As a financial vehicle to promote EE&C, the Sustainable and Renewable Energy Development Authority Fund (SREDA Fund) is another option. SREDA Fund can provide finance for EE/RE activities in both private and public sectors. SREDA Fund can be sourced from grants or loans obtained from the Government, local authorities and international donor agencies, as well as earnings from businesses (consultancy fees, etc.).

BB and IDCOL are the key financial institutions to support EE&C. They can handle funds budgeted from MOF and on-lend money to establishments or individuals who need money for investing in energy efficiency (EE) facilities and equipment. Both BB and IDCOL already have experiences as a financial promoter of RE investments. While BB is the central bank of Bangladesh, it also has the role of a development finance institution which provides loans to private-sector businesses via PFIs (Participating Financial Institutions).

(5) MOEF

The Ministry of Environment and Forest (MOEF) is the responsible authority for global warming issues, which must be tightly dealt with energy and EE&C policies. MOEF has the following roles and responsibility:

- Coordination between countermeasures for global warming and EE&C policies.

- Coordination between the policies related to ozone layer destructive material such as refrigerants used in AC, refrigerator and chilling machine, and high energy efficiency products.
- Provision of regulations on pollution control and waste disposal, applicable to EE&C policies implementation (eccentric EE&C implementation without human life and health care should be avoided).

(6) MOC

Activation of energy efficient product trade is expected for the promotion of EE&C in our country. For that purpose, The Ministry of Commerce (MOC) has the following roles and responsibility:

- Encouragement of trade of (high) energy efficiency products, including removal of NTB (Non-Tariff Barrier) collaborating with foreign countries
- Awareness and dissemination to the traders, retail shops and consumers

(7) MOHPW

The Ministry of Housing and Public Works (MOHPW) has started the enactment of the New Version of Bangladesh National Building Code (BNBC [Revised]) and the Green Building Guideline (GBG), which can promote EE&C at buildings. Therefore, MOHPW is expected to take following roles and responsibilities:

- To implement BNBC [Revised] steadily, including continuous up-dating the regulation
- To widely promote and spread GBG
- To coordinate EE requirement in the building codes with SREDA
- Awareness and dissemination to the building owners, developers, designers and building users
- To support Ministry of Transportation for preparing EE&C plans on transportation

(8) MOT

EECMP has been made excluding plans for EE&C on transportation sector. This Ministry of Transportation (MOT) is expected to take the following roles and responsibilities:

- To prepare EE&C plans on transportation sector and add them to the EECMP
- To make coordination with SREDA especially on the level of EE&C requirement

(9) MOE

Awareness and dissemination of EE&C is the basic policy of self-reliant EE&C implementation. The Ministry of Education (MOE) is expected to be in charge of this field and have the following roles and responsibility:

- Introduction of EE&C, as one of themes for environmental education
- Initial instruction of EE&C to teachers
- EE&C improvement in schools
- Promotion of EE&C activities in households through students

- Promotion of self-reliant EE&C activities of the children

(10) MOA

Modernization and mechanization in our country's agriculture will accelerate growth in energy consumption. The Ministry of Agriculture (MOA) is expected to take the following roles and responsibility:

- Education of irrigation consumers including concerned organizations staffs
- Introduction of irrigation based on RE on massive scale

(11) Ministry of Information

Medias is influential on EE&C awareness and dissemination. The Ministry of Information (MOI) is expected to have roles and responsibility relating on media's activities in EE&C.

3.2.5 Local Governments

Local governments are expected to take the following roles and responsibilities:

- To make efforts to plan, formulate and implement their own EE&C policies, with due considerations to their social and natural conditions
- To conduct urban planning to promote "Low carbon city", in which low energy consumption occurs by means of EE buildings and public transportation system
- To take initiatives and develop projects on EE&C activities in order to lead and motivate the people and establishments to follow suit. The same EE&C actions are expected to occur in public hospitals, schools and other institutes under the local governments.
- Administration of BNBC [Revised] and GBG
- Take more advanced (progressive) policy than the Government, if possible

3.2.6 Energy Supply-side

Energy supply companies are also large energy consumers. Therefore, they are expected to take the following roles and responsibilities:

- To improve energy conversion and transmission efficiency at their plants and delivery systems
- To give instruction and advisory services on EE&C to customers (energy consumers) To collect/analyze energy consumption data, report to SREDA which monitors nationwide energy consumptions
- To prepare EE&C plan for energy supply sectors, which is not included under EECMP
- To formulate a functional tariff system, in order to provide incentives for EE&C and peak demand shifting

3.2.7 Establishments (Business Operators)

The establishments of both private and public sectors are expected to take the following roles and responsibilities:

(1) Compliance with EE&C Rules and Regulations

Establishments should keep and follow the EE&C rules and regulations, which will be introduced and scheduled to be officially issued by the Government, such as Energy Management Program, EE Labeling Program and EE Building Program.

(2) EE&C as a Social Responsibility

Establishments must understand that energy is a social common resource, which should be used fairly and rationally for the general public. They are expected to make plans for efficient energy use, monitor their energy use, and frequently review their EE&C implementation situation. They should instruct the employees about rational energy use, and jointly improve the activities with the other establishments, associations, unions and central/local governments, sharing information and technologies on EE&C.

(3) Culture and Life-style of EE&C

Establishments are expected to create EE&C culture and life-style and disseminate it to the people.

(4) Preparation for the Coming Energy Price-up

It will be impossible to keep the energy prices in future as cheap as the present which are mainly maintained by the governmental subsidy. Establishments should prepare the society for higher energy prices in near future.

(5) Specific Roles of Establishments

Relating to the EE&C programs introduced in this plan, the establishments should have the roles shown in Table 3.2-1.

Table 3.2-1 Specific Roles of Establishments

Organization	Expected role
Industry and industrial associations	■ Voluntary energy management ■ Study and introduction of EE&C technologies ■ Experts training ■ Employees training ■ Benchmarking by industrial sub-sectors and production process
Manufacturers and importers of appliance/equipment	■ Development and sales of high efficiency products ■ Participation in the EE Labeling Program

Organization	Expected role
Building owners, designers and developers	■ Compliance with building codes ■ Development of green building approach ■ Design buildings based on LCC (Life Cycle Cost) and $LCCO_2$ (Life Cycle CO_2)
Energy importers, traders, dealers	■ Supply of energy trade data to SREDA and/or other authorities
Media	■ Dissemination of culture and life-style of EE&C ■ Voluntary broadcast of EE&C news

3.2.8 People and Society

(1) Better Life with Rational Energy Use

Possession and use of home appliances, such as refrigerators, TVs, ACs, computers and automobiles are rapidly increasing due to economic growth. It is strongly recommended to purchase high-efficient products when people buy new ones. (Social system to mobilize people to choose high-efficient products is to be structured.)

(2) Preparation for the Coming Energy Price Increase

It will be impossible to keep the energy prices in future as cheap as the present levels, which are mainly maintained by the governmental subsidies. We have to recognize this situation and properly prepare consumers for higher energy prices in near future. EE&C is the most effective countermeasure.

3.2.9 NPOs and NGOs

Our country is the country where relatively a large number of NPOs and NGOs exist and have functional activities, influencing people's life. Therefore, they are expected to take the following roles and responsibilities:

- To incorporate EE&C activities into their businesses, services and projects
- To develop new businesses, services and projects related to EE&C

3.2.10 International Donor Agencies

International donor agencies (donors) provide grants, loans, and/or technical assistance for promoting EE&C dissemination for our country. Their roles are defined as follows:

- Long-term and continuous technical and financial support for proliferation of EE&C policy measures
- Capacity development for EE&C regulators and promoters: including ministry officials, staffs of public and private establishments, etc.
- Donor coordination to guarantee synergism with EE&C activities

Figure 3.2-2 shows a perspective of the projects which have been supported by the donors in our country, categorized by policy and financial supports (vertical axis) and demand-side and supply-side EE&C (horizontal axis). As shown at the bottom right of the figure, loans for the purpose of promoting

demand-side EE&C seems not be implemented except for some small components. Possibility of mobilizing private funds for these untouched areas utilizing policy-based finance will also be needed.

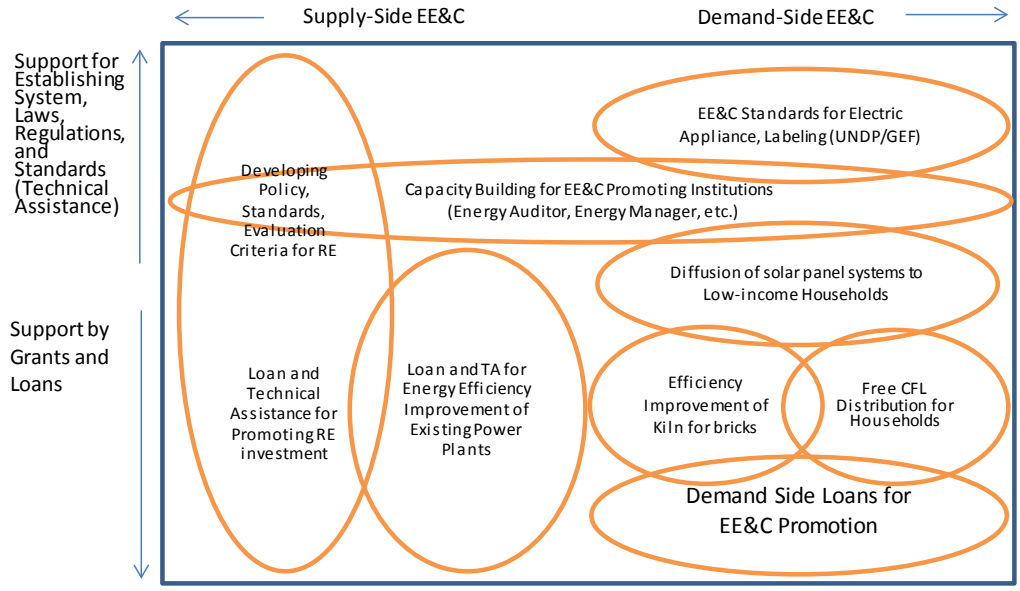


Figure 3.2-2 Projects Supported by International Donor Agencies (Perspective)

At present, there are several donors, which are actively supporting EE&C in our country: ADB (Asia), GIZ/KfW (Germany), JICA (Japan), World Bank, UNDP, and USAID (USA) etc. It is important for all donors to know what others are doing for EE&C for this country. When they try to have interactive communication, their works will result in more synergism for all EE&C activities in our country.

3.2.11 Energy Experts

Energy experts who have experiences to work at energy consuming industries and/or have knowledge about energy and EE&C are expected to take the following roles and responsibilities:

- To be a leader of EE&C implementation
- To watch and share the latest EE&C technologies and do their own capacity development
- Networking and information sharing among the energy experts
- Establishing the community of energy experts

3.2.12 Academics, Laboratories and Researchers

Many professors and researchers are interested in the energy situation in our country and carrying out studies on energy issues. They are expected to take the following roles and responsibilities:

- To stimulate young generation people to become energy experts
- To participate in the committees and WGs for EE&C policy making, and to give advices and opinions from a neutral point of view
- To carry out researches and development on the themes for rational energy supply and EE&C

- To take parts in energy efficiency measurement and test for appliances/equipment as a 3rd party laboratory

3.2.13 Committees and WGs

Several committees and working groups (WGs) must be formulated inviting relevant stakeholders, governmental organizations and academies to figure out an effective and feasible plan. Committees and WGs are expected to be continuously formulated focusing on the following roles and responsibilities:

- To periodically monitor and review implementation and achievement of EECMP
- To disseminate EECMP and EE&C programs through the industrial associations, which take parts in the committees and/or WGs

3.3 EE&C Programs (Overview)

Action plans for the major EE&C policies and programs are drafted in this clause. Necessity of policies and programs covering the relating situation on energy consumption, program outline and implementation methodology, stakeholders' roles and responsibilities, roadmap and expected outcome are introduced hereinafter.

Action plan for the transportation sector, energy supply sector and the issue of energy tariffs have not yet been included in EECMP. Policies on these remaining fields will be studied and issued in future.

3.4 Energy Management Program

3.4.1 Overview

Due to inefficient and old boilers, furnaces and motors used in the industries, a huge amount of energy is being wasted. The electricity consumption is increasing rapidly especially in the residential sector, recently. This sector is responsible for about 50% of the total electricity use while, the industrial sector share is 34%, and the commercial sector shares 9%.

Consumption of natural gas in industrial sector includes consumption for captive power. Also, gas consumption in industrial sector (incl. captive power) is increasing rapidly, recently.

Since the industrial sector is the largest energy consumer of natural gas and electricity, EE&C implementation in the industrial sector is the highest priority issue. EE&C can be achieved by conduction of "energy management", which includes collection and analysis of energy consumption data, measurement of equipment energy efficiency, calculation of energy intensity, review of production process and plan and realization of EE&C measures, etc.

In this context, nationwide promotion of energy consumers' energy management in their factories and buildings is necessary.

"Energy Management Program" is the nationwide EE&C program, enforcing mandatory energy management to the large energy consumers who are designated by the government. The program has been introduced in many countries.

3.4.2 Overall Structure of Energy Management Program

Overall structure of planed Energy Management Program is summarized in Figure 3.4-1. Large energy consumers in industrial sector (factories) and commercial sector (buildings) will be named as “designated (large) energy consumers” (DCs) by the regulation. They are obliged to implement energy management system (EMS). The energy management system includes a) establishment of energy management system, b) appointment of energy manager, c) compliance to benchmark (energy intensity target) and d) EE&C reporting to the Government (SREDA). SREDA will provide rules and standards, such as regulation of the program, DC’s designation criteria, energy manager’s/auditor’s certification system and benchmarks. SREDA will also conduct energy consumption data collection/analysis and other supporting service. As utilization of energy and EE&C experts, certified energy auditors and accredited energy auditors will provide commercial base EE&C services to the DCs and other energy consumers.

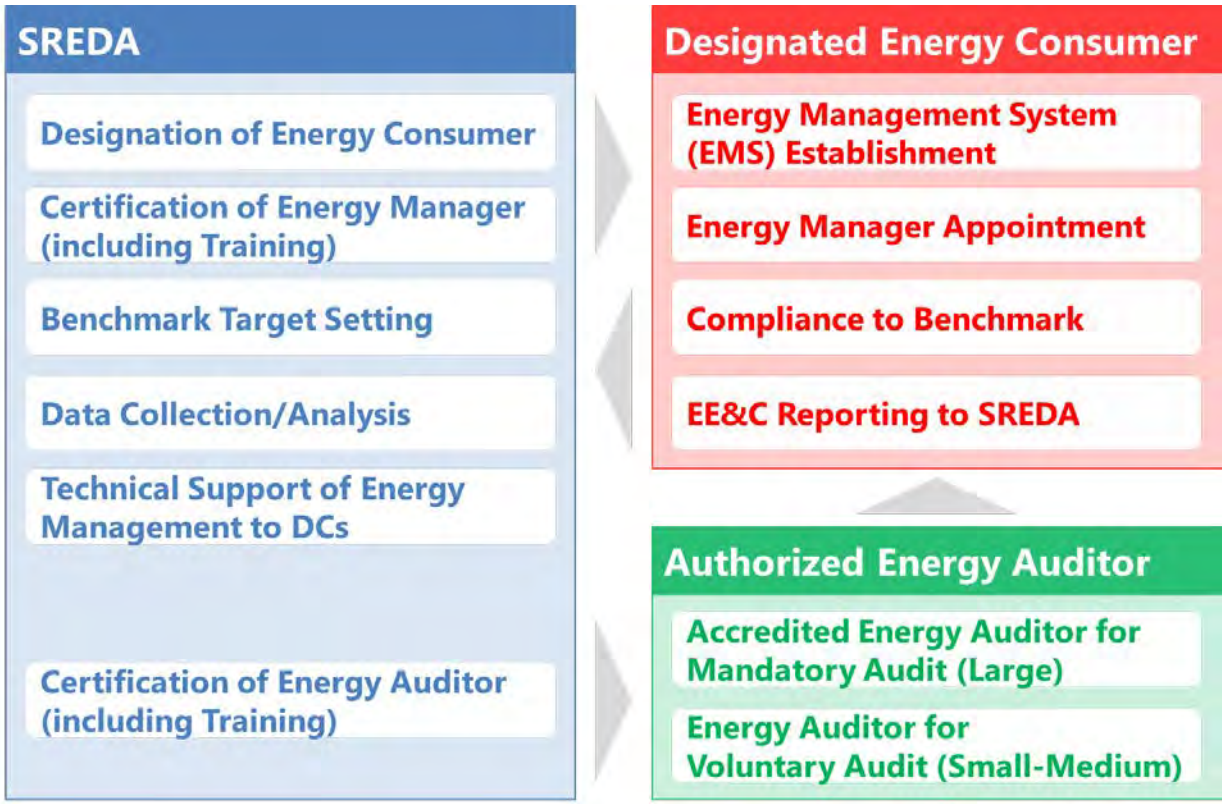


Figure 3.4-1 Overall Structure of Planed Energy Management Program

3.4.3 Designation of Large Energy Consumers

50% of national primary energy is consumed in industrial sector. And 30% of energy in industry sector is consumed in about 100 large factories. And if these large factories can improve energy consumption by 20%, then national energy consumption will reduce by 3%. Designated large energy consumers (DCs) program aims to improve energy efficiency in large consumers in accordance with the leadership by SREDA. The numbers of DCs is estimated about 100 at first stage and will be increased to 1000 in 2030.

“Designated large energy consumers” (DCs) are defined by the regulation. Designation criteria of DCs by annual energy consumption are shown in Table 3.4-1 DCs, whose annual energy consumptions exceed the threshold value, must submit application sheets. DCs’ annual energy consumptions are calculated by

using the heat value of fuels and primary energy conversion factor of the grid electricity as shown in Table 1.3-4.

Table 3.4-1 Designation Criteria and Number of DCs by Category

No.	Category	Criteria for DCs (Annual energy consumption toe)	Numbers of candidates for DCs
01	Chemical fertilizer factories	10,000	10
02	Paper and pulp industries	6,000	8
03	Textile industries: - Spinning, Weaving and dyeing,	3,000	15
04	Garments industries	3,000	7
05	Cement factories and clinker grinding factories	10,000	14
06	Iron and steel (rerolling mills)	10,000	23
07	Chemical and pharmaceutical industries	6,000	9
08	Glass industries	6,000	5
09	Ceramic industries	6,000	9
10	Transportation terminals (including seaports, airport, stations)	3,000	2
11	Commercial and institution buildings (including office buildings, hotels, shopping malls, hospitals, educational facilities)	3,000	10
99	Other Industries and installations as published by government notifications	3,000	1
	Total		113

Source: Estimation by JICA Project Team

3.4.4 Energy Management in DCs and Other Energy Consumers

DCs are obligated to conduct “mandatory energy management” in their factories and/or buildings, in order to implement EE&C measures. Energy consumers out of DCs are also expected to conduct energy management. The mandatory energy management consists of the following elements:

(1) Establishment of EMS (Energy Management System)

DCs must establish EMS, which includes the following actions:

- Setting up EE&C target and establishing energy management team (group)
- Appointing a full-time energy manager
- Implement EE&C activities according to EE&C promotion plan
- Conduct energy audits of the facilities on annual base
- Follow the EE&C target and certain criteria including benchmarks, minimum energy efficiency standards and specific technology requirements
- Conduct training of EE&C activities for management and employees
- Accreditation of ISO 50001 is welcome. It will be recognized as the establishment of EMS.

(2) Appointment of Energy Manager

Energy managers are a cadre, who runs EMS and conducts EE&C actions in the factory and/or buildings including in-house energy audits. The energy manager in DCs must acquire a national certificate of "energy manager".

(3) Energy Audit

Energy consumers will implement energy audits for their facilities or buildings periodically. DCs must submit energy audit reports to the Government (SREDA). The energy audits will be done by certified energy auditors. In case of large DCs, the energy audits must be done by "accredited energy auditors"

(4) Annual Energy Report

DCs must prepare annual energy reports and submit them to the Government (SREDA). SREDA will check the trend of energy intensity for the five consecutive years. The annual energy reports will contain the followings:

- Total energy consumption (by source of energy, i.e., fuel, heat and electricity)
- Name, outline, operating condition and modification of energy intensive equipment
- Energy efficiency and productivity levels (relative to output, measured through the production volume)
- Energy intensity trend for 5 years
- Identification of appointed energy manager
- Annual EE&C plan including the measures and targets as shown in Table 3.4-2
- Medium term EE&C plan including the measures and targets as shown in Table 3.4-2

Table 3.4-2 EE&C Improvement Plan

Type of plan	Target setting	Obligation
Annual EE&C plan and targets	Covers 12 month from the submission of the annual energy report containing the short term EE&C measures	To prepare revised improvement plan to SREDA if the targets were not met for two consecutive years.
Medium term EE&C plan and targets	Covers up to 36 months from the submission of the annual energy report containing the medium term EE&C measures. The plan may be reviewed and revised on rolling basis.	To prepare revised improvement plan to SREDA if the target is not met or if downward revisions of the target were to be made for more than three times during the planned term period.

3.4.5 Certification of Energy Manager, Certified Energy Auditor and Accredited Energy Auditor

The Government (SREDA) will establish the national certification system of energy managers, certified energy auditors and accredited energy auditors, the details of which include the followings:

- Training program
- Examination
- Provision of qualification criteria for the applicants of training programs and examinations of the energy managers, energy auditors and accredited energy auditors, including their required knowledge and work experiences.
- Disclosure and maintenance of personnel list of energy managers, certified energy auditors and accredited energy auditors.

Participation of a large number of eligible candidates to the national certification system is expected. Industrial sector, academics and relevant parties should identify and appoint the candidates.

3.4.6 Benchmarking

Benchmark is the target values of energy efficiency, which will be defined for the large energy consuming sub-sectors with specific processes, such as steel-making, cement, paper & pulp and soda chemical. Benchmark is described in kgoe/ ton of production or floor area (m^2). Since the manufacturing processes of these industries are the same as those of the other countries in the world, their energy intensity data are comparable to those of other countries without any adjustments.

Benchmark data will be reported to SREDA by an annual energy report. Those factories which attained the target levels will be awarded by SREDA, with their names and award data published on the SREDA website.

The candidate industries qualified for the benchmarking at the initial stage of implementation are shown in Table 3.4-3, with their benchmark indices and target levels. Target level figures in the table are the references based on international data. The real target levels for Bangladesh industries shall be decided through discussions between manufacturers and SREDA.

Table 3.4-3 Benchmark Target Level by Industrial Sub-sector

Sector	Benchmark index	Target level
Normal steel-making by high frequency induction furnace	(Energy consumption in steel-making) / (crude steel production) + (Energy consumption in rolling) / (rolled steel production)	212 kgoe/t or less
Normal steel-making by re-rolling mill	(Energy consumption in rolling) / (rolled steel production)	50 kgoe/t or less
Cement manufacturing with rotary kiln	(Energy consumption in raw material) / (clinker production) + (Energy consumption in burning) / (clinker production through burning) + (Energy consumption in finishing) / (Cement production) + (Energy consumption in delivery) / (Cement and clinker volume delivered)	93 kgoe/t or less

Sector	Benchmark index	Target level
Cement manufacturing by grinding process	+ (Energy consumption in finishing) / (Cement production) + (Energy consumption in delivery) / (Cement and clinker volume delivered)	16 kgoe/t or less
Printing paper manufacturing	(Energy consumption) / (Production)	204 kgoe/t or less
Board paper manufacturing	(Energy consumption) / (Paper production)	118 kgoe/t or less
Soda chemical	(Energy consumption in electrolysis) / (Caustic soda weight in electrolysis bath) + (Steam consumption in condensation) / (liquid caustic soda weight)	82 kgoe/t or less

Source: Data provided by Prof. Ijaz, BUET

Target level will be changed with the increase of EE technologies

The role of benchmarking will be decided by SREDA, including voluntary targets and the future mandatory targets (with penalty systems).

3.4.7 DCs' Energy Consumption Data Collection System

(1) Objective

DCs are obligated to report their annual energy consumption and EE&C actions to SREDA. SREDA will develop "Periodical Energy Consumption Reporting System (PRS)" which has the following objectives:

- To support DCs in making the reports, grasping their own energy consumption and reviewing EE&C actions.
- To monitor DCs' EE&C actions and make administrative instructions, if necessary.
- To aggregate energy consumption data by sector and sub-sector; calculate energy intensity; and grasp nationwide energy consumption and EE&C implementation trends.
- To utilized the data for the benchmarking program.
- To disclose accumulated data to raise awareness and ensure dissemination of EE&C actions.

(2) Energy Data Reporting

Energy data to be reported is shown in Table 3.4-4. Each datum listed in the table below is collected annually. Besides annual energy consumption, monthly consumption data are also reported optionally.

Table 3.4-4 Reporting Items

Items	Content
Electricity	Grid generated, Captive power generated
Liquid fuel	Petrol/Octane, Naphtha, Kerosene, Diesel oil, Furnace oil
Gaseous fuel	Natural gas, LPG
Solid fuel	Coal

Items	Content
In the case of factories	Production or Service activity and their volume
In the case of buildings	Floor areas
Energy intensity	Energy consumption(toe) per unit production or floor area Changes in energy intensity data for the past 5 years
Main energy consuming equipment	Name, Specification, Present status

Figure 3.4-2 shows a reporting scheme of the periodical energy report

Energy managers prepare annual energy report under the president or CEO's supervision. Energy manager can submit the report to SREDA by either of the following two methods.

Method -1: Prepare paper report and send it to SREDA directly or by mail. Submission by e-mail will be permitted. The data is fed to computer by SREDA officers.

Method -2: Energy managers login the Energy Reporting page of SREDA website with LN (login name) and PW (password), and input the energy data in the decided format of each establishment.

Energy consumption data are sent to Data Base (DB) server and accumulated. The DB data are processed as statistical graphs and disclosed on the energy consumption statistics page on the SREDA website. It is accessible to anyone with a PC, tablet or smart phone.

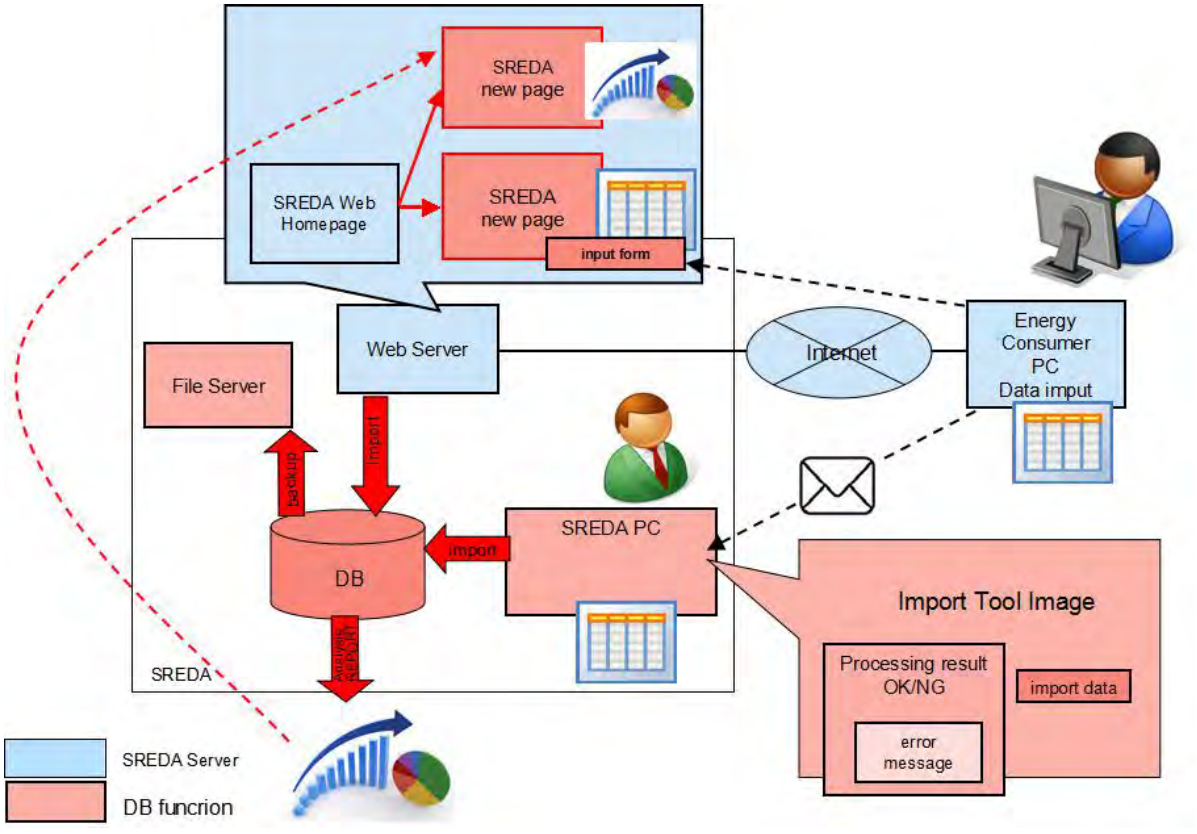


Figure 3.4-2 Periodical Reporting System in 2014

3.4.8 Roles and Responsibilities of Energy Management Program

Roles and responsibilities of each participating party in the program are summarized in Table 3.4-5.

Table 3.4-5 Roles and Responsibilities under Energy Management Program

Party	Roles and responsibilities	
SREDA	Legislation	■ Issuance and enforcement of the regulation
	Designation	■ Monitoring of energy consumptions of DC candidates ■ Collection of EE&C reports
	Energy manager/auditor	■ Certification ■ Provision of training programs
	Follow up	■ Analysis of EE&C reports ■ Benchmarking process
	Support	■ Rental of energy measuring instruments and tools
Establishments	Comply to designation	■ Report on energy consumptions ■ Self-declaration as a DC ■ Submission of EE&C report to SREDA
	Energy management	■ Assignment of energy managers ■ Establishment of EMS (Energy Management System) ■ Energy management including annual energy audits ■ In-house training of energy managers
	Follow up	■ Reporting ■ Benchmarking results
Energy manager, Energy auditor, Accredited energy auditor	Certification	■ Issuance of certificates
	EE&C implementation	■ Operation of EMS ■ Energy audits
Industrial association	■ Voluntary benchmarking	
Energy experts	■ Participation in the training and examination programs	

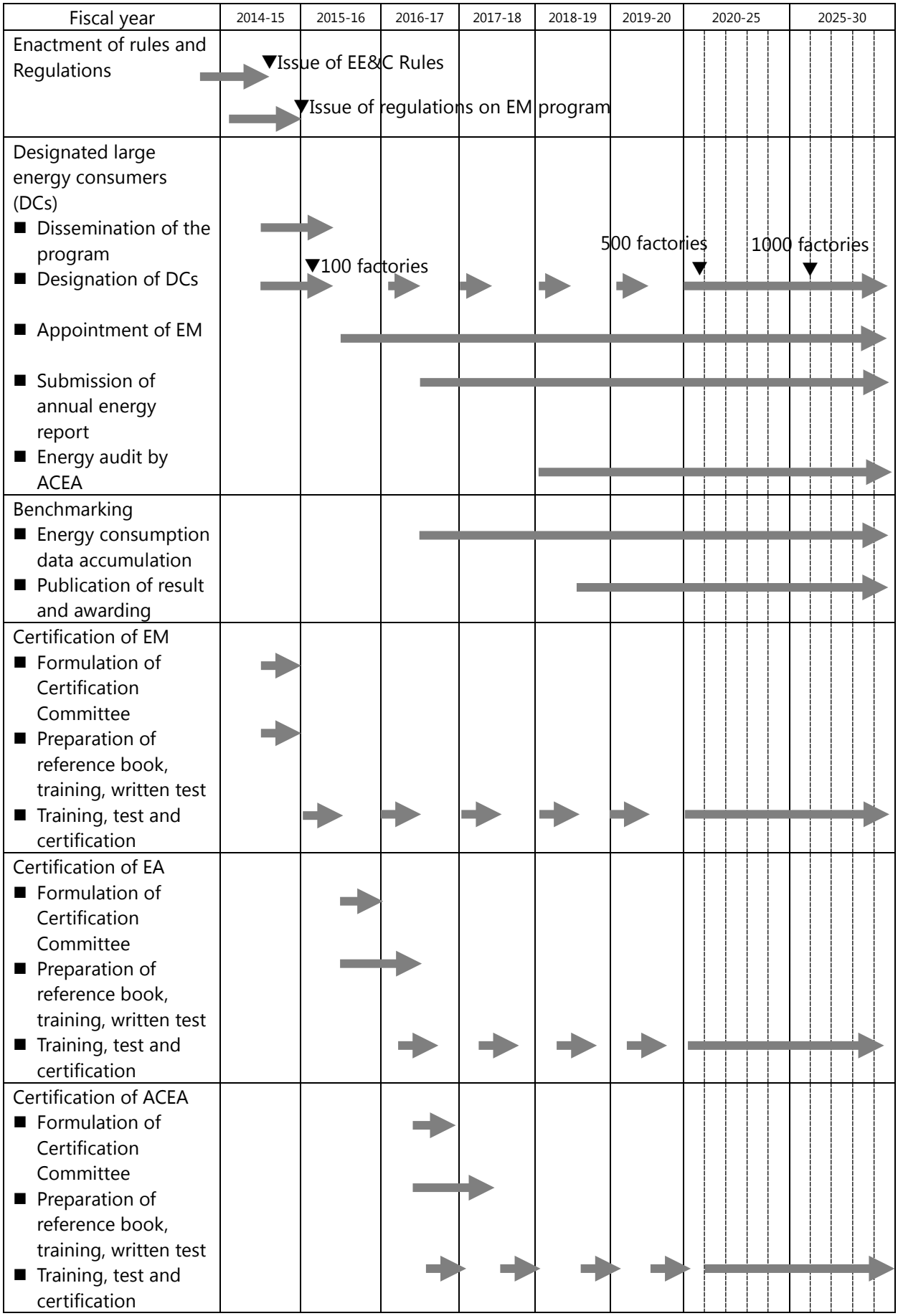
3.4.9 Check and Review

- Designation criteria of DCs will be reviewed every 5 years.
- Qualification criteria of energy manager and auditor will be reviewed on regular intervals (e.g., once in every 5 years)
- Examination of energy managers and auditors will be reviewed every year (or every alternate year)
- Benchmarks such as energy intensities will be reviewed every 5 years.

3.4.10 Roadmap up to 2030

Roadmap up to 2030 for the Energy Management Program implementation is shown in Table 3.4-6. Targeted coverage ratio (as a percentage share of the total energy consumption), which is expected to be achieved by introducing the regulatory measures below, is shown in Table 3.4-7.

Table 3.4-6 Energy Management Program Implementation Roadmap



Fiscal year	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-25	2025-30
Periodical Energy Consumption Reporting System (PRS) ■ Development ■ Trial operation ■ Operation								

Table 3.4-7 Targeted Coverage Ratios of Energy Management Program by Industrial Sub-sector(shares in total energy consumption)

Fiscal year	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-25	2025-30
Chemical soda			30%				50%	70%
EE&C measures			EMS					
					EE equipment			
Chemical fertilizer			30%				50%	
Cement			30%				50%	
Steel-making & re-rolling			30%				50%	70%
EE&C measures			EMS				Heat recovery	
Brick (Factory size is small)								10%
Glass							50%	
Chilling food & cold storage							50%	
Pulp &paper							50%	
Textile			30%				50%	
Garment							30%	
Sanitary and tiles industry (Factory size is small)								30%

3.5 EE Labeling Program

3.5.1 General

The purpose of EE Labeling Program is to promote sales of high efficiency products in the market. The program is applied mainly on home appliances, such as ACs, refrigerators, TVs, lightings, and fans. Due to the rapid economic growth, the number of home appliances, which will be purchased by the people, will expand remarkably in the coming years. In order to achieve the EE&C target by 2030, therefore, the

average efficiency of each home appliance is expected to increase by 20-30%. And it is considered that the EE Labelling Program is the most effective measure to promote EE&C in the residential sector.

Penetration of high efficiency appliances contributes not only to the reduction of energy consumption (kWh), but also to the reduction of electricity demand (i.e., peak load demand in kW).

Table 3.5-1 shows energy efficiency improvement rates of the latest EE&C technology on home appliances/equipment compared with the conventional technology.

Table 3.5-1 EE&C Technology of Home Appliances/Equipment

Appliance	EE&C technology	Improvement of efficiency
Room Air Conditioner	Large evaporation coil Inverter drive COP: more than 4.0 Efficient at partial load	Example: COP; 2.5 - 4.0
Refrigerator and freezer	High performance heat insulation, high efficiency compressor	Annual electricity consumption, comparing similar type 10 year old ;1/3
TV	LCD, LED back light, standby mode	Electricity consumption CRT/ LCD = 2/1
3 phase induction motor	High efficiency motor	Efficiency gain: 10-50%
Lighting fixture	CFL, LED, T-8 FL	Electricity consumption Incandescent: CFL = 4:1

Note: COP means co-efficient of performance; consumed kW/ input kW
CFL means compact florescent lamp

Our country is joining BRESL (Barrier Removal and Cost Effective Efficiency Standards and Labeling) Program under UNDP, and has already started EE Labeling Program. However, the current label program has limited impact on the market, because elements of the program, as shown in Table 3.5-2, have not yet been sufficiently and suitably prepared. We should develop and prepare the missing elements promptly.

Source: BSTI

Figure 3.5-1 Bangladesh EE Label

Table 3.5-2 Elements for the EE Labeling Program

Element	Description
EE measurement method	Unified measurement method for energy efficiency (EE) is needed, in order to evaluate and compare the EE performance of the products fairly. Measurement method includes EE indicator (unit), test protocol, test facility, measurement devices, and EE calculation method. The method must be issued as national standards (BDS) or quoted by international standards such as ISO/IEC.
Star rating criteria	Criteria for giving star numbers on measured EE performance are necessary. The criteria must be designed according to EE&C policy and market condition. MEPS (Minimum Energy Performance Standard) can be included in the criteria. The criteria must be issued as governmental notice or national standards (BDS).
EE verification system	Verification system to maintain credit of the labels is needed. EE data used in the labels must be checked by some authority.
EE testing laboratory	Capable laboratories, which can conduct EE measurement tests, are needed for the program. National laboratories, international 3rd party laboratories and also manufactures in-house laboratories can also be candidates.
Program operation body	Authority that conducts the label certificates issue, monitors labels in the markets, provides programs information, reviews star rating criteria and follow-up EE products market penetration.

3.5.2 Overall Structure of EE Labeling Program

Overall structure of planed EE Labeling Program is summarized in Figure 3.5-2. Verification system assuring reliability of the label and product EE performance are to be included.

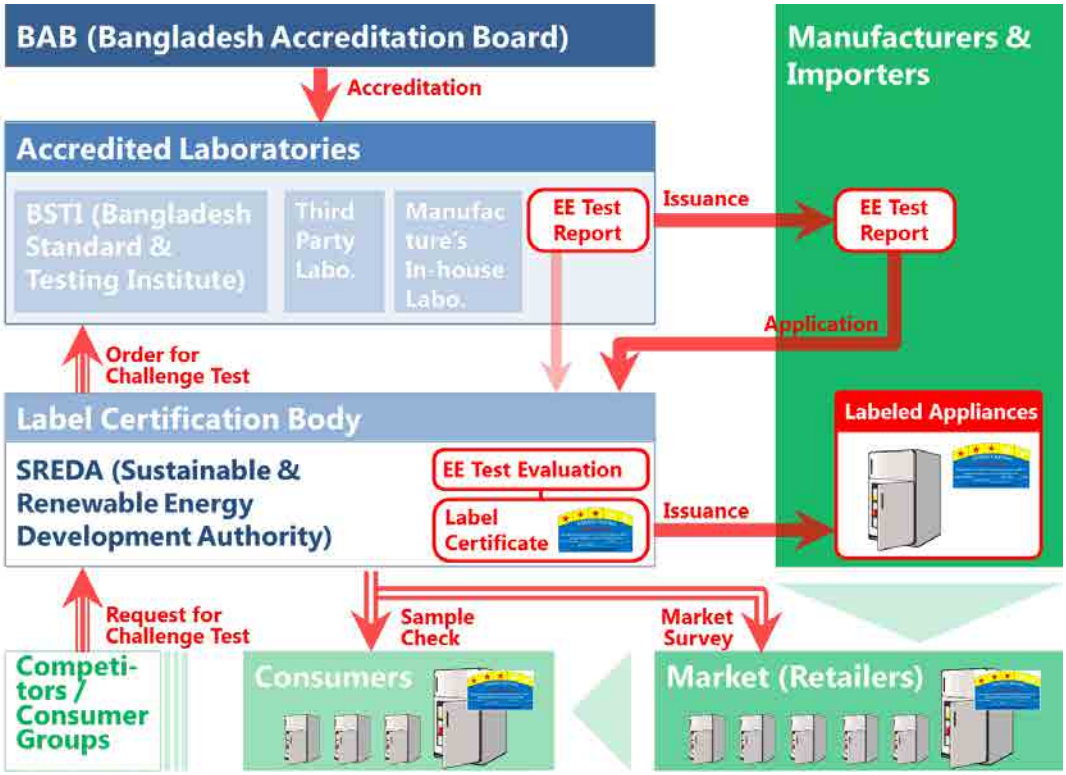


Figure 3.5-2 Overall Structure of Planed EE Labeling Program

Program operation procedure is as following:

1) Manufacturers/importers get EE test on their products at accredited laboratories.
2) Accredited laboratories should have been accredited by BAB through ISO17025, etc.
3) Manufacturers/importers which have in-house laboratories can get EE test at their laboratories, provided laboratories are accredited by BAB
4) Label certification body evaluates the EE test report and issue label certificate on the product with star rating, and delivers it to the manufacturer/importer
5) Manufacturers/importers affix the label on the products or their packages, and deliver them to the markets.
6) Label certification body carry out EE check test for the products sold in the market collecting samples at random, in order to maintain labels reliability.
7) Anybody can claim challenge test to the label certification body, provided the test cost is backed by him/her

3.5.3 Laboratories Capacity Development and Accreditation

Sustainable participation of the testing facilities must be accompanied with periodical maintenance, calibration, skilled personnel and demand of EE tests. Capacity development for skilled personnel needs long time and experiences, especially in case of refrigerator and AC. BSTI will develop its testing ability. On the other hand, BAB must issue accreditation for the eligible laboratories by accessing laboratories' test facility, staffs and quality. Therefore, BAB must be knowledgeable about testing procedures.

3.5.4 Products EE Database

In order to provide energy efficiency data of home appliances to customers, it is effective to construct a "product EE database", which shows not only energy efficiency and stars in label, but also capacity, size, performance and other product information. The database will be developed and maintained by SREDA.

3.5.5 Harmonization with International and/or Regional EE Labeling Programs

Many countries have their own EE Labeling Program and label design. Some countries have 5 star rating, 4 star rating, and others have 7-10 star rating. Also EE measurement methods (standards) are different by country. To break through this chaos-like situation, regional and/or worldwide discussion to harmonize the standard and labeling (S&L) has started. Our country will join in this movement, analyzing neighboring countries' and world trends, to establish our EE Labeling Program properly. Also, We must study "mutual recognition agreement (MRA)", which can rationalize laboratory accreditation system in corporation with other countries.

3.5.6 Roles of Parties (Stakeholders)

Many parties are expected to take parts in the EE Labeling Program. Their roles are summarized in Table 3.5-3.

Table 3.5-3 Roles of Parties (Stakeholders)

Party (stakeholder)	Role
SREDA	■ Total management of the program ■ Issue of star rating criteria ■ Label certification, as requested by manufacturers ■ Provision of products EE database ■ Analyze neighboring countries, and join in the harmonization
BSTI	■ Provision and maintenance of BDS on EE measurement ■ Harmonization with other countries ■ EE test in 3rd party laboratory
Directorate of National Consumer Rights Protection (DNCRP) of MOC	■ Promotion of EE products trading
Manufacturers and importers	■ Join in the program ■ Compliance on the regulation of the program ■ Development of EE products ■ Instruction (explanation) of EE performance to customers
Retail shops, traders	■ Understanding of the program ■ Instruction (explanation) of EE performance to customers
Customers	■ Understanding of the program ■ Selection of EE products
3rd party laboratory	■ Join in the program ■ Obtain accreditation on EE tests
BAB	■ Accreditation of laboratories on EE test
EE Labeling Program Committee	■ Review of the program ■ Recommendation on BDSs and renewal of star rating criteria

3.5.7 Check and Review

Sales data of the labeled products and efficient products will be collected by market researches. The target monitoring items are shown in Table 3.5-4 and 3.5-5.

Table 3.5-4 Monitoring of Programs Implementation

Item	Indicator	Interval
EE Labeling Program	■ EE labels penetration ■ Sales of labeled products ■ Energy efficiency	Every 3 years
People's conscious on EE label	■ Is the label meaning understood? ■ EE products procurement promotion	Every 5 years
Energy consumption at households	■ Energy consumption by appliance and equipment ■ Penetration of EE products	Every 5 years

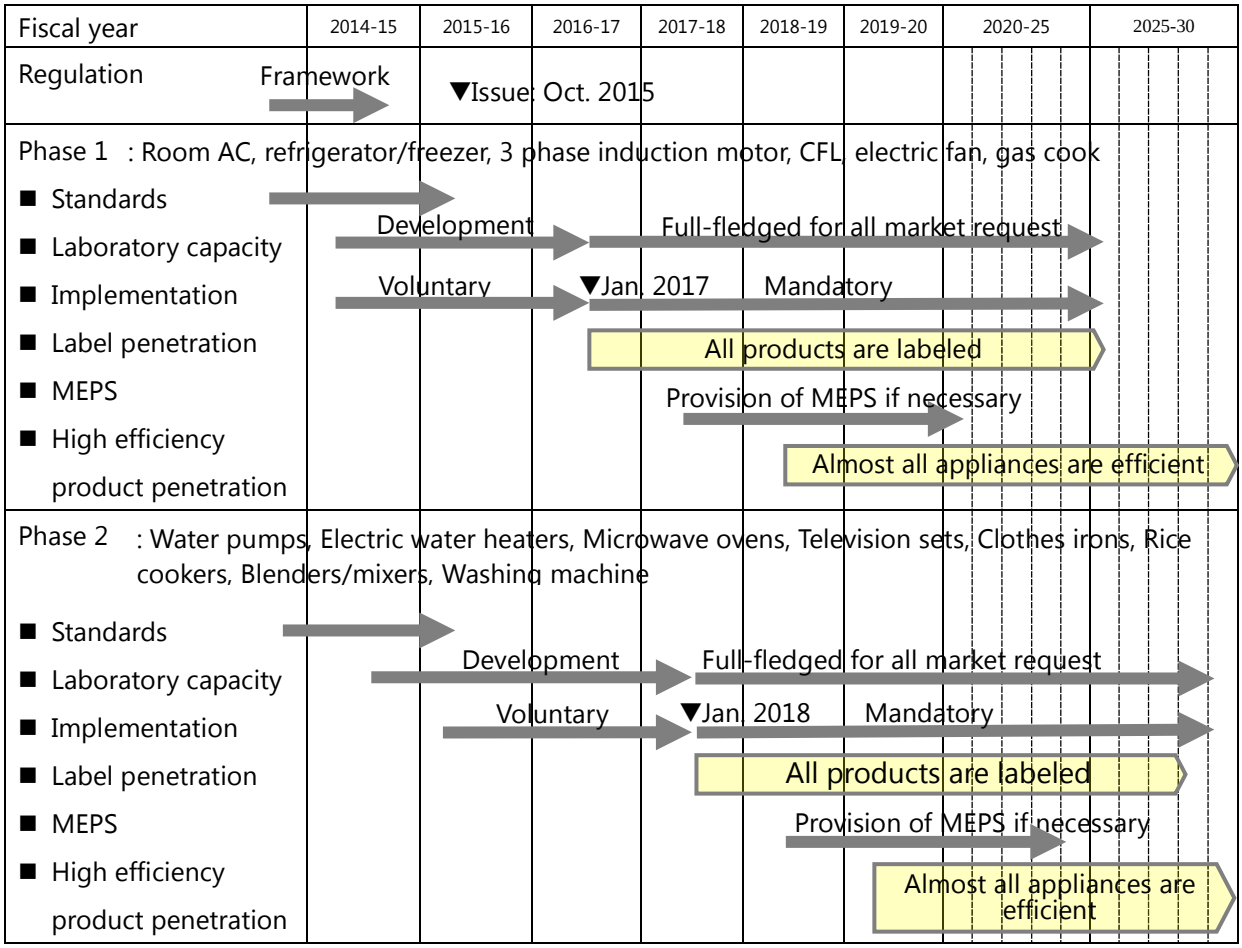
Table 3.5-5 Check and Review Points on Program Implementation

Item	Point
EE measurement method	■ Comparison with other countries for harmonization
Star rating criteria	■ Suitability of star rating criteria, relation to advanced EE technology, penetration of EE products, and domestic manufacturers' capacity. ■ The criteria will be gradually up-graded.

3.5.8 Roadmap up to 2030

The EE Labeling Program is initially starting as voluntary program, because mandatory program needs full provision of EE testing services, since it is requested by manufacturers and importers, who are obligated to get EE products data, and have not their own test facilities. It will require long time and budget for the provision of test facilities from the EE&C administration side. In case of the voluntary program, manufacturers and importers can join the program, if they have in-house laboratories or they can outsource EE test to some 3rd party laboratories. Roadmap up to 2030 for EE Labeling Program implementation is shown in Table 3.5-6. Targeted energy efficiency (EE) by appliance, which is expected to be achieved by EE Labeling Program, is shown in Table3.5-7.

Table 3.5-6 EE Labeling Program Implementation Poadmap



Fiscal year	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-25	2025-30
Phase 3: other appliances ■ Standards ■ Implementation					Voluntary			

Table 3.5-7 Targeted EE Improvement by Appliance

Fiscal year	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-25	2025-30
Room AC EE (COP, APF, SPF)		100%			125%		150%	200%
Refrigerant		R32 (ODP: 0, GWP: 675)					R1234yf (ODP: 0, GWP: 4)	
Refrigerator EE (kWh/year)		100%			125%		150%	200%
Refrigerant		R600 (ODP: 0, GWP: 4)						
TV EE (kWh/year)		100%			125%		150%	200%
Lighting LED sales		100%			125%		150%	200%
Motor		100%			115%		130%	

COP: Coefficient of Performance, APF: Annual Performance Factor, SPF: Seasonal Performance Factor

ODP: Ozone Depletion Potential, GWP: Global Warming Potential, R32 & R600; refrigerant

3.6 EE Building Program

3.6.1 Overview

The amount of energy consumption in buildings is not so large compared with industrial and residential sectors at present. Besides the energy consumption is rapidly increasing in buildings in our country. Especially new buildings construction is remarkable in city area. Therefore it is needed to implement an effective counter measures to mitigate this issue. And New Version of Bangladesh National Building Code (BNBC [Revised]) is going to be published by Ministry of Housing and Public Works (MOHPW), taking into consideration EE&C in buildings as well. BNBC [Revised] is the core program for promoting EE buildings.

EE&C measures for buildings are as followings:

- Reduction of incoming heat from outside to inside by means of heat insulation, air-tight door/window and sun shine control
- Introduction of energy efficiency building equipment and appliances
- Appropriate use, operation and maintenance of the building and building equipment

However, these EE&C measures and rational energy use are not yet sufficiently implemented in our country.

Bangladesh National Building Code (BNBC) is the mandatory program which provides regulation and/or minimum requirement of building type (office, residence, commercial building, etc.), size (height, floor area), structure strength, indoor condition, construction material, etc.

Currently, addition of energy efficiency requirement of buildings in the code is on-going. BNBC [Revised], will be issued instead of the existing BNBC, by MOHPW. BNBC [Revised] will be the core program for promoting EE&C in Buildings and contain the following requirement on building energy efficiency:

- Heat insulation and/or ventilation performance of building envelope
- Energy efficiency of building equipment (HVAC, lighting, fans, hot water supply, lift, escalator, renewable energy options)
- Water efficiency and management

On the other hand, Green Building Guideline (GBG) is a voluntary program that provides recommendations not only on energy/water use efficiency but also on reduction of environmental impact caused by building construction, use and decommissioning. Development of green building guideline is an international movement. GBG is planned for the completion by 2025.

EE&C requirement issues in BNCB [Revised] are the minimum standards. On the other hand, EE&C requirement issues in GBG will be recommended and effective since it allows obtaining upper-grade EE&C performance than the buildings fulfilling BNCB [Revised].

3.6.2 Overall Structure of EE Building Program

Overall structure of planed EE Building Program is summarized in Figure 3.6-3. Stakeholders' compliance with BNCB [Revised] and voluntary development of Green Buildings is expected. Local governments role on intermediation are important.

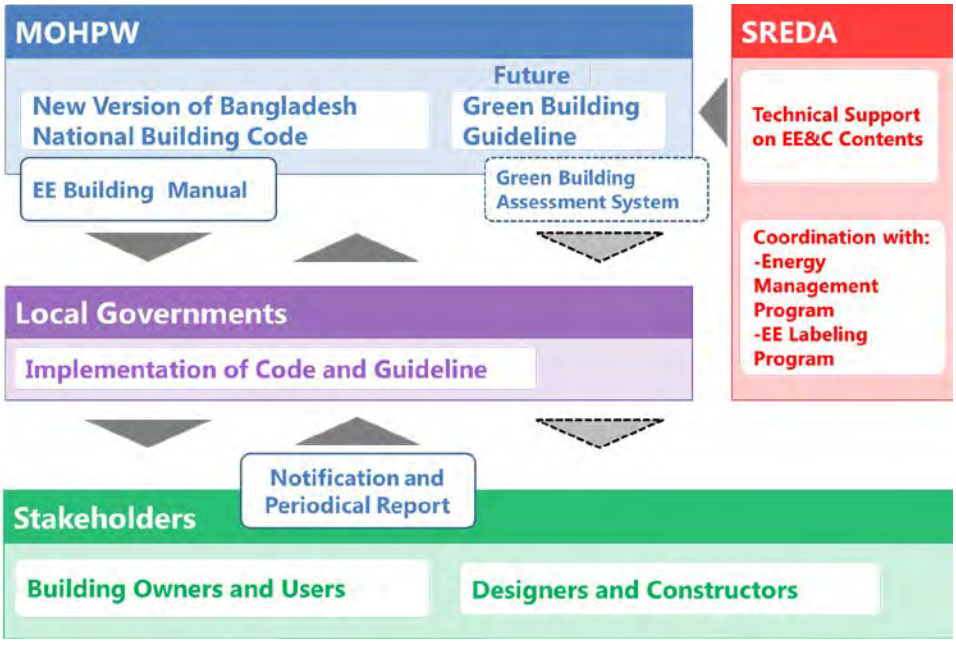


Figure 3.6-1 Overall Structure of Planned EE Building Program

3.6.3 New Version of Bangladesh National Building Code (BNBC [Revised])

(1) EE&C Requirement Issues in BNBC [Revised]

Provisions of EE&C requirements in BNBC [Revised] consist of minimum requirement, standard specification and recommendations on the design and construction method. Table 3.6-1 shows outline of the requirement.

Table 3.6-1 EE&C Requirement Issues in BNBC [Revised]

Category	Content
Building envelope	■ Roof insulation and green roofing system ■ Window to wall ratio ■ Window opening ■ Shading
HVAC(Heating, Ventilation and Air-Conditioning)	■ HVAC system ■ Ceiling and wall mounted fans
Hot water supply	■ Solar hot water system
Lighting	■ Day lighting and supplementary lighting system ■ Lighting power density ■ Occupancy sensors
Lift and escalator	■ Energy efficiency of lift and escalator
Renewable energy	■ Solar Power ■ Other renewable energy
Others	■ Water management (Reuse of gray water, efficient fittings in toilets)

Some requirements in BNBC [Revised] quote the criteria from foreign building codes and standards. To make them more compatible to our country's climate, culture and manner and more acceptable for our laws and regulations, they will be reviewed and revised.

Also, EE&C requirements of building insulation materials will be introduced in accordance with EE&C materials to be presented in the GBG.

(2) Application of BNBC [Revised]

In order to widely promote EE&C for buildings in our country, application of EE&C requirement issues in BNBC [Revised] will be implemented and extended in a phased manner (under study by MOHPW). Table 3.6-2 suggests how the areas can be changed to expand the coverage of the code.

Table 3.6-2 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 a calendar year from January to December.

(3) Roles and Responsibilities for BNBC [Revised] Enforcement

For enforcing BNBC [Revised] and promoting EE&C in the buildings, all stakeholders must understand and carry out their roles and responsibilities as shown in Table 3.6-3. In order to disseminate the roles and responsibilities to all stakeholders, nationwide awareness raising program and capacity development program are needed.

Table 3.6-3 Roles and Responsibilities of Related Stakeholders

Party		Design	Construction	Operation	Demolition	Roles and responsibilities
GoB	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 in coordination 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 the related organizations ・ 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

Party	Design	Construction	Operation	Demolition	Roles and responsibilities
					・ Examination of the program suitability, considering local conditions ・ Promotion of the program for 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 governments 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 local governments 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 program regulation ・ 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 Building EE&C Performance

Building permit under the existing BNBC is the procedure to check and verify that buildings are surely designed in accordance with rules and regulations and are constructed following the original plan and design. However actual EE&C performance of the buildings cannot be assured by the current procedure.

Additional check and monitoring system as shown in Table 3.6-4 will be provided in BNBC [Revised]. Submission of Notification and periodical report will be obligated for large scale building owners.

Table 3.6-4 Check and Monitoring Systems 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 construction of the buildings.
	Notification for EE&C measures	Building owners report Notification on EE&C measures to the local governmental agency, prior to start of 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, publication of the company name and/or penalty are imposed.
Construction	Building Permit (existing)	Local governmental agency inspects 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 and design, the local governmental agency recommends and instructs to modify them. If the buildings are not modified, the local governmental agency does not permit buildings use.
Operation	Periodical Report for EE&C measures	Building owners present Periodical Report to the local governmental agency. In the Periodical Report, the operation and maintenance conditions concerning the items described in the Notification are reported.

3.6.4 Green Building Guideline (GBG)

(1) Application of Guideline

GBG is a voluntary program and is developing as a guideline for the design and construction of upper-grade EE&C and low environment impact buildings rather than the buildings under BNBC [Revised]. The objects of GBG are offices, rental & mercantile (shopping malls), residential, hospitals, schools and hotels in new large scale projects by both public and private sectors. The Governments will carry out awareness rising of the guideline for building designers and developers.

(2) EE&C Recommendation in GBG

GBG is developed to reduce not only energy and water consumptions but also environmental impacts during construction, use and decommissioning of the buildings. GBG, as a voluntary program, will give recommendation on use of energy and water, waste management, indoor environmental condition, material use at construction and other environmental issues.

3.6.5 Other Programs for Promoting EE&C in Buildings

(1) Development of EE&C Building Manual

In order to encourage proper and effective EE&C implementation in BNBC [Revised], EE&C building manual for local governments, building owners and users, designers and constructors, will be developed and published by MOHPW, in the initial BNBC [Revised] implementation stage. The manual should

include detailed explanations and concrete construction methods for EE&C measures described in BNBC [Revised]. Also the manual will include not only general measures applicable to all buildings but, also, a variety of recommended measures appropriate and economically beneficial depending on the specific conditions of the individual building and location.

(2) Development of Green Building Assessment System

Green Building Assessment System will be developed by MOHPW, in accordance with the GBG development which is compatible to our country's climate, culture and manner and is acceptable for Bangladeshi laws and regulations. The system will start to be voluntarily applied for large scale development projects such as shopping malls, airport buildings, hotels and hospitals.

In the future, the Green Building Assessment System with GBG will be used as an evaluation method for certification of "Green building" and/or "Net zero energy building". Green building owners may be rewarded or incentives may be given.

(3) EE&C for Existing Buildings under Energy Management Program

In order to encourage energy efficient operation of existing buildings, retrofit with energy efficient technologies and other measures able to reduce energy consumption in existing buildings will be supported.

In the near future, large scale buildings classified as designated large consumers under the Energy Management Program will implement EE&C activities or retrofitting under the program to be leaded by SREDA. SREDA will develop criteria and list buildings, classified as designated large consumers under the Energy Management Program, in association with MOHPW and HBRI.

On the other hand, in the future, MOHPW and Housing and Building Research Institute (HBRI), in cooperation with SREDA, will expand EE&C measures in BNBC [Revised] and GBG to existing buildings.

3.6.6 Check and Review of Programs

(1) Check and Review of Programs

MOHPW and HBRI will regularly check and review the progress situations for BNBC [Revised] implementation and GBG development. If any delay and/or changes on the situations arise, MOHPW and HBRI, in association with SREDA, will prepare reschedules for them. SREDA will provide supports and cooperation to be needed for BNBC [Revised] implementation and GBG development.

(2) Preparation for Statistical Database

Building statistical database is necessary to check and review EE&C in buildings. However, the present database for buildings is not sufficient. Building statistical database is needed and properly maintained. The database will include not only existing/constructed floor areas and amount of buildings by building

type but also the energy consumption and conditions of EE&C equipment and facilities, which will be researched by consultants and/or be collected through the documentation systems produced under BNBC [Revised], GBG and the other programs like Energy Management Program.

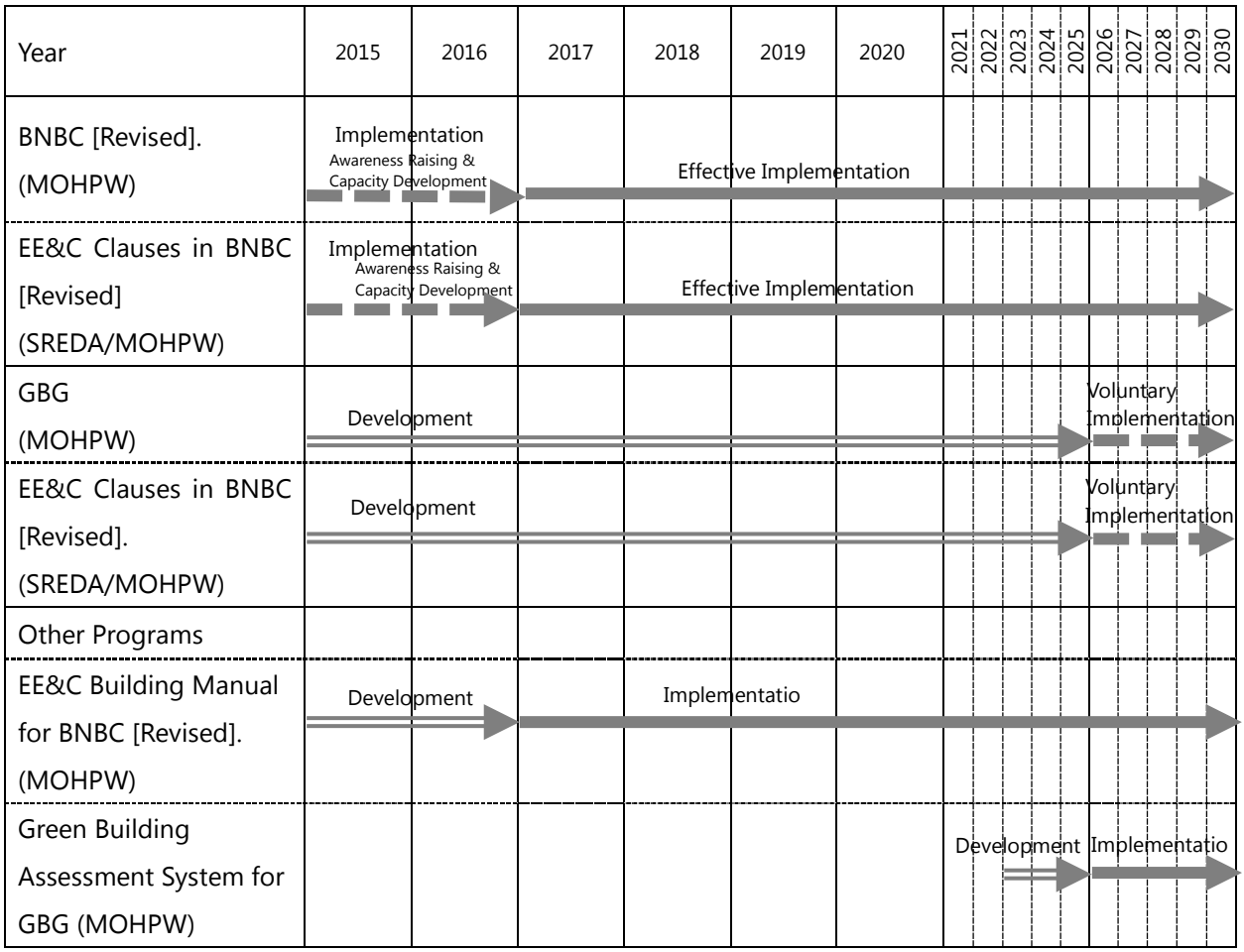
3.6.7 Roadmap up to 2030

Roadmap up to 2030 for Program Implementation of BNBC [Revised] and GBG is shown in Table 3.6-5. Expected energy savings in accordance with the predicted EE&C realization rate of BNBC [Revised] are shown in Table 3.6-6.

Considering that the current BNBC realization rate is low and BNBC [Revised] implementation is conducted in a phased manner, the predicted EE&C realization rate of BNBC [Revised] must be quite low at the being. Through the awareness raising and capacity development actions by the Government for local governments and the other stakeholders, it is possible to increase the realization rate step by step for full wide use of BNBC [Revised].

The first largest issue is to conquer the existing buildings that neglect the rules under BNBC.

Table3.6-5 Program Implementation of BNBC [Revised] and GBG Roadmap



Note: Calendar year from January to December is used on a) "Recommendations for Green Building Code for Bangladesh, MOHPW/HBRI and b) "Development Green Building Code for Bangladesh, Development Design Consultants Ltd."

Table 3.6-6 Expected Energy Savings in Accordance with Predicted EE&C Implementation Ratio of BNBC [Revised]

Year		2015	2016	2017	2018	2019	2020	2025	2030
Office	Realization rate	12.5%		25%		56.3%		100%	
	Savings (GWh/year)	0	6.1	12.2	24.4	36.6	64.0	265.3	509.3
Hospital	Realization rate	12.5%		25%		56.3%		100%	
	Savings (GWh/year)	0	3.5	7.0	14.1	21.1	37.0	153.2	294.0
School	Realization rate	12.5%		25%		56.3%		100%	
	Savings (GWh/year)	0	0.0	0.0	0.1	0.1	0.2	1.0	1.9
Residential	Realization rate	0.25%		1.5%		15.0%		100%	
	Savings (GWh/year)	0	1.7	3.5	14.2	25.0	133.0	2,509.8	6,111.1
Rental / Mercantile	Realization rate	12.5%		30%		56.3%		100%	
	Savings (GWh/year)	0	6.6	13.2	29.1	45.0	74.7	293.0	557.6
Hotel	Realization rate	12.5%		25%		56.3%		100%	
	Savings (GWh/year)	0	0.1	0.2	0.4	0.6	1.0	4.0	7.7
Total	Savings (GWh/year)	0	18.1	36.2	82.2	128.4	310.0	3,226.4	7,481.6

Note: Percentages in the table are the predicted EE&C realization rates for new construction buildings in each year, which are prepared based on the discussion in EE Building Programs WG held by SREDA and JICA and the follow-up discussion with HBRI in November, 2014, considering the increase of the BNBC [Revised]. Compliance ratio and the increase of target buildings in a phased implementation manner

3.7 EE&C Financial Incentive Programs

3.7.1 Overview

Financial support is a key component to disseminate EE&C policies and activities. It motivates people to incorporate EE&C activities into their business and daily lives.

Financial incentives, in definition, are monetary rewards provided for performance of targeted objectives; and they can provide economic benefits for implementing EE&C projects to motivate people's behavior. Also, financial incentives in general have good effects on raising the people's awareness on EE&C. Financial incentives will bring a positive economic impact, which will help the government to adopt a market-based pricing system.

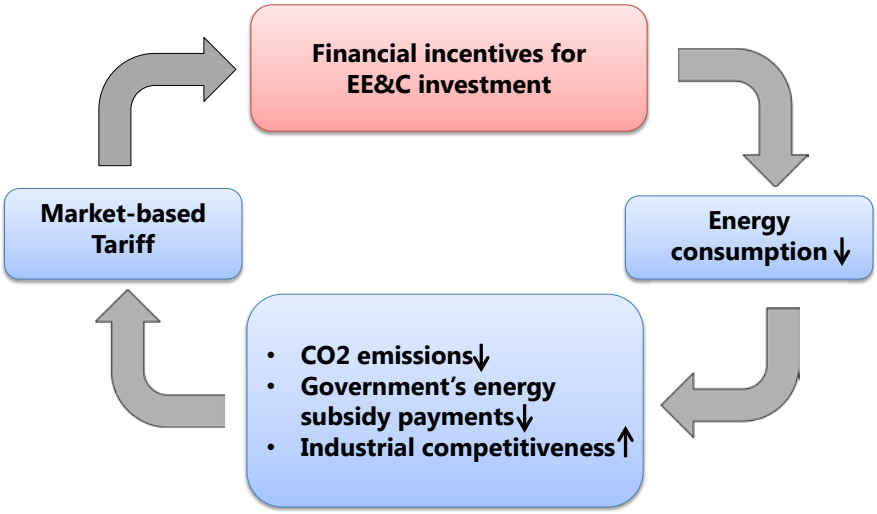


Figure 3.7-1 Virtuous Circle of Financial Incentives

For the nationwide dissemination of EE&C policies in our country, especially among industries, it is necessary to provide financial support which is feasible and thus able to be implemented in the local context. (See Figure 3.7-2)

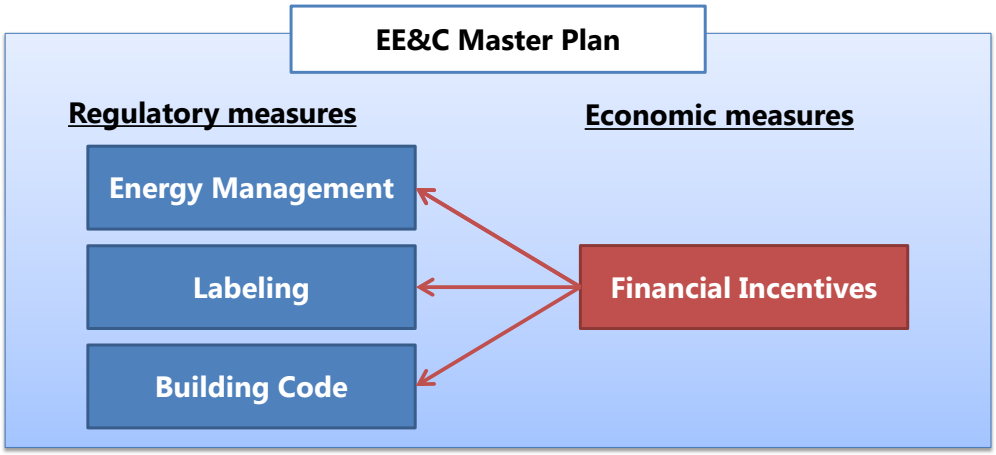


Figure 3.7-2 EE&C Policies and Financial Support/ Incentives

(1) Types of Financial Incentives

One of the bottlenecks, which have been preventing people from implementing EE&C activities is the fact that the prices of EE equipment are generally higher than those of the conventional technology. In order to facilitate the execution and dissemination of EE&C policies in our country, therefore, it is effective to provide financial support. The major financial incentives include subsidies, preferential taxation and low interest loans, the details of which are described below:

1) Subsidies

For the quick diffusion of EE facilities and equipment, subsidies can be an effective financial incentive measure since they directly reduced the initial costs of purchasing EE equipment. Beneficiaries would be

both individuals and establishments. By specifying the target EE appliances, subsidies could facilitate fast and quick nationwide installation. Subsidies are generally suitable for the application for a limited period of time, in order not to grant long-term privileges to early bird beneficiaries.

2) Preferential Taxation

Preferential taxation, tax reductions or exemptions, or accelerated depreciation, can be applied to individuals and establishments. Tax incentives will be effective to stimulate people to purchase EE goods, as long as such goods are taxable. One good point about tax incentive is that there is no need to change or add new procedures to the present taxation processes when introducing these incentives. Accelerated depreciation, which allows companies to place the bulk of the costs of an asset in the first few years of its useful life, is also profitable especially, for the industrial and commercial sectors, which are capital intensive.

3) Low-interest Financing (Loans)

In order to provide a long term financial support for the promotion of EE&C policies, concessional loans are the most suitable and effective. It is especially effective for establishments which plan to introduce or replace large amount of machines and equipment with highly energy-efficient ones. The target beneficiaries for such loan program will be limited compare to the other two financial incentives (namely, preferential taxes and subsidies); it has an advantage of easier implementation through ordinary bank loan procedures. Also, the administrator (such as the central and local governments) can adopt this incentive with less financial burdens compared with the other two financial incentives.

Table 3.7-1 shows major three types of financial incentives, which are suitable for EE&C promotion. Their advantages and disadvantages are also summarized in Table 3.7-1.

Table 3.7-1 Types of Financial Incentives for EE&C Promotion

	Examples	Pros 	Cons 
Subsidies	- Investment subsidy - Rebate program - Buy-down grants etc.	- 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, Refinance Line for Renewable Energy etc.) - ODA loans (loans provided by international donor agencies)	- 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 entities

In a broad sense, preferential taxation and subsidy measures are implemented by the Government, whereas low interest loans are provided by financial institutions. Since loans are not gratuitous, and must be repaid thoroughly, beneficiaries are limited to those establishments 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 establishment 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.

(2) The Best Choice of Financial Incentives to Implement in Our Country

For the first step of effective and prompt implementation of EE&C activities in our country, low-interest loan program is the best choice. Here are the reasons:

- Long-term financial support for end-users: Encourage industries to work with energy efficient machineries with improved production quality and quantity (increasing industrial competitiveness)
- Easy to implement for banks and non-bank financial institutions (NBFIs): No need to create a new loan process - Adopting same credit appraisals as normal ones and using eligible lists/ criteria for technical appraisals)
- Less financial burden for the Government: The loan fund will be returned to the Government with interest from participating financial institutions (PFIs: banks and NBFIs)

3.7.2 Low-interest Loan Program: "EE&C Promotion Loan Program"

EE&C Promotional Loan Program, low-interest loan program, will be implemented by setting goals below:

1. Promotion of the nationwide adoption, execution and proliferation of Energy Management Program, EE Labeling Program and EE Building Program.
2. Creation of new markets for investments in (a) industrial sector EE&C, (b) EE equipment/ appliances and (c) green buildings.

To achieve the main goals, EE&C Promotional Loan Program will need to be designed into two phases, the first phase for implementing flagship EE&C projects to prove the economic viability of EE&C, and the second phase for the nationwide dissemination of EE&C investments.

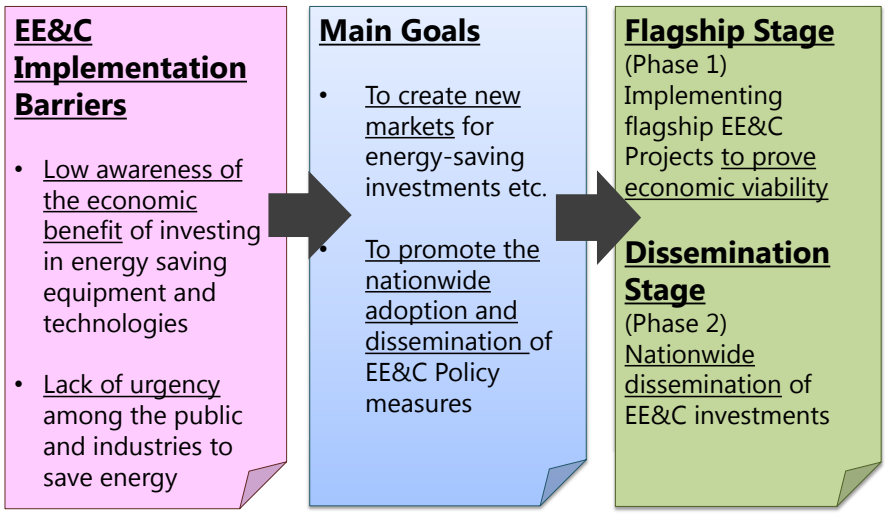


Figure 3.7-3 Low-Interest Loan Program

The primary beneficiaries of each program are large energy consuming establishments, wholesaler/ distributors/ manufacturers, building owners and developers. For the details, see Table 3.7-2.

Table 3.7-2 Expected Beneficiaries by EE&C Policy

Policy	Beneficiaries	Goals
Energy management program	Large energy consuming establishments and building owners who are able to appoint energy manager(s)	To reduce total energy consumption through energy audits and energy efficiency (EE) improvements
EE Labeling Program	Wholesalers/ distributors/ manufacturers which sell EE appliances to end-users on installments, and consumers (EE appliance users)	To promote installment sales of EE equipment/ appliances to consumers
Green Building Program	Building owners and developers	To promote construction of GBs and EEBs

(1) Flagship Stage

Flagship project stage is necessary to show the economic benefits of EE&C investments to enlighten the general public, especially in the industrial and residential sectors, which are the largest energy consumers in this country. In addition, flagship projects will contribute to the creation of viable and bankable energy efficiency markets for EE equipment/ appliances, green buildings and industrial sector energy management, which is indispensable to convince private sector investors, namely, financial institutions and establishments. In order to meet these objectives, it is important that flagship projects shall be selected carefully in order to ensure their technical viability as well as financial profitability.

(2) Dissemination Stage

Dissemination stage will be implemented in order to facilitate the execution and nationwide proliferation of the three EE&C policy measures. In this stage, participating financial institutions, namely, banks and non-bank financial institutions including leasing companies and ESCOs (See BOX 1) are urged to provide finance for EE&C investments by end users. In order to make this stage successful, the following activities need to be provided:

- Education of financial institutions (both executives and loan officers) on the economic benefits of EE&C financing (based on the results of flagship projects), financial appraisals method of EE&C projects taking into account the value of energy-saving benefits and the concept of life cycle costs (See BOX 2)
- EE awareness-raising of establishments in industrial sector by introducing the economic benefits of flagship projects, the concepts of simple payback period (See BOX 3) and life cycle costs

According to our survey, average EE improvement of 36% and 30% between 2015 and 2030 can be expected in residential and industrial sector, respectively, considering the current levels of technology in the country. Even under the current low energy prices there is obviously a huge energy saving potential. Adequate financial incentives, therefore, will be needed to motivate financial institutions, establishments in industrial sector, owners of buildings and the households to save energy which unless otherwise will be wasted.

BOX 1 ESCO and quasi-ESCO services

ESCO (Energy Service Company) provides a comprehensive energy-saving services (including provision of energy-saving solutions, instalment of EE equipment, maintenance and operation of installed equipment). ESCO engages in a performance based contract with a client firm guaranteeing certain level of energy efficiency (EE) improvements (i.e. reduction of energy consumption and/or costs) and, in return, receives remuneration out of thus achieved energy savings.

The source of payments to such ESCO services derives from the energy-savings achieved, and the total payment amount will be arranged so as not to exceed the client's current total energy bill.

There are two major types of models in ESCO business: 1) the guaranteed savings mode in which ESCOs provide clients with performance guarantees, but no financing; and 2) the shared savings model in which ESCOs provide performance guarantees as well as financing.

In the former model, clients themselves procure funds from banks based on their credibility and make repayments out of energy cost savings. And in the latter, energy cost savings will be split between the client and ESCO based on a pre-determined rate. There are also cases where ESCOs are in alliance with banks and leasing companies.

There also exists quasi-ESCO businesses to which no one provides performance guarantees, but financial institutions (such as banks, leasing companies and ESCOs) agree to provide

financing based on cash flow expected to be generated from their energy-saving projects. In a quasi-ESCO project, a client firm may enjoy an advantage of introducing EE equipment without any additional financial burden, but at the same time, unlike an ordinary ESCO business, it will have no risk hedge against underperformance due to incidents such as electricity price falls which make it impossible to achieve expected energy cost reductions. In such a case it is important to involve well established and trusted manufacturers which can provide high quality EE products with long warranty and good maintenance services.

BOX 2 The concept of lifecycle cost (LCC) and EE product

The costs of ownership of an asset involve various costs throughout the useful life of the asset.

1) Initial purchase costs
2) Operation and maintenance (O&M) costs
3) Disposal costs

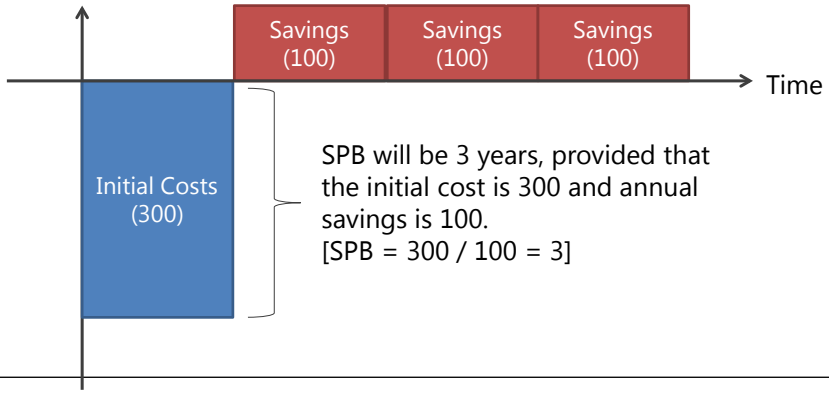
Especially when choosing over electric devices, one has to consider energy efficiency of the product, since it will directly affect the costs of operation and maintenance through monthly energy bills.

Therefore, it is wise for all investors, business entities, government and the households, to always consider the LCC when making a purchase decision. Highly energy efficient product may cost higher at the initial purchase, however in the course of its useful life, O&M cost will be very small compared to non-efficient products.

BOX 3 Simple Payback Period (SPB)

By purchasing an energy efficient product, one can save money through reduced monthly energy bills.

Simple payback period is the number of year in which the initial costs of the product can be repaid by the annual energy savings generated from the ownership of the product. Therefore, the higher the energy efficiency, the shorter the simple payback period will be for the same investment cost.



(3) Timing to Move on to Dissemination Stage

With regard to the timing to move on to the dissemination stage, the Government should wait until the market interest rates start to pick up again. Under the current market situation, where interest rates are constantly slipping downwards, end user interest rates will not be attractive enough to encourage EE&C investments. PFIs would need to ensure certain amount of interest margins to cover the risks involved in promoting EE&C loans, which will make the end-user interest rate high when the market interest rate is on the down ward trend.

3.7.3 Check and Review of Loan Program

(1) SREDA's Responsibility

SREDA is a nodal institution for identification, promotion, facilitation and overall coordination of all national renewable energy and EE&C programs. In other words, SREDA has to ensure its monitoring authority over EE&C activities in this country by receiving reports from relevant ministries, financial institutions, and other organizations which are in charge of data collection related to EE&C. For example, financial institutions which provide policy promotion programs will report SREDA the total amount of money disbursed, what these incentives are used for, how the energy saving was achieved (e.g. replacing and/or installing EE equipment), etc. (See Figure 3.7-4)

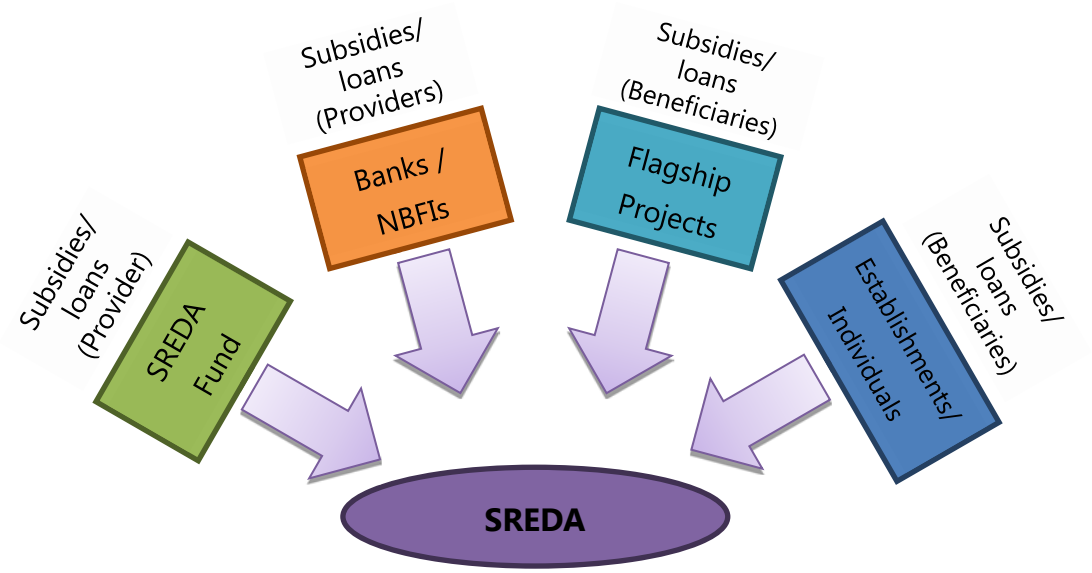


Figure 3.7-4 EE Effects Reporting to SREDA

(2) Technical Standard Committee

It is recommended that SREDA will establish an independent Technical Standard Committee for the implementation of the EE&C policy promotion loan program. Main roles and responsibilities of the Committee will be to compile the eligible EE equipment list/ EE standards and criteria to PFIs in order to support their technical appraisals of EE&C projects. SREDA as the secretariat of the Standard Committee will hold meetings on regular basis (for instance, every 6 months) to review and revise the

list/standards/criteria reflecting the market trend by inviting technical experts from both private and public sectors.

3.7.4 Roadmap up to 2030

The roadmap up to 2030 for the establishment of EE&C finance program is shown in Table 3.7-3. In order to execute and disseminate EE&C policies, it is highly recommended that the Government will provide an EE&C policy promotion loan program starting as early as possible. Idealistically an adequate timing for the start of this program would be the year 2016, taking into account the enforcement processes of EE Rule and Regulations, Energy Management Program, EE Labeling Program and BNBC [Revised].

With regard to the implementation of the EE&C policy promotion loan program, it is recommended that the program will be implemented in two parts: the introductory phase where selected flagship projects will be financed as showcases; and the dissemination phase where the nationwide EE&C investments will be stimulated through financing via participating finance institutions (PFIs).

It is considered effective to finance flagship projects for a short and limited period of time (for three years between 2016 and 2018) in order to show the actual economic benefits of EE&C investments to the private sector investors, both financiers and establishments. On the second phase, the data on EE&C effects collected from flagship projects will be disseminated to private sector investors through financing via PFIs which is expected to start as early as in 2019, following the completion of the three-year loan disbursement for flagship projects. See Table 3.7-3 for the details of the establishment of EE&C policy promotion loan program.

During the nationwide EE&C policy dissemination phase, subsidy as a financial incentive can also be provided by utilizing the revolving loan fund (i.e. collected principal and interest payments from the first phase loans). Part of the fund earmarked for grants can be provided to support energy audits, EE electric appliances testing, interest subsidies for EE equipment investments, etc.

In addition, as a supplementary financial incentive measure, the Government can also consider the adoption of tax incentives (tax reduction/ exemption) targeted at specific industrial manufacturers sector, which produce high energy efficient products. As for the import duties of EE&C goods and materials, it is recommended that the Government will continue the already granted preferential treatment to industrial sector products (as low as 2%) as long as necessary.

Table 3.7-3 EE&C Finance Program Roadmap

Fiscal year	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-25	2025-30
1. Low Interest Loans 1.1 Loan preparations ■ Financial mechanism (Design financial schemes) ■ Flagship projects selection (For introductory phase) ■ Executing agencies/ PFIs (For dissemination phase) ■ EE equipment list, technical criteria								
1.2 Loan disbursements ■ Flagship Projects ■ EE&C Policy Promotion Loans								
1.3 Monitoring of EE&C								
2. Subsidies 2.1 Preparation ■ Select targets methods of EE promotion (e.g. energy audits, green buildings rating system, EE testing) ■ Pool source of subsidies by collecting principals and interest payments from EE&C loan program								
2.2 Provision of grants								
3. Tax Incentives 3.1 Low Duties (2%) for all imported EE industrial machineries								
3.2 Duty free for solar panels & materials, LED and raw materials								
3.3 Add energy efficiency (EE) products to the list of "Renewable Energy (RE) Products" for tax benefits	Submit proposals to NBR by mid-May							
3.4 Income tax reductions for EE product manufacturers								
3.5 Others (accelerated depreciation, etc.)								

To implement financial incentives, SREDA and the Government can utilize concessional loans and grants available from international donor agencies as well as its own tax revenues. In the future, for the country's sustainable energy supply and demand management, the Government may create a new source of fund, such as tax on fossil fuels, part of which can be earmarked for promoting investments in EE&C activities as well as the overall reform of the energy supply and demand sectors.

3.8 Government's Own Initiative on EE&C Implementation

3.8.1 Overview

The Energy Management Program and EE Building Program mentioned above must be also applied on governmental organizations, which include local governments, state-owned companies, semi-governmental organizations and other public sectors. The governmental organizations will surely comply with the regulations of the EE&C programs and implement EE&C. Also, the governmental organizations will take part in the voluntary EE&C programs, such as EE Labeling Program and GBC (Green Building Code) by adopting EE products on their purchase, design and construction of green buildings. The EE&C activities and results will be monitored and disclosed to all people, in order to inspire and promote them to take EE&C actions.

Government facilities and activities include office buildings, schools, hospitals, military facilities, government provided or managed housing, vehicle fleets, roads, bridges, airports, other infrastructure and works/businesses there.

3.8.2 Planning

Firstly, SREDA will develop a typical EE&C action plan which can be applied to all governmental organizations. Secondly, governmental organizations will prepare their own EE&C action plan, and submit them to SREDA. The plan must include contents as shown in Table 3.8-1

Table 3.8-1 Governmental Organizations' EE&C Action Plan (Examples of Contents)

Item	Contents, example
EE&C target	Annual energy consumption, unit energy consumption per production, etc.
Energy management	Appointment of energy manager
Monitoring	Energy consumption data collection mechanism
Check and review	Formulation of third party committee
Action plan	EE&C actions which are customized for each organization: Use of buildings, vehicle, office automation machine, etc.
Capacity development, awareness, training	Periodical implementation
Procurement, outsourcing	Consideration of EE&C and life-cycle on procurement and outsourcing
Other	Accreditation of ISO14000, ISO50001 by organization

3.8.3 EE&C Implementation

The governmental organizations must conduct EE&C actions according to the plan, and make efforts to achieve the EE&C target.

3.8.4 Monitoring, Reporting and Disclosure

Governmental organizations must report their monitoring result on EE&C actions, and disclose it to the public annually. SREDA will analyze the reports. When some negligence on EE&C implementation is found, it must give necessary instruction to the governmental organizations.

3.8.5 Support Services by SREDA

SREDA will provide information on energy efficient products recommended for government procurement, energy efficient design features for new buildings, good practices for energy management and retrofit, and or advisory services for EE&C planning and implementation including energy audits.

3.8.6 Check and Review of Program

Check and review of the program must be done by the governmental organizations individually. SREDA will check and review nationwide performance of the Government's own EE&C initiative.

3.8.7 Roadmap up to 2030

As shown in "Phase 1", SREDA and the governmental organizations must start the program. Table 3.8-2 shows the roadmap of the program implementation for the governmental organizations up to 2030. Table3.8-3 shows the targeted realization rate by program.

Table 3.8-2 Roadmap of Program Implementation by Governmental Organizations

Fiscal year	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-25	2025-30
SREDA Typical EE&C plan	→	▼Delivery to all governmental organizations						
Phase 1 : Ministries in central government ■ Planning		→						
■ Implementation			→	→	→	→	→	→
■ Monitoring, reporting and check/review				→	→	→	→	→

Fiscal year	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-25	2025-30
Phase 2 : Other governmental organizations and public sectors ■ Planning ■ Implementation ■ Monitoring, reporting and check/review								

Table 3.8-3 Targeted Realization Rate by Program

Fiscal year	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-25	2025-30
Energy audits for government facilities				100%				
Appointment of energy managers and auditors selected from government staffs				10 managers 3 auditors				
Certification of green building			Trial Implementation					
Accreditation of ISO14001/50001 in governmental organizations			Trial Implementation					
Primary energy consumption		-15%			-20%			

3.9 Country's Energy Consumption Data Collection Mechanism

3.9.1 General

In order to curry out nationwide energy management is firstly necessary to grasp and monitor our country's total energy consumption and also to break down the energy consumption by sector such as industry, business, transportation, residence and energy supply. Country's total energy consumption can be relatively easy to grasp, through the amount of domestic energy production and energy import from foreign countries.

3.9.2 Energy Data Collection in Our Country

The International Energy Agency (IEA) was founded in 1973 by 28 member states. It has been working for to plan energy policy with the balance on environmental protection, energy security and economic development. And IEA performs statistical survey on manufacturing and energy around the world, and has issued various books and reports. "World Energy Outlook" is the typical one which shows the forecast of the energy market over the medium and long-term.

By analyzing the energy data of IEA, annual energy usage of each country including Bangladesh can be grasped.

(1) Roles and Responsibility

Table 3.9-1 shows the role share of planned and existing databases, for formulating effective energy consumption data collecting mechanism among the related governmental organizations.

Table 3.9-1 Roles of Parties for Energy Data Collecting

Party (stakeholder)	Role
MPEMR	■ Energy supply data collection for policy making
SREDA	■ Energy demand data collection for policy making and awareness raising for consumers ■ Analysis of energy consumption including energy intensity
National Statistics Bureau	■ Other national common data collection
Energy supplier (power companies, gas companies, importers, etc.)	■ Supply of energy sales data ■ Disclosure of data analysis (break down by sector, etc.)
Industrial associations	■ Supply of production data ■ Disclosure of data analysis (energy intensity, etc.)

(2) Roadmap up to 2030

Roadmap up to 2030 for the establishment of energy consumption data collection mechanism is shown in Table 3.9-2.

Table 3.9-2 Energy Consumption Data Collection Mechanism Roadmap

Fiscal year	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-25	2025-30
Design and establishing energy data collection mechanism	→							
Operation of energy data collection mechanism		→	→	→	→	→	→	→
Issue of data collection and analysis report		→	→	→	→	→	→	→

3.10 Global Warming Countermeasure

3.10.1 Overview

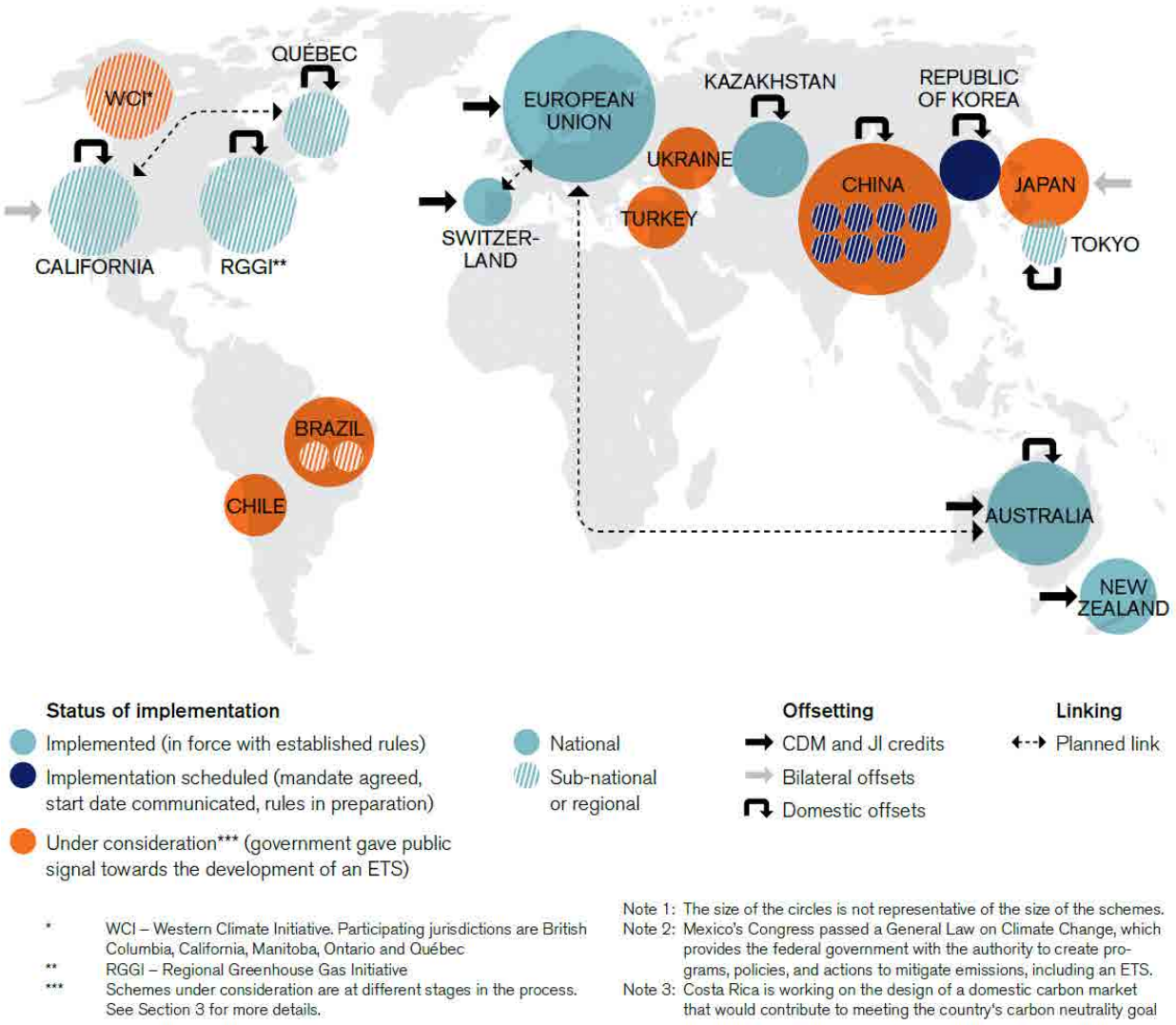
(1) Carbon Market

As discussed at the Introduction, policies and actions are already established in many countries, as a way to stimulate Climate Change mitigation. Figure 3.10-1 shows the geographical distribution of operational and near operational programs at the end of 2013. Some of them, as shown by the straight black arrow are international, in the sense that they may provide revenue for Climate Change mitigation actions occurring in other country.

By far the largest market for international carbon credit is the EU-ETS[12], shown at Figure 3.10-1 as the big blue ball. According with these carbon market rules, which includes the Clean Development Mechanism (CDM), which associates projects developed in DC and LDC to a certain amount of carbon credits. These carbon credits have a value at the market. Other carbon markets or similar rewarding markets exist and new ones may grow soon, as is the case of the California Cap and Trade Program and the Japanese Joint Cooperation Mechanism also shown in Figure 3.10-1.

New agreements about Climate Change will be set at the end of 2015, and dependent on the extension that the regulation covers a growing share of GHG emissions in all participating country, and on the level of the cap defined, it is possible that further carbon credits or some equivalent reward will show up. An increase in the value of 1 ton of CO_2eq avoided is widely expected if reductions on global GHG emission shall follow the suggestion of IPCC, which is a decline of 20% in the next few years and more than 50% by 2050.

[12] EU-ETS means European Union Emission Trade Scheme



Source: Mapping Carbon Pricing Initiatives – Development and Prospects 2013 World Bank Report2013.pdf

Figure 3.10-1 Map of Existing, Emerging and Potential Emission Trading Schemes

(2) Capacity Development as "Carbon Abatement Project"

All carbon abatement project associated with Climate Change mitigation requires monitoring, reporting and verification (MRV), considering that its purpose is the real abatement of a quantified amount of GHG emission. Even before expenses with MRV occur, usually a complete document has to be prepared, explaining details of the project, which implies in more costs for the project owner. Furthermore, project implementation has its own cost. Table 3.10-1 lists all these costs for some of the most common project categories and it is important to comment that the values quoted may be underestimated since only a share of the presented projects are registry and qualifies for carbon credits. Finally, not only money is necessary to registry a project, but the availability of qualified personnel to design and implem is needed. Thus, EECMP proposes Capacity Development on this issue.

Finally, EECMP recognizes that considering our country's extreme fragile situation regarding Climate Change impacts, a good control about all actions and projects performed in the country, yielding GHG emissions abatement, shall be fully monitored and used as a marketing activity at global level.

Table 3.10-1 Total Cost of New Carbon Abatement Projects Registry in EU-ETS (CDM Projects), According with Technology Used.

Type	Abatement costs[23] (€/tCO_2e) *Source: Table 2*	Transaction costs (€/tCO_2e) *Source: Table 5*	Total costs (€) *Sum abatement and transaction costs*	CER price band (€)
N_2O adipic acid	Around 0	Around 0.16	Around 0.2	**Around 0**
N_2O nitric acid	Around 0	0.27 – 0.34	Around 0.3	
Coal mine methane	Around 0	0.21 – 0.26	0.2 – 0.3	
EE own generation	Around 0	0.26 – 0.38	0.3 – 0.4	
Biomass energy	0 – 3.9	0.49 – 0.81	0.5 – 4.7	**0 - 5**
EE households	0 – 3.9	0.58 – 1.33	0.6 – 5.2	
Hydro large-scale	0 – 3.9	0.26 – 0.36	0.3 – 4.3	
Hydro small-scale	0 – 3.9	0.51 – 0.90	0.5 – 4.8	
Landfill gas	0 – 3.9	0.33 – 0.45	0.3 – 4.3	
Methane avoidance	0 – 3.9	0.54 – 1.00	0.5 – 4.9	
Wind large-scale	3.9 – 7.8	0.92 – 1.58	4.2 – 8.3	**5 – 10**
Wind small-scale	3.9 – 7.8	0.41 – 0.91	4.8 – 9.4	
Solar	>7.8	0.33 – 0.49	Above 8.1	**> 10**
Fossil fuel switch	Estimates vary[24]	0.21 – 0.24	Estimates vary	Estimates vary

Source: UNEP Risoe, CDM and PoA pipelines, March 2013

3.10.2 Capacity Development and Carbon Abatement Awareness Raising

(1) Capacity Development

All carbon value associated with Climate Change mitigation requires MRV. To perform MRV not only money is necessary, but the availability of qualified personnel to design and implementation is needed.

(2) Awareness Raising

It is necessary that the Government and major private establishments accurately understand about carbon impacts on Climate Change and the relevance to accurately quantify carbon abatement due EE&C projects. These evaluations can directly yield complementary resource of international money helping our country's development. Thus, awareness rising will be obtained through seminars, folders, and notes prepared and distributed by SREDA.

3.11 Cooperation with International Donor Agencies

There are several projects cooperated by international donor agencies (donors) for supporting the effort of EE&C from the demand side: for example, ADB, GIZ, JICA, USAID, World Bank etc.

The EECMP will mobilize donors' access to EE&C activities. The donors are expected to communicate closely and cooperate with the Government in order to avoid duplication of their support and to create synergetic efforts.

Chapter 4 Economic Analysis of the EE&C Programs

4.1 Background and Objectives

Economic viability and benefits of EE&C measures are already well introduced and tested[13]. Nevertheless, when it comes to a nationwide implementation of EE&C programs, it is not as easy and smooth as electricity 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 concept of Negawatt power, namely, an amount of energy (measured in watts) saved through EE&C, or the cash flow from EE&C which financiers (investors or lenders) do not know how to collateralize[14].

One way to solve these problems and promote a nationwide EE&C implementation is to convince the interested parties by showing the economic benefits of EE&C programs, which can generate Negawatt power, an alternative energy to the conventional power that can generate extra incomes.

4.2 Economic Impact of EE&C Implementation

The direct economic benefit of EE&C implementation is energy consumption reduction (toe). Without proactively implementing EE&C programs, the total energy consumption of this country may expand three folds from 25 million toe (Mtoe) in 2013 to 72 Mtoe in 2030. In order to fulfill the growing appetite of the economy, it is important for the Government to minimize the energy wastes and maximize the use of available energy, including the Negawatt power.

According to the EE&C target of EECMP, the Government aims to improve energy intensity (i.e., national primary energy consumption per gross domestic product/GDP) by 15% in 2020 and by 20% in 2030 compared to the 2013 level. This goal is considered attainable based on the estimation that the industrial, commercial and residential sectors currently have the potential to save energy by 21%, 10% and 28.8%, respectively. The following are the two scenarios for the calculation of the economic benefits of energy savings expected to be generated through EE&C implementation in the period between 2015 and 2030: In Target Scenario (Moderate Case), the energy saving potential realization rate in 2030 will be 80% (i.e., 80% of expected energy savings by 2030 will be accomplished), whereas in Stretch Scenario (Ambitious Case), the potential realization rate will be 100% (or expected energy savings by 2030 will be fully accomplished). (Refer to 2.1.4)

For Target Scenario, a total of approx. 66 Mtoe (or 78 billion m3 of gas equivalent) is expected to be saved within the 15 years between 2016 and 2030. The total energy savings in monetary terms will amount to approx. BDT 530 billion in the period or an annual average of BDT 35 billion, at the current

[13] 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/

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

weighted average natural gas price[15]. The energy intensity in 2030 will be improved by 20% compared to the 2013 level and the energy consumption in 2030 will be reduced by 17% (or by 12 Mtoe) compared with the BAU case.

As for Stretch Scenario, a total of approx. 100 million toe (or 118 billion m3 of gas equivalent) is expected to be saved in the period. The total energy savings in monetary terms will amount to BDT 805 billion (or an annual average of BDT 54 billion). The energy intensity in 2030 will be improve by 24.6 % compared to the 2013 level while the energy consumption will be reduced by 22% compared with the BAU case. (See Figure 4.2-1)

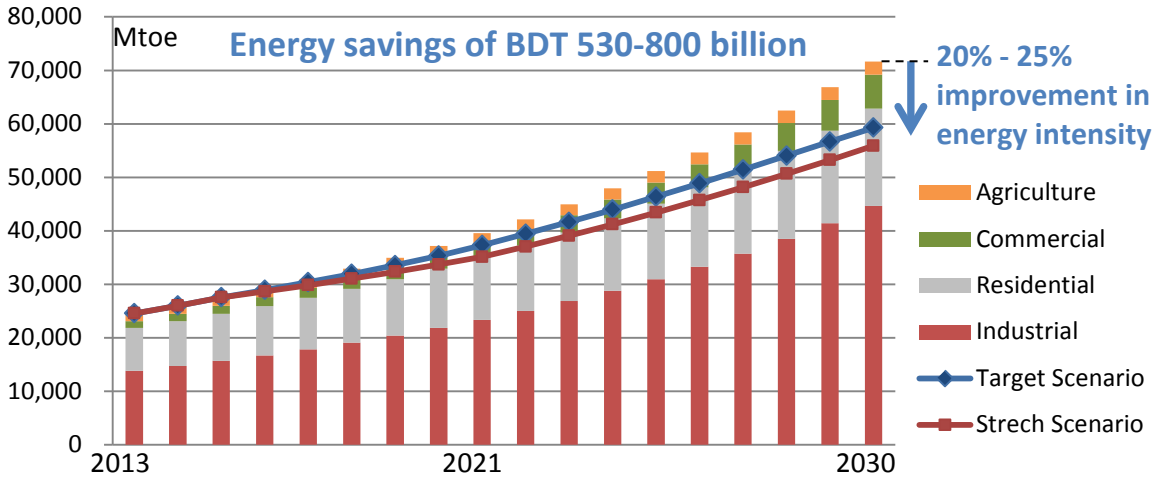
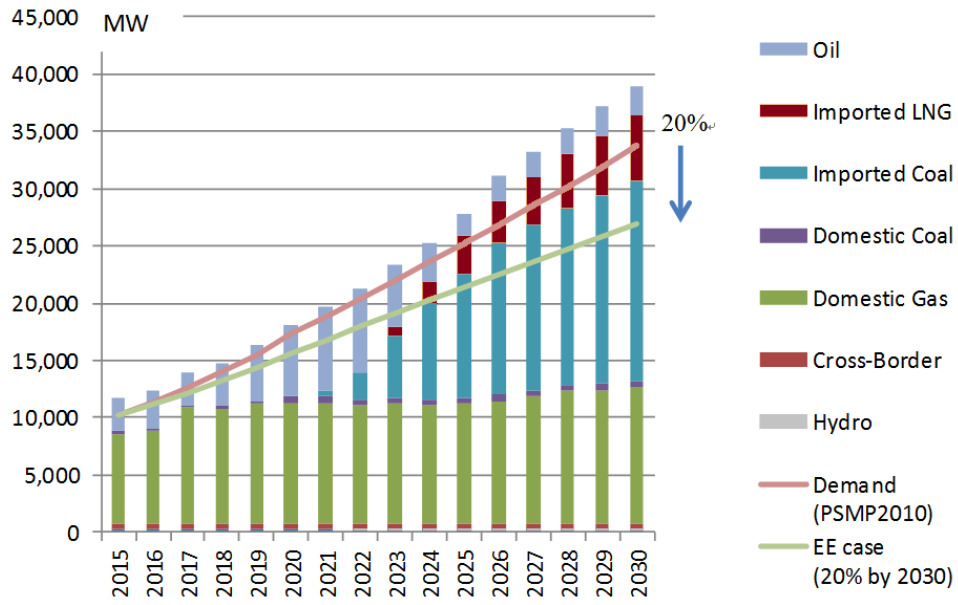


Figure 4.2-1 Realization of Energy Saving Potential by 2030

In addition, as shown in Figures 4.2-2, energy-saving activities promoted under EECMP will directly affect power supply through reduced power demand. If the power demand can be gradually reduced in the period between 2015 and 2030 to reach 20% reduction in 2030 compared with BAU (i.e., a total of 42 GW reduction), power supply can be saved by 48 GW, which implies that the necessary development of additional power supply capacity can also be reduced by 8 GW from 27 GW to 19 GW. As a result, the amount of imports of expensive fuels for power generation will decrease remarkably: The total energy savings would amount to BDT 2.3 trillion (or an annual average of BDT 135 billion), which is equivalent of 6% of national budget and 1% of GDP (2013).

[15] Based on the recent gas tariff proposal, weighted average tariff is calculated as 195BDT/MCF, raised from the current 140.6BDT/MCF. 195BDT/MCF is equal to 6.8BDT/m3 (1MCF = 28.3m3)



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

Figure 4.2-2 Impact on Power Demand and Supply

Besides the economic benefit of energy consumption reductions, EE&C could also bring about several other positive economic impacts to the energy demand side (namely, residential, industrial and commercial sectors) as well as to the energy supply side of the economy as shown in Figure 4.2-3.

1) For the residential sector, reduction in consumption of energy (gas and electricity) implies extra pocket money, which contributes to poverty reduction that improves health and social conditions of daily life of the people.
2) For the industrial sector, EE&C implies less energy costs per unit of production, which will increase industrial competitiveness and thus promote reinvestments in other productive activities that contribute to job creation.
3) For the commercial sector, EE&C implies an efficient energy management of buildings, which contributed to appreciation of asset values.
4) For the electricity supply side, less electricity demand as a result of EE&C implies less fuel costs for electricity generation, which contributes not only to the improvement of trade balance through decreased fuel imports, but also to the improvement of energy security of the country.
5) For the Government, less energy demand implies less public budgets for electricity generation, which contributes to less energy subsidies and thus better management of limited resources as well as better fiscal management.
6) Lastly, less energy demand implies less GHG emissions and thus climate change mitigation, which will contribute to the enhancement of environmental sustainability and therewith the accomplishment of the Millennium Development Goals.

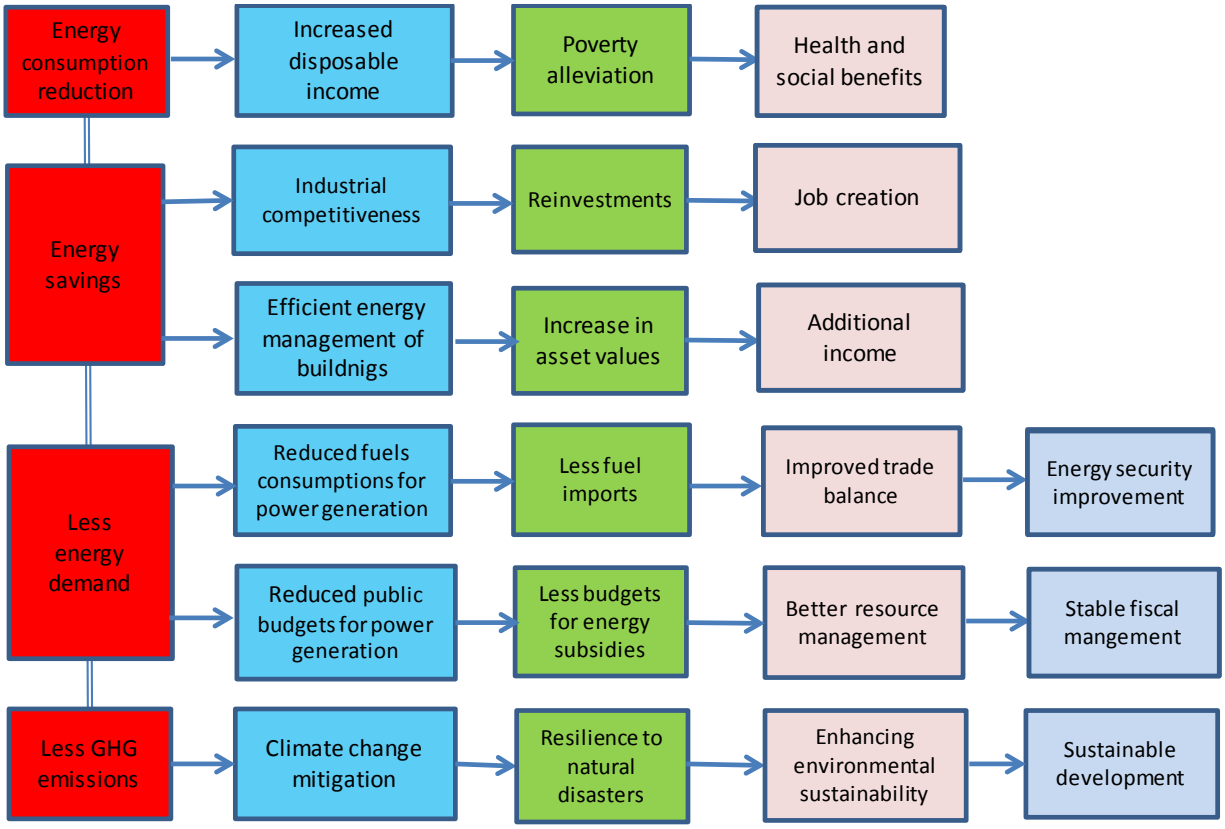
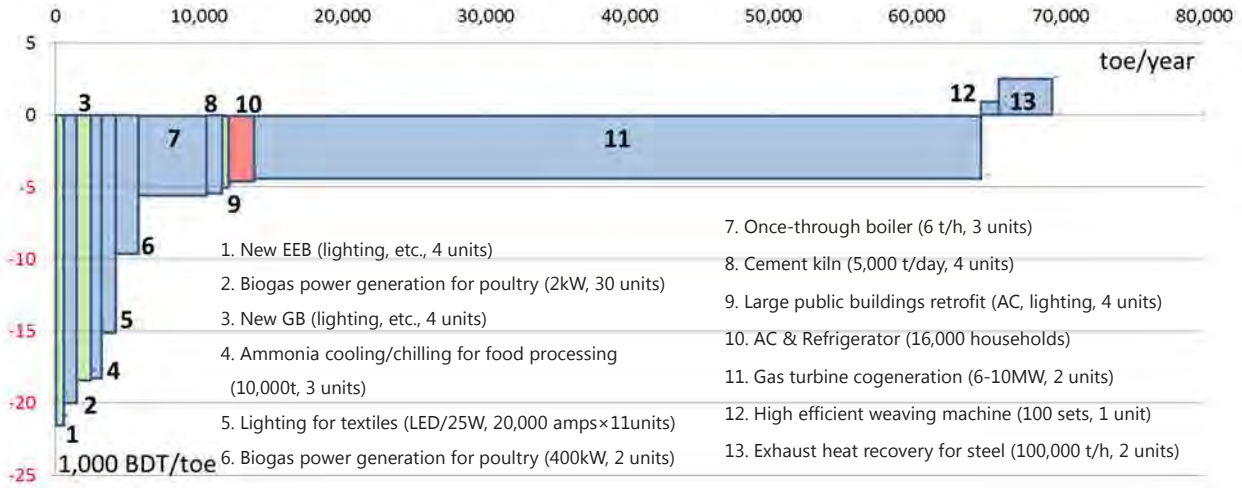


Figure 4.2-3 Economic Benefits of EE&C Implementation

4.3 Cost-Benefit Analysis

For the sake of effective utilization of limited public resources, it is important for the Government to prioritize implementation of EE&C programs and projects according to their cost effectiveness. Marginal Abatement Cost (MAC) curve can be drawn by plotting the data of costs (BDT) per unit of energy reduced (toe) and annual amount of energy reduced. In the MAC curve, the project which require the lowest costs (BDT) per unit of energy saved (toe) is placed at the lower left of the diagram and the project with the highest cost will be placed at the upper right of the diagram, as shown in Figure 4.3-2. In other words, 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. For the effective allocation of limited resources, it is wise for the government to prioritize the implementation of EE&C projects according to their cost effectiveness.



Source: Compiled by JICA EE&C MP Project Team based on independently collected data

Figure 4.3-1 MAC Curve of EE&C Flagship Projects

With regard to EE&C programs, namely, EE Building Program, EE Labeling Program and Energy Management Program, it is also recommended for the Government to prioritize their implementation according to their cost effectiveness. Most of the projects to be promoted under these three Programs are cost effective and can be implemented with a net benefit.

Table 4.3-1 EE&C Projects (Examples) Representing Each EE&C Program

EE&C program	Content (EE&C measures, etc.)
Energy Management Program (Regulatory measures)	■ Once-through boiler for manufacturing ■ Gas turbine cogeneration to textiles ■ Lighting (LED) for textiles ■ Ammonia cooling/chilling for food processing ■ High efficient weaving machine for textiles ■ Exhaust heat recovery for steel
EE Labeling Program (Regulatory measures)	■ Lightings ■ ACs ■ Refrigerators ■ TVs ■ Washing machines
EE Building Program (Regulatory measures)	■ New green buildings ■ New EE buildings
EE&C Finance Program (Financial measures)	Low interest loans, subsidies and preferential taxes for the promotion of: ■ Installment sales of EE type appliances to the residential sector ■ Purchase of EE type industrial machineries and equipment in the industrial sector ■ Production of EE type machineries and equipment in the industrial sector ■ Construction of new green buildings and EE buildings in the commercial sector and government sectors ■ Investments in EE retrofitting of old buildings in the government sector

Chapter 5 Capacity Development and EE&C Awareness Raising

5.1 Overview

5.1.1 Roles of the Government on Capacity Development and Awareness Raising

Initially, the Government leads and has a responsibility for capacity development and awareness raising to promote EE&C. Besides considering the importance of EE&C for our country, such roles are to be taken not only by the Government but also by relevant private sectors, NPO/NGO, individuals and other parties. Thus nationwide structure for EE&C awareness raising has to be formulated.

5.1.2 Capacity Development

For EE&C implementation, capacity development for governmental organizations, private sectors and energy experts is needed. It is important to cooperate with related organizations and programs to implement these activities effectively.

5.1.3 Awareness Raising

We are required to accurately understand about the energy and natural resource issues, for nationwide EE&C implementation. In order to realize this, the Government will promote an awareness raising and information provision for all stakeholders more effectively. The final goal is that all the people and establishment take voluntary EE&C actions.

5.2 Roles of the Government on Capacity Development and Awareness Raising

SREDA is the leading agency on capacity development and awareness raising. It carries out the following roles and actions in cooperation with the related governmental and/or private organizations and programs.

- Preparation of regulations and guidelines for EE&C implementation, specifying good practices and developing pilot and demonstration projects as a showcasing
- Capacity development of the other governmental organizations
- Capacity development of energy experts
- Capacity development of private sectors
- Awareness raising for residential sector

Other governmental organizations conduct capacity development and awareness raising for themselves and their sub-structuring organizations and related stakeholders, such as schools, industrial associations, etc.

5.3 Capacity Development for the Government

SREDA will lead overall issues to promote EE&C in our country. And it has the responsibility to formulate capacity development programs for the governmental organizations (both central and local).

Nationwide EE&C cannot be realized only by SREDA, but by the comprehensive cooperation and partnership among other governmental organizations and local governments.

5.4 Capacity Development for Energy Experts

Energy experts, who have knowledge, experiences and interest in EE&C, are the candidates for future energy managers, certified energy auditors and accredited energy auditors. SREDA will develop the capacity of these energy experts, through training programs. Besides because of the limitation of SREDA's capacity, not only SREDA but also our country's social systems must focus on the capacity development for energy experts; such as university curricula, internal training courses in establishments, publication of educational materials and introduction of success experiences from abroad etc.

5.5 Capacity Development and Awareness Raising for Private Sectors

5.5.1 Overview

Capacity development and awareness raising for private sectors will be implemented though National EE&C award, in accordance with the yearly electricity week, monthly seminar and monthly focus group seminar. Focus group seminars will be implemented focusing on the effective target sectors.

5.5.2 National EE&C Award and Yearly Electricity Week

National EE&C awards are given for the establishments and energy managers, whose activities are worth being highly evaluated and to be good examples for the people. The targets of EE&C award consist of public buildings and commercial buildings.

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

5.5.3 Monthly Seminar and Monthly Focus Group Discussion

SREDA is carrying out seminars and focus groups (important consumers to implement EE measures at time) discussion for target energy consumers on monthly basis. And these activities must be improved and continued.

5.5.4 Efforts by Industrial Association

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

5.6 Awareness Raising for Residential Sector

5.6.1 Overview

Awareness raising for residential sector consists of EE&C school program initiative and media campaign.

5.6.2 EE&C School/University Program Initiative

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

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

Educational curricula on efficient use of energy and its conservation for primary, secondary and higher educational institutions, universities or autonomous bodies will be prepared by SREDA, Ministry of Education 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 curriculums:

- Exhibition of video clips and documentaries on energy efficiency and conservation practices and their benefits.
- Organizing spot quiz.
- Introduction of appropriate posters in schools.
- Organizing thematic art competition.
- Motivational talks by experts or professionals

5.6.3 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. The Government will conduct media campaign in cooperation with related governmental and/or private organizations being coordinated by SREDA.

5.7 Roadmap

Roadmap up to 2030 for awareness raising program implementation is shown in Table 5.7-1. Targeted people's consciousness level is shown in Table5.7-2.

Table 5.7-1 Awareness Raising Program Implementation Roadmap

Fiscal year	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-25	2025-30
Planning	Drafting	▼Issue of the Awareness Plan						
Award ■ Preparation of Guideline ■ For establishments ■ For Energy Manager								
Yearly Electricity Week (December) ■ International Seminar ■ Workshop ■ Exhibition								
Monthly Seminar								
Monthly Focus Group Discussion								
School/university Program ■ Survey ■ Regular Implementation								
Media Campaign								

Table 5.7-2 Targeted People's EE&C Consciousness Level

Fiscal year	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-25	2025-30
People's EE&C conscious	Not so high		High			Very high		

References

Reference 1: Framework of Energy Management Program

Reference 2: Framework of EE Labeling Program

- 2-1: Part 1. General
- 2-2: Part 2. Compact Fluorescent Lamp
- 2-3: Part 3. Refrigerator
- 2-4: Part 4. AC (Air Conditioner)
- 2-5: Part 5. TV (Television)
- 2-6: Part 6. Electric Fan
- 2-7: Part 7. Electric Ballast
- 2-8: Part 8. Induction Motor

Reference 3: Reference for EE Building Program

- 3-1: Notification
- 3-2: Periodical Report

Reference 1
Framework of Energy Management Program

Reference - 1

FRAMEWORK
OF
ENERGY MANAGEMENT PROGRAM
(DRAFT)

March, 2015

Prepared by;
Energy Management Program Committee
EE&C Master Plan Project in Bangladesh

Contents

Introduction

Energy Management Program has been drafted in Energy Efficiency and Conservation Rules (EE&C Rules). This document named “Framework” has been prepared summarizing opinions and ideas of stakeholders who are concerned with Energy Management Program.

The framework is the basic structure of the regulation for the Energy Management Program, showing how to promote energy efficiency and conservation in industry sector, commercial sector and the government. Therefore, the documents will be used as the recommendation to the government on making nation-wide regulation for the operation and maintenance of the program.

Energy Management Program Committee

	Name	Status
Chairperson	Mr. Siddique Zobair,	Member of SREDA
Member	Mr. Sheikh Faezul Amin	Secretary, SREDA and Deputy Secretary PD, MOPEMR
Member	Mr. Md. Abdur Rouf Miah	Director, Sustainable Energy, Power cell.
Member	Professor Dr. Md. Zohurul Hoq	Departmental Head, Mechanical Division, BUET
Member	Mr. Md. Aminur Rahman	Sr. Asstt. Secretary, BERC
Member	Mr. Shah. Zulfiqar Haider	Director (EE & C) SREDA
Member	Mr. Kamrul Ahmed	Assistant Director , SREDA
Member	Mr. A.H.M. Mohiuddin	Executive Engineer, PS&P, DPDC.
Member	Engr. Mohammad Nashir Uddin Miah	Executive Engineer, Agargaon BOB Division, DESCO.
Member	Mr. Md. Rafiqul Islam	Assistant Director , Energy Audit Cell
Member	Mr. Q. A. Sharhan Sadique	Deputy Director, Power Cell
Member	Mr. S. M. Sanzud Lumen	SREDA
Advisor	Dr. Kimio Yoshida	JICA Project Team(Leader)
Advisor	Mr. Norio Fukushima	JICA Project Team
Advisor	Mr. Yoshihiko Saeki	JICA Project Team
Advisor	Ms. Minako Mochida-Matsukawa	Energy specialist, JICA-Bangladesh

1 Purpose

The purpose of energy management is to promote efficient use of energy in industry sector and commercial sector, which include large energy consuming establishments in Bangladesh. Energy efficiency and conservation (EE&C) activities have the purpose to reduce production cost and strengthen international competitiveness, as well as reduction of carbon emission.

The important component of Energy Management Program is to identify the Designated Energy Consumers (DCs). The Government supports DCs to become energy efficient through energy auditing. Another important component of Energy Management Program is to develop energy managers and energy auditors in the country, who play important roles to facilitate the DCs to become energy efficient.

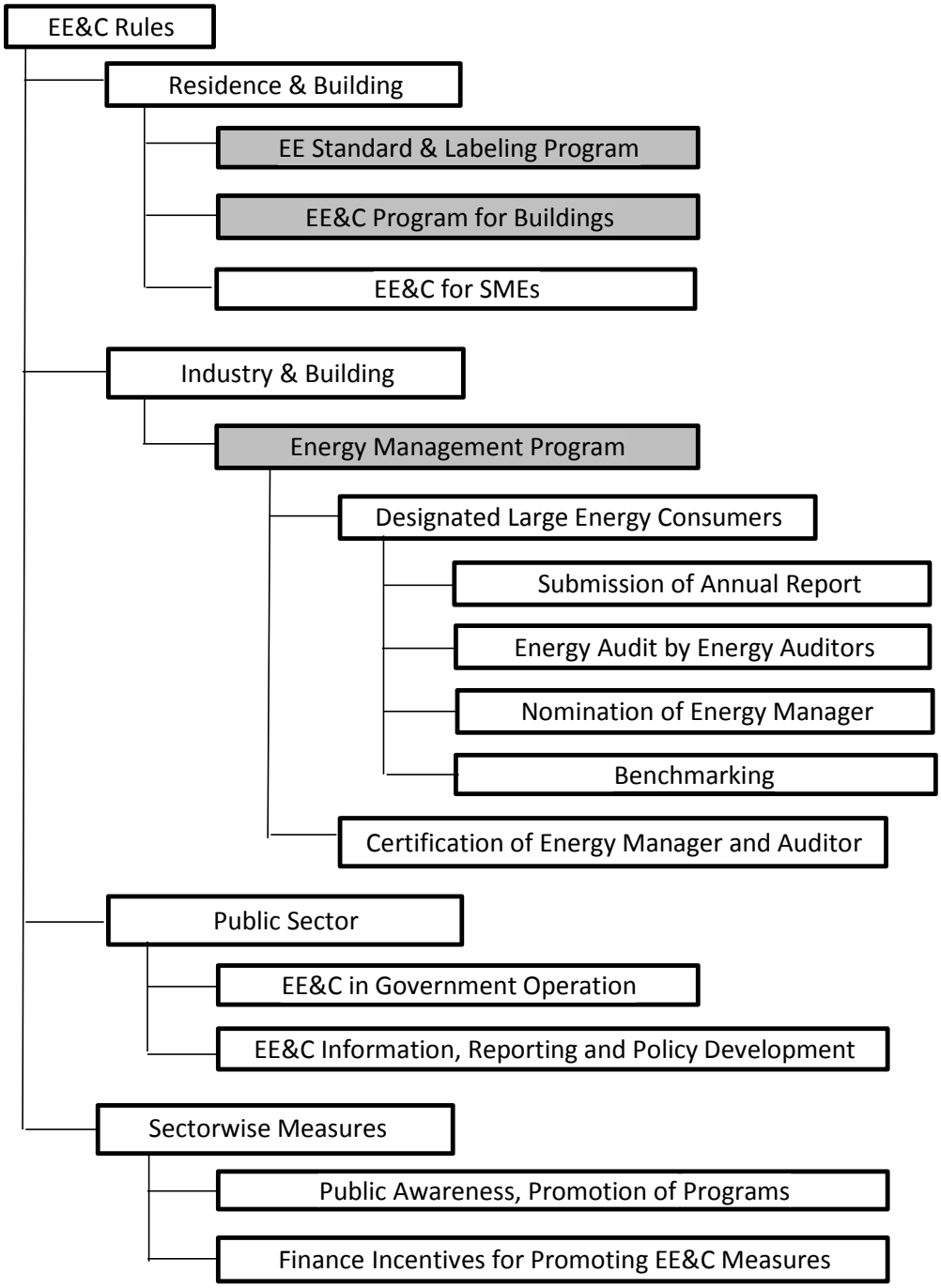
2 Operation of Energy Management Program

Energy Management Program will be conducted by the government in cooperation with the stakeholders, including establishments in industry and commercial sectors, EE&C consultants, and the academy.

Legal structure of EE&C Rules is shown below:

SREDA Acts — EE&C Rules — Energy Management Regulation
EE Labeling Regulation

Energy Management Program is mainly focusing on industrial and building sectors. The diagram of EE&C Rules is shown in Figure 2-1



Source: compiled by JICA Project Team based on EE&C Rule (draft)

Figure 2-1 Diagram of Energy Efficiency and Conservation Rules

3 Definition

3.1 Act

“Act” means Sustainable and Renewable Energy Development Authority Act, 2012

3.2 Rules

“Rules” means Energy Efficiency and Conservation Rules.

3.3 Primary Energy

“Primary Energy” means energy form that is found in nature such as coal, oil, natural gas solar, and wind.

3.4 Secondary Energy

“Secondary Energy” means energy that has been converted from a primary form, either renewable or non-renewable energy, into another energy form, such as gasoline or electricity for distribution and use.

3.5 Fuel

“Fuel” means energy resources that are in combustible form.

3.6 Ministry

“Ministry” means the Power Division of Ministry of Power, Energy and Mineral Resources (MPEMR), unless otherwise specified.

3.7 Authority

“Authority” means the Sustainable and Renewable Energy Development Authority (SREDA).

3.8 Chairman

“Chairman” means the head of the Sustainable and Renewable Energy Development Authority (SREDA).

3.9 Commercial building

“Commercial Building” means any building designated as commercial use by municipal or other competent authorities.

3.10 User

“Users” means those who use any form of energy for residential, commercial, industrial, agricultural, transportation purposes, and any other purposes.

3.11 Energy Use Standard

“Energy Use Standard” means a specified level of use of energy either in absolute terms or relative to the level of output or performance for a specific process, machinery, equipment etc.

3.12 Notification

“Notification” means notification published in the official gazette.

3.13 Establishment

“Establishment” means any establishment described under these Rules. The establishment includes both private and public (governmental).

3.14 Compulsory

“Compulsory” means made compulsory according to the rules and regulations of the Act.

3.15 SCHEDULE

“SCHEDULE” means a list incorporated into these Rules, for example, of industries, establishment and other installations identified as potential large energy consuming establishments.

3.16 Energy supply side

“Energy supply side” is the establishment or individual which/who supply energy to the consumers.

3.17 Designated Large Energy Consumer (DCs)

“Designated Large Energy Consumer” means any establishment who is deemed by the Authority to fall under the designation criteria stipulated by the government.

3.18 Small and Medium-Sized Enterprises (SMEs)

“Small and Medium-Sized Enterprises (SMEs)” means any establishments defined as SME under the circular issued by the Bangladesh Bank, as per National Policy Order 2010; or any revision thereafter.

3.19 Industry sector

“Industry sector” means the category of businesses, establishments and/or energy use purposes which deal with industrial and agricultural production.

3.20 Commercial sector

“Commercial sector” means the category of businesses, establishments and/or energy use purposes which mainly deal on use of buildings and public utilities such as offices, shops, hotels, hospitals, road lighting, traffic signs, water treatment system, etc.

3.21 Transportation sector

“Transportation sector” means the category of businesses, establishments and/or energy use purposes which deal with transportation services such as cars, railway, aviation, marine traffic, etc.

3.22 Private sector and public sector

“Private sector” and “public sector” are the distinction between private businesses or public businesses. Industry sector, commercial sector and transportation sector involve the private sector and

public sector respectively. Therefore, categorization of private sector and public sector will not be done in the document.

3.23 Energy management

"Energy management" is that energy consumers manage their energy consumption, including planning, staff organization, record, report, etc.

3.24 Energy Manager (EM)

"Energy manager (EM)" is the staff in energy consumer, who is assigned by the establishment to be in charge and responsible on energy management. EM certificate is issued by the Authority or its authorized entity.

3.25 Certified Energy Auditor (CEA)

"Certified Energy Auditor (CEA)" is the energy auditor who holds Energy Auditor Certificate, issued by the Authority or its authorized entity. .

3.26 Accredited Energy Auditor (ACEA)

"Accredited Energy Auditor" is the energy auditor who holds Accredited Energy Auditor Certificate, issued by the Authority or its authorized entity..

3.27 Certification Committee

"Certification Committee" is the committee, which conducts advisory on establishing EM, CEA and ACEA certification system, which include certification procedure, qualification standard, training and examinations, etc.

3.28 Benchmarking

"Benchmarking" is a procedure to show benchmarks of energy consumption standard and target to the energy consumers. The benchmarks include energy intensity, which is given by unit energy consumption per production, process, sales, building floor area, etc.

3.29 Energy Management Program Committee

"Energy Management Program Committee" is the committee, which conducts advisory on establishing Energy Management Program for the government.

3.30 Electricity Act

"Electricity Act" means Electricity Act, 1910 (IX of 1910), or any revision thereto;

4 Designated Large Energy Consumers Program (DCs Program)

4.1 Outline of DCs Program

DCs Program is mandatorily applied on energy consumers to promote EE&C in industry and commercial sectors. The Authority will nominate, designates and oblige large energy consumers to manage energy use. Besides, Authority will support energy consumers' EE&C activities.

Outline of DCs Program is shown in Figure 4.1-1.

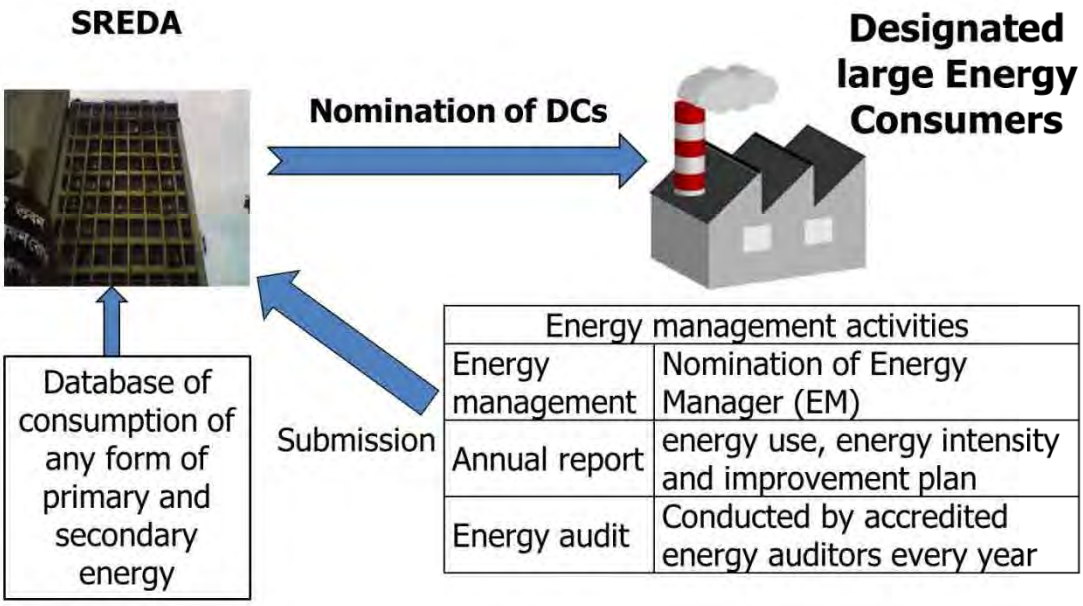


Figure 4.1-1 Outline of DCs Program

DCs Program will be initially applied in industry and commercial sectors. Ministry should consider about the program application on transportation sector and energy supply side.

4.2 Roles

4.2.1 Authority

(1) Provision of DCs designation criteria

To develop and set criteria for identifying and designating "large energy consumers"
(Sec. 6.1 (i), Rules)

- Designation criteria for DCs at first stage is shown in Table 4.2-1
- Annual energy consumption will be calculated on the basis of primary energy conversion of ton of oil equivalent (toe). Heat value of 10,000 mega calorie (Mcal) is converted as 1 ton of oil equivalent. Primary energy conversion factor is shown in Attachment 1, Table A1-1. Primary energy conversion factor will be reviewed by Authority from time to time or/ and when required. (3 years are recommendable)
- The Authority will publish DCs designation criteria.
- The Authority will designate DCs, based on the database of primary and secondary energy

consumed and the amount sold as per criteria fixed by the Authority. .

- The Authority will confirm a benchmark value for energy consumption for each category of DCs.

Table 4.2-1 DCs Designation Criteria at First Stage (Draft)

Industrial sub-sector	Annual energy consumption (toe/year)
Chemical fertilizer	10,000 or over (34,900MWh or over 11,800,000m^3 Gas or over)
Steel-making and re-rolling	
Cement	
Paper and pulp	6,000 or over (20,900MWh or over 7,980,000m^3 Gas or over)
Chemical	
Glass	
Ceramics	
Textile and Garment	
Buildings	3,000 or over (10,500MWh or over 3,540,000m^3 Gas or over)

(2) Publishing of DCs list

To publish and update a list of DCs on the web-site of Authority **(Sec. 6.1 (iii), Rules)**

- The name, location and sub-sector of DCs will be indicated in the list of DCs on the website by the end of December of each year.

(3) Collection of annual report of DCs and energy consumption report by other energy consumers

To require any energy consuming establishments, including DCs to report energy use and other relevant data. **(Sec. 6.1 (iv), Rules)**

- The Authority will require submission of annual report on energy use and improvement plan to DCs and specified consumers, which were defined by SREDA.
- The Authority can require submission of energy consumption report to any energy consuming establishments in industry and commercial sectors every 3 years.

(4) Provision of annual report format

To publish conditions and requirements for reporting of energy consumptions and other relevant data, including procedures, formats and content of the reporting and means to identify and handle confidential business information. **(Sec. 6.1 (v), Rules)**

- Format of annual report in hard copy base for DCs (draft) is shown in Attachment 2.
- Electronic format of annual report will be shown in Authority web-site.

(5) Provision of energy audit scheme

To publish conditions, requirements and procedures for conducting annual energy audits and reporting. Contents and format of audit reports must be provided by the Authority, as well as the means of identifying and handling of confidential business information. **(Sec. 6.1 (vi), Rules)**

- Energy audit scheme for DCs is shown in Table 4.2-2

Table 4.2-2 Energy Audit Scheme for DCs

Items	Terms and condition
Organizations or establishments for energy audit	Organizations or companies listed by the Authority
Listed organizations or establishments for energy audit	1) Minimum required numbers of CEAs: 1 Accredited Energy Auditor (ACEA) and 1 Certified Energy Auditor (CEA) 2) Measuring instrument: company's property or rental
Energy audit fee	Paid by DCs
Energy audit Report	To be submitted by DCs within 1 month after the energy audit with a copy to the Authority.

- Format of energy audit report (example) is shown in Attachment 3

(6) Provision of EM's duty, etc.

To publish requirements for qualifications and guidelines describing the detailed duties of Energy Managers (EMs) and other relevant procedures and information; **(Sec. 6.1 (ix), Rules)**

- Appointment and qualification of EM is shown in Table 4.2-3.

Table 4.2-3 Appointment and Qualification of EM for DCs

Energy consumer	Appointment number of EM	Qualification of EM
DCs	1	Certified Energy Manager

- Duties of EM are as follows:

  EM should have the responsibility to support DCs management top's activities including the following tasks:

  1) To make five-year plan and annual plan for EE&C in the establishment.
  2) To organize management network of energy-consuming activities in the establishment;
  3) To organize implementation of measures on EE&C in accordance with the approved objectives and plans;
  4) To organize monitoring and assessment on the performance of EE&C measures, and to propose solutions for overcoming obstacles arising during EE&C implementation;

5) To record and supervise the energy consumption demand of equipment and whole production line, status of newly installed, improved, repaired energy-consuming equipment;

6) To make and submit annual energy reports as stipulated;

7) To assist the top management in informing, disseminating, training, rewarding and disciplining EE&C activities.

8) To assist the top management in planning and attaining EE&C target.

9) To keep record of energy consumption on monthly basis in a standard format.

10) To provide necessary data and information on energy uses by the organization/establishments as required by the Authority.

11) To ensure proper compliance of recommendations made by the energy audit team in their audit report.

(7) Advisory for DCs

To issue guidance, enforcement mechanism, and provide advisory to the establishments to support the establishments to attain their energy conservation targets. **(Sec. 6.1 (xi), Rules)**

- Authority will provide advisory services on EE&C implementation.

(8) Provision of Benchmark targets

To develop and set certain criteria of Benchmark targets for energy reduction by production process in industrial sub-sectors **(Sec. 6.1 (xii), Rules)**

- Benchmark targets will be defined by the production process in industrial sub-sector, comparing energy intensity in similar production process.
- Benchmark targets (draft) are shown in Table 4.2-4. The targets will be decided through discussion of Authority and relevant establishments and associations in industry sector according to actual energy intensity and annual report of DCs.
- Benchmarking index and calculation equations are shown in Attachment 1, Table A1-2.

Table 4.2-4 Benchmark Targets (draft)

Industrial sub-sector and production process	Target value of energy intensity (toe/ton)	
Chemical fertilizer (Urea)	700	
Steel-making and re-rolling	212	Products: Bar steel Induction furnace + re-rolling line
Steel re-rolling	64	Products: Bar steel
Cement kiln + mill	130	Material grinding + Rotary kiln + cement grinding

Industrial sub-sector and production process	Target value of energy intensity (toe/ton)	
Cement mill	16	Cement grinding
Print paper	210	
Board paper		
Soda chemical	300	Products: Caustic soda (NaOH)

(9) Provision of Minimum Energy Efficiency Standards (MEPS)

To develop and set certain criteria of Minimum Energy Efficiency Standard (MEPS), such as energy units per unit of output, for specific industrial processes and major technologies such as furnaces, industrial boilers, chillers and brick kilns. **(Sec. 6.1 (xii), Rules)**

- The Authority can provide MEPS on the industrial equipment and/or production process.

(10) Provision of technology requirement

To develop and set certain criteria of specific technology requirements, such as waste heat recovery or cogeneration for boilers and chillers over a certain size and in certain industries **(Sec. 6.1 (xii), Rules)**

- Criteria of specific technology requirement are shown in Attachment 4.

(11) Administrative instruction

To disclose a list of non-compliant establishments, which will be renewed on annual basis **(Sec. 6.1 (xiii), Rules)**

- The name of non-compliant establishments will be disclosed on the Authority website.
- The Authority will announce and widely disseminate information about the program to the energy consumers.
- The Authority will give administrative recommendation, instruction and direction to DCs and other energy consumers, if necessary.
- The Authority will give penalty to the energy consumers on their contravention activities.
- The Authority will take action of prosecution if necessary.

(12) Inspection of DCs

To enter upon or inspect to the premises of designated consumers **(Sec.23, Chapter 7, Act)**

- The Authority may enter the premises of DCs to inspect the following matters:
  1) Appointment of EM

2) Energy consumption

3) Condition of energy consuming equipment

4.2.2 Designated Large Energy Consumers (DCs)

(1) Designation

To be designated as DCs by the Authority **(Sec. 6.1 (i), Rules)**

- Large energy consuming establishments will be designated as DCs by the Authority based on the energy consumption of previous year.
- Large energy consuming establishments should submit applications of DCs to the Authority, when energy consumption exceeds the criteria of DCs. Alternatively the Authority may nominate the Industry as DC based on its energy consumption analysis.
-
- DCs can make applications to cancel the designation of DCs to the Authority, when their energy consumption becomes less than the designation criteria of DCs.

(2) Energy audit

To conduct an energy audit of the facilities on annual basis. The results of the audit, including planned energy conservation measures and targets based on the audit, will be reported to the Authority as the "annual energy report". **(Sec. 6.1 (vi), Rules)**

- DCs should conduct energy audit every year.
- DCs should decide EE&C target, based on energy audit results.
- DCs should submit annual energy report including the result of energy audit to the Authority by the end of September.
- Formats of annual energy report and energy audit report will be published by the Authority.

(3) Appointment of EM

To appoint a full-time EM to keep account of energy conservation by the establishment, and suggest energy efficiency improvement measures. **(Sec. 6.1 (viii), Rules)**

- DCs should appoint EM according to regulation of the Authority. (See Table 4.2-3)
- DCs should submit the name of appointed EM to the Authority. When EM changes, DCs should report the change to the Authority.

(4) Annual report

To meet the energy conservation measures and targets, submitted to the Authority with the energy audit report. The requirement will initially be on a voluntary basis, and gradually be made mandatory. The Authority will provide the framework and timeline for this transition.
(Sec. 6.1 (x), Rules)

(5) Inspection

To accept the inspection of Authority **(Sec.23, Chapter 7, Acts)**

- DCs should accept inspectors of the Authority for the following inspection:
  1) Appointment of EM
  2) Energy consumption
  3) Condition of energy consuming equipment

4.2.3 Establishments other than DCs

(1) Submission of energy consumption data

Establishments other than DCs should submit energy use data to the Authority in accordance with the request of the Authority. **(Sec. 6.1 (iv), Rules)**

(2) Check and record of periodical energy consumption

- The energy consumers are expected to check and record their energy consumption periodically.

(3) Voluntary energy management

- The energy consumers are expected to conduct energy management in their business.
- The energy consumers are expected to have energy audits, entrusting it to Certified Energy Auditors (CEAs) and/or Accredited Energy Auditors (ACEAs).

5 Certification of EM, CEA and ACEA

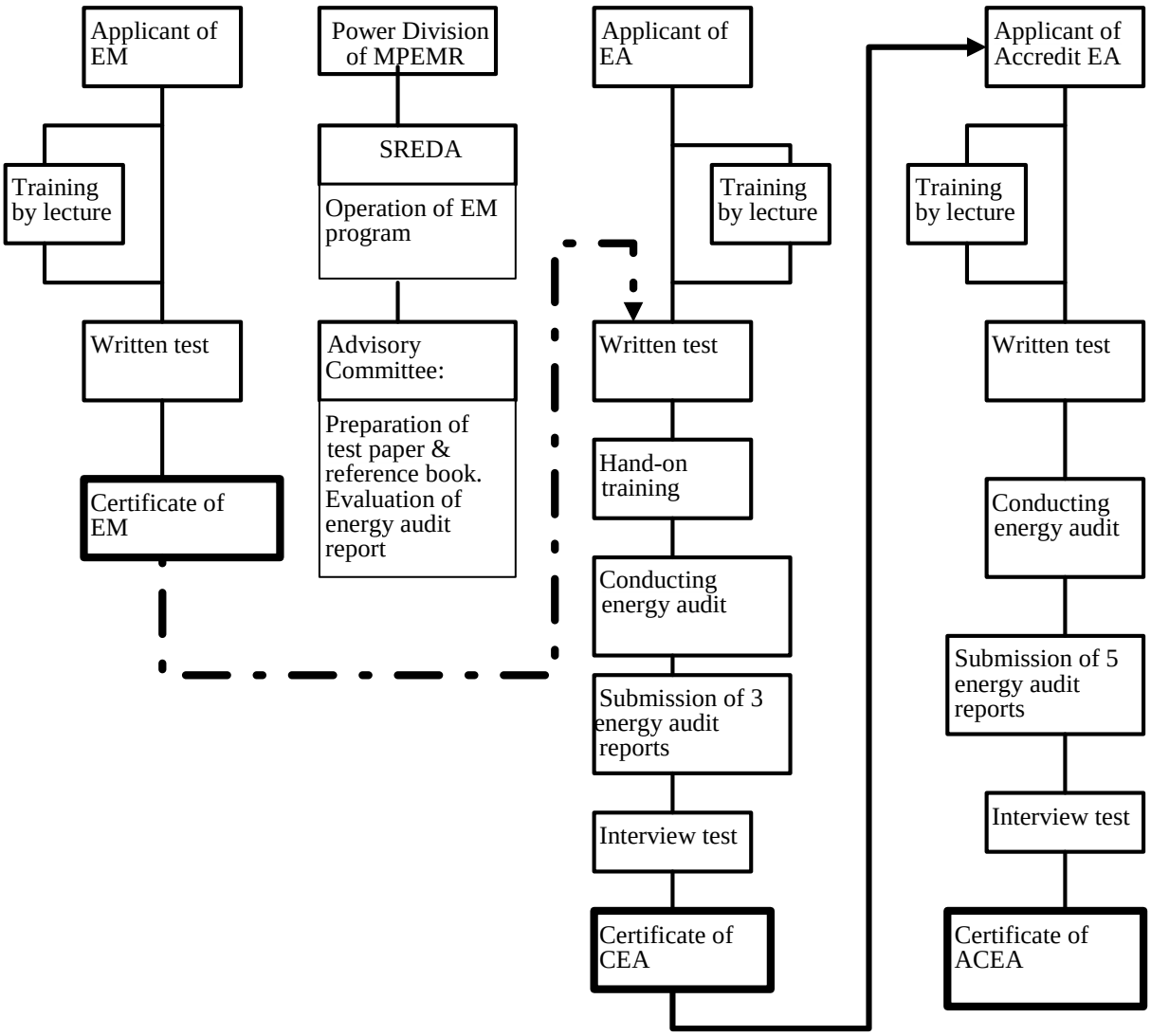
5.1 Outline

National certification system concerning energy management should include 1) Energy Manager (EM) certificate, 2) Certified Energy Auditor (CEA) certificate and 3) Accredited Energy Auditor (ACEA) certificate. Scope of the jobs and businesses of the certified person are shown in Table 5.1-1.

Table 5.1-1 National Certification and Scope of Job and Business

No.	Certificates	Scope of job and business
1	Energy manager (EM)	1) To be appointed as EM in DCs
2	Certified Energy auditor (CEA)	1) To conduct energy audit services for factories and buildings other than DCs. 2) To conduct energy audit services for DCs under the supervision of ACEA.
3	Accredited energy auditor (ACEA)	1) To conduct energy audit service for DCs

Certification flow chart is shown in Figure 5.1-1.



Source: Compiled by JICA Project Team

Figure 5.1-1 Certification Flow of EM, CEA and ACEA

Training will be given to all applicants and then written test will be performed. The chart may be corrected accordingly.

5.2 Roles

5.2.1 Authority

(1) Provision of competency standards of EM Certification

To arrange a system for certifying EMs for DCs and set specific requirements for qualifications. (Sec.6.2 (v), Rules)

To implement certification examinations, certification standards and programs, or training programs to develop the capacity of Ems, CEAs and ACEAs; **(Sec.6.2 (vi), Rules)**

- Competency standards of EM Certification are shown in Table 5.2-1.

Table 5.2-1 Competency Standards of EM Certification

item	Energy Manager (EM)
Eligibility Criteria	Graduate in engineering or equivalent
Lecture training	5-day voluntary training
Written test	3-subjects paper including heat and electricity field

- All applicants can take voluntary training before taking written test.
- The Authority will prepare the contents of the written test and training and publish the following information for the applicants of EM to take written test and lecture training.
  1) Subjects and timetable of written test and training
  2) Venue and date of written test and training
  3) Date and destination to submit the application form of written test and training
  4) Fees for written test and training
- The Authority will establish Certification Committee, to prepare the curriculum of training course and contents of written test, to score the test and to propose the candidates of lecturers of training course, etc.
- Reference books of energy management will be published by the Authority, which will be delivered to the applicants of the test with certain charges.
- Test papers and textbooks for lecture training will be prepared in the scope of the reference books of energy management. The contents of reference book of energy management (draft) are shown in Attachment 5, Table A5-1. The reference books will be revised every 3 years according to the development of new EE&C technologies.
- The subjects of written test will be composed of 3 parts, as shown in Attachment 5, Table A5-3.
- An example of written test form for EM is shown in Attachment 6.

(2) Provision of competency standard of CEA and ACEA

To establish a system of CEA and ACEA and set specific requirements for certificating them. Procedures by means of application, examinations and registration will be stipulated in Regulations under the Act. **(Sec.6.2 (i), Rules)**

- Competency standards for CEA and ACEA are shown in Table 5.2-2.

Table 5.2-2 Competency Standards of CEA and ACEA Certification

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

- The Authority will prepare the contents of the written test and training and publish the following information for the applicants of EM to take written test and lecture training.
  1) Subjects and timetable of written test and training
  2) Venue and date of written test and training
  3) Date and destination to submit the application form of written test and training
  4) Fees for written test and training
- The Authority will establish Certification Committee to prepare curriculum of training course, scope of written test, reference books and test paper, to score test paper, to propose teachers of training course, etc.
- Reference books of energy audit service will be published by the Authority, which will be delivered to the applicants of the test with certain charges.
- Test papers and textbooks of lecture training will be prepared in the scope of the reference books of energy management and energy audit. The contents of reference book of energy audit (draft) are shown in Attachment 5, Table A5-2. The reference books will be revised every 3 years according to development of new EE&C technologies.

(3) Certification of EM

- The subjects of written test (draft) are shown in Attachment 5, Table A5-3.
- The written test form for EM (example) is shown in Attachment 6.

- The applicants can get training courses provided by the Authority.

(4) Certification of CEA

- The subjects of written test (draft) are shown in Attachment 5, Table A5-4.
- The written test form for CEA (example) is shown in Attachment 7.
- The Authority will prepare practical training or hands-on training for capacity building of CEA in order to deepen applicant's knowledge on measurement and measurement equipment. The practical training site will be decided by the Authority. Subjects of practical training course are shown in Attachment 5, Table A5-5.
- Measurement equipment for practical training course (draft) is shown in Attachment 5, Table 5-6.
- Evaluation criteria of energy audit reports, submitted along with the application, are shown in Attachment 5, Table A5-7.
- Evaluation criteria of oral interviewing, conducted along with the application, is shown in Attachment 5, Table A5-8.

(5) Certification of ACEA

- Subjects of written test for ACEA are composed of 3 parts. The contents and form of written test will be determined by Authority.
- Evaluation criteria of energy audit reports are shown in Attachment 5, Table A5-7.
- Evaluation criteria of oral interview, conducted with the application, are shown in Attachment 5, Table A5-8.

(6) Provision of CEA and ACEA list

To prepare, disclose and maintain the list of CEAs and ACEAs. The list will be disclosed on the Authority's website, accessible to public, and revised on regular basis as stipulated by the Authority. **(Sec.6.2 (ii), Rules)**

- The Authority will publish name and correspondence data such as address, telephone numbers and e-mail address of CEA and ACEA on its website.

(7) Creation of jobs and social status of EM, CEA and ACEA

- The Authority must develop and provide jobs and businesses, in which CEA and ACEA can join and become active.
- The Authority must establish and assure the social status of EM, CEA and ACEA.

5.2.2 Certification Committee

(1) Formulation

- Certification Committee will be established by the Authority as and when required.
- Members of the committee may consist of the following categories:
  1) Academic persons from universities
  2) Consultants and experts on relevant field
  3) Officials from the Authority or other governmental organization
  4) Office staff from Authority for secretariat

(2) Tasks and responsibility on the Certification Committee

- Certification Committee should have a responsibility on the following tasks:
  1) To prepare curriculum of training course and lecture ,
  2) To decide passing score of written test
  3) To prepare written test paper,
  4) To prepare reference books
  5) To score test paper,
  6) To evaluate energy audit report and applicants interview
  7) To decide successful applicants
  8) To propose lecturers for training course,
- Committee members should have duty of confidentiality. The committee members should make agreement with the Authority for confidentiality on contents of test paper.

(3) Other tasks and responsibility

- Certification Committee is expected to support and/or give advisory on improvement of the certification system to the Authority.

5.2.3 EM, CEA and ACEA

(1) Information to Authority

- EM, CEA and ACEAs will provide information to Authority if they need to update any information in the website.

6 Monitoring and Review of the Program

6.1 Outline

Energy Management Program will be improved based on monitoring result and stakeholders' discussion on program review.

6.2 Roles

6.2.1 Authority

(1) Monitoring of DCs' energy consumption and EE&C implementation

- The Authority will monitor DCs' energy consumption and EE&C implementation by collecting and analyzing their annual reports and energy audit reports.
- The Authority will prepare annual report on DC's energy consumption and EE&C implementation for study and discussion of the Energy Management Program Committee.
- The Authority will prepare annual report on the certifications of EM, CEA and ACEA.

(2) Issue of revised regulations on the program

- The Authority will issue revised regulation on the program in accordance with the recommendation prepared by Energy Management Program Committee.

6.2.2 Energy Management Program Committee and WGs

(1) Formulation

- Energy Management Program Committee will be established by the Authority in regulary basis for review of Energy Management Program.
- Members of the committee will consist of the following categories:
  1) Academic persons from universities
  2) Consultants and experts on relevant field
  3) Representatives from establishments (industrial associations, etc.)
  4) Officials from SREDA
  5) Representatives from other governmental organizations
- WGs (Working Groups) will be also formulated under the committee to study and discuss specific matter by industrial sub-sector and other technical topics.

(2) Tasks and responsibility of Energy Management Program Committee

- Energy Management Program Committee will provide advisory and recommendation on issues for the program improvement.
- This committee has a responsibility for setting and revision of the criteria on DCs and benchmarking.

6.2.3 DCs and Associations

(1) Cooperation on the program improvement

- DCs, industrial associations and other stakeholders on the program are expected to cooperate with the Authority for the program improvement and participate in the relevant meetings.

6.2.4 EM, CEA and ACEA

(1) Cooperation on the program improvement

- EM, CEA and ACEA and other experts on energy and EE&C are expected to cooperate with the Authority for the program improvement and participate in the relevant meetings.

7 Roadmap and Internal Relationship of Sub-programs

As a summary, Figure 7-1 shows a roadmap of Energy Management Program and internal relationship of sub-programs

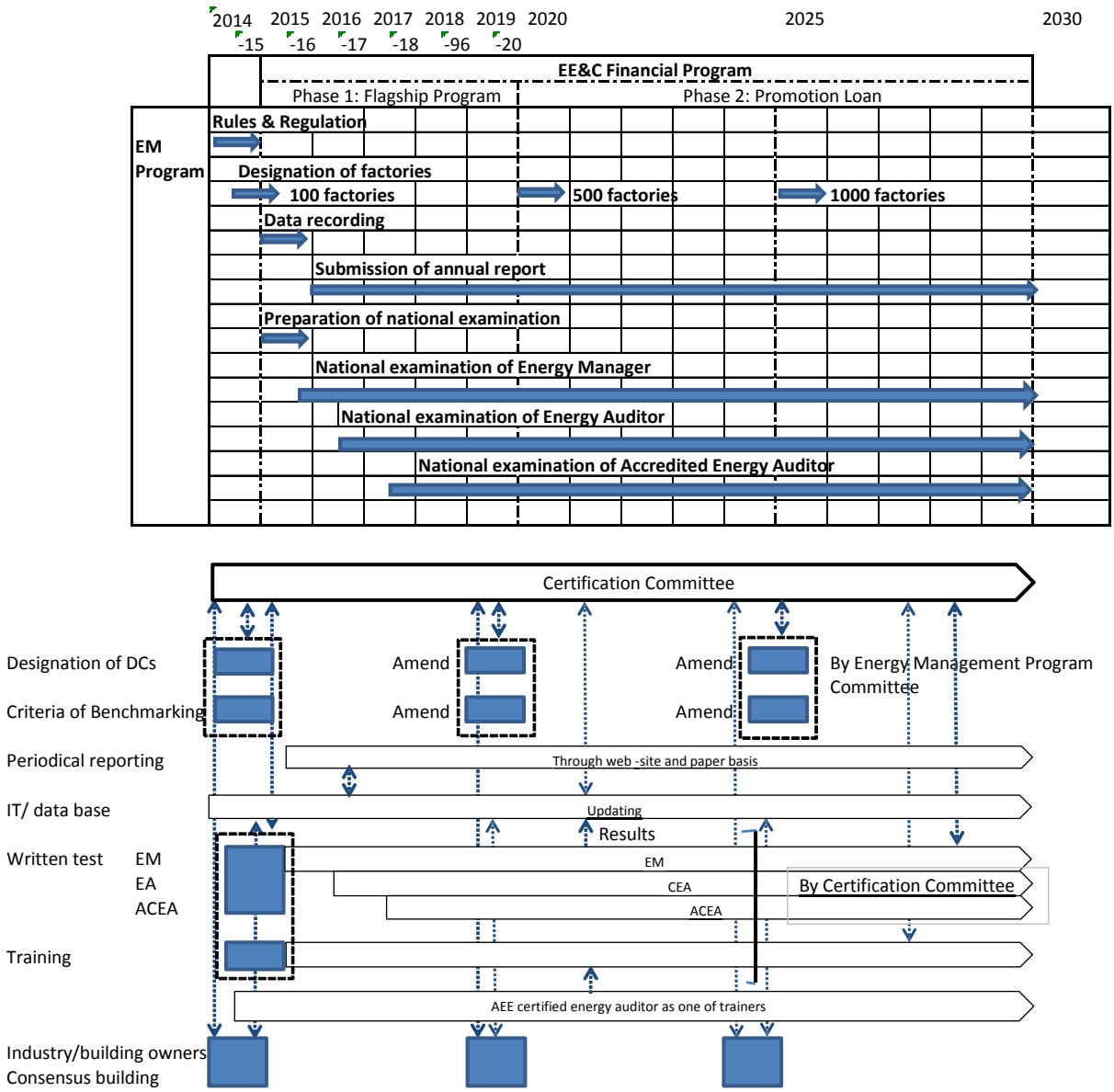


Figure 7-1 Roadmap and Internal Relationship in Energy Management Program

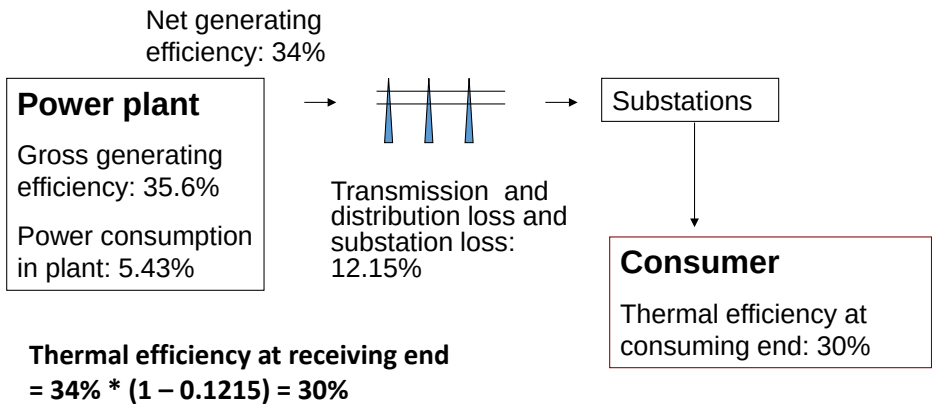
Attachment 1: Specific Provisions on Designation, Energy Management and Benchmarking

Table A1-1 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: Thermal efficiency at receiving end = 30%

Calculation of thermal efficiency at receiving end of consumer is shown in Figure A1-1.



Source: (1) Gross generating efficiency: Merit order dispatch list of power plant based on fuel cost, 15,01,2014
(2) Power consumption in plant and Distribution & system loss: Annual report 2011-2012, BPDB

Figure A1-1 Thermal Efficiency and Loss of Grid Power in Bangladesh in 2012

Table A1-2 Benchmarking Index

Sub-sector	Calculation of benchmarking index
1. Normal steel-making by electric furnace	$= \frac{\text{Energy consumption in steel-making}}{\text{Crude steel production}}$ $+ \frac{\text{Energy consumption in rolling}}{\text{Rolled steel production}}$
2. Steel re-rolling	$\frac{\text{Energy consumption in rolling}}{\text{Rolled steel production}}$
3. Cement manufacturing	$= \frac{\text{Energy consumption in raw material}}{\text{Clinker production}}$ $+ \frac{\text{Energy consumption in burning}}{\text{Clinker production}}$ $+ \frac{\text{Energy consumption in finishing}}{\text{Cement production}}$ $+ \frac{\text{Energy consumption in delivery}}{\text{Cement production}}$
4. Cement finishing	$= \frac{\text{Energy consumption in finishing}}{\text{Cement production}}$ $+ \frac{\text{Energy consumption in delivery}}{\text{Cement production}}$
5. Paper manufacturing	$= \frac{\text{Energy consumption}}{\text{Paper production}}$
6. Soda chemical (NaOH)	$= \frac{\text{Energy consumption in electrolysis}}{\text{Caustic soda weight in electrolysis bath}}$ $+ \frac{\text{Steam consumption in condensation}}{\text{Liquid caustic soda weight}}$

Attachment 2: Format of Annual Energy Report of DCs

Form xx (Pertaining to Article yy)

* Date received	
* Date processed	

Annual Energy Report

To MESSRS._____

Date

Address

Name (Official stamp)

Representative (Signature)

This report is presented in compliance with the provisions of Item xx of Article yy of the Energy Efficiency & Conservation Rules.

Number of Designated Energy Consumer		
Specific emission factory No.		
Name of factory		
Address	Tel (- -) Cell No. Fax (- -) e-mail:	
Business that factory is engaged in		Classified No.
Prepared by		
EM/CEA/ACEA Certificate No. No. of Lecture Certification of Responsible Person		

Table 1 Consumption of energy and byproduct energy sold

Type of energy, etc.		Unit	Fiscal year:					
			Consumption		Amount of byproduct energy sold			
					Amount sold		Amount not contributed to the own production	
			Quantity	Heat value (toe)	Quantity	Heat value (toe)	Quantity	Heat value (toe)
Kerosene		ton						
Diesel oil		ton						
Furnace oil		ton						
	Liquefied petroleum gas (LPG)	ton						
	Natural gases	1,000 m^3						
Coal		ton						
Other fuels, etc.								
	( )							
Steam for industry		GJ						
Steam for other than industry		GJ						
Hot water		GJ						
Cold water		GJ						
Sub-total of fuel and heat		GJ						
Electricity	Purchased electricity other than above	MWh						
	In-house electricity generation	MWh						
Sub-total of electricity		MWh/GJ						
toe in total								
toe in crude oil terms				a		b		c
Change from the previous year (%)								

Table 2 Outline, operating conditions, new installations, modifications, or removal of equipment pertaining to rational use of energy and main equipment that consume energy

	Name of equipment	Outline of equipment	Operating conditions	New installation, modification or removal
Energy intensive equipment				
Main equipment other than the above that consume energy				

Table 3 Production volume etc.

	Fiscal year:	Change from previous year (%)
Production volume, floor area or other value which has close relation with consumption of energy ( )	d	

Table 4 Energy intensity relating to the use of energy

	Fiscal year:	Change from previous year (%)
Energy intensity $= \frac{\text{Energy consumption (ton in oil terms) } (a - (b + c))}{\text{Production volume, floor area or other value which has close relation with consumption of energy } d}$		

Table 5 Change of energy intensity relating to the use of energy for past 5 years

	FY:	FY:	FY:	FY:	FY:	Average change of energy intensity in 5 fiscal years
Energy intensity in use						
Change from previous year (%)		A	B	C	D	

Table 6 If a 1% or more improvement in annual average value of energy intensity has not been attained for past 5 years (A) or improvement of energy intensity has not been attained compared with the previous year (B), provide the reason.

Reason for (A)
Reason for (B)

[Remarks]

1. The size of the form shall be the Standard A4.
2. Report shall be printed, or typed duly signed by the competent authority.
3. There shall be no entry in the column marked with (*) at the beginning of Report.
4. Enter the number given by Authority.
5. Enter the classified name and number in the column of business related to the factory according to the detailed classification of Bangladesh Standard Industrial Classification (or any other approved classification/code) on the business conducted in the factory.
6. Enter the value in each unit and value in terms of heat amount in the "Consumption" columns of Table 1 by kinds of energy.
7. The columns for unused energy may be left blank in Table 1.
8. Enter the sales amount by kinds of energy and energy that do not contribute to their own production in the column of "Amount of byproduct energy sold" of Table 1.
9. Enter the type of fuel, such as oil refinery gas, in the parentheses in the column below the "City gas" in section "Other fuels." of Table 1, and the consumption. If two or more kinds of fuels have to be entered, provide new columns as required.
10. In the conversion to heat value form consumption of "Steam for industry", "Steam for other than industry", "Hot water" and "Cold water" columns of Table 1, if a calculation method of heat value is used instead of the conversion factor specified in Annex Table 2 of the EE&C Rules, provide the data used as a basis for the calculation method.
11. Enter the amount of electric power sold in the column of "Amount sold" of "In-house electricity generation".
12. Converted heat value to be entered in the column of the amount of byproduct energy sold of "In-house electricity generation" in Table 1 is the converted value on a basis of 12,000 kilojoules for 1 kilowatt-hour or the converted heat value of fuel used for the electricity generation. (Thermal efficiency: 30%).
13. Enter the calculation value of the amount of unused for production column by the kind of electricity in Table 1, in the case that the amount of unused for production is not measured by the kind of electricity in Table 1.
14. Regarding fuels to be entered in toe in Table 1, the symbol T (for Tera) or P (for Peta) may be suffixed to the figures.
15. When calculating the total consumption of energy in Table 1, it is not necessary to add energy and their byproducts together. In this case, the kind and the quantity of such energy that was not added, should be noted below on Table 1.
16. Enter the fiscal year in question in the upper columns of Tables 1, 3 and 4. In the "Change from the previous year" column of each table, enter the value calculated by using the value stated in the periodical report submitted in the previous year (for Table 3 and Table 4, the value for the previous year shall be, in principle, the value calculated based on the formula used for the calculation of the value for the year in question). The calculation method shall be as follows.

$$\text{Rate of change over previous year}\,(\%) = \frac{\text{Value for the fiscal year in question}}{\text{Value for the previous year}} \times 100\ (\%)$$

17. In Table 2, enter the matters so that energy annual consumption for the equipment concerned covers 80% of total energy consumption in the factory.
18. Enter production volume, or amount, or value which has close relation with floor area or consumption of other energy, etc. in the “Production volume, floor area or other value which has close relation with consumption of energy” on Table 3, and enter the unit in parentheses. Whichever may be selected, the same unit shall be used throughout the year. If a report is made in the preceding fiscal year or before, the same unit as used in the report shall be used in principle. A total of converted values for individual products based on the quantity of energy, etc. required to produce the main products in the factory may be entered in the column.
19. “Energy intensity” in Table 4 refers to the amount of energy consumed per unit of production.
20. Enter the 5 fiscal years including the latest fiscal years in the upper column of Table 5. Enter the calculated value obtained by the calculation formula used for the year in the column “Energy intensity in use” and “Change from previous year”.
21. Enter the value of 4th root of multiplied value of “change from the previous year” for the past 5 years in the column “Average change of energy intensity in 5 fiscal years” of Table 5. The calculation method shall be as follows.

    Average change of energy intensity in 5 fiscal years (%) = (A × B × C × D)^0.25 (%)

22. In Table 6, in the case that “Reason of (A)” is the same as “Reason of (B)”, “Same as (A)” may be entered.

Attachment 3: Form of Energy Audit Report (Example)

Energy Audit Report for Factory

1. Outline of Factory

1) Factory name:

2) Location:

3) Business description

Sub-sector:

Main product of the factory:

Capital: -

Annual shipment amount: -

The number of employees of the factory: - Persons

4) Main person in charge at the energy audit: (Mr. Ms.)

2. Outline of Energy Audit

1) Person engaged in energy audit

2) Energy auditing date from to (day, month, year)

3) Request items on energy audit (main items): Fill the request items of the factory from the questionnaire

3. Summary of Energy Audit Results

(1) Improvement proposal items and the expected effect after improvement measure implementation

	Observation list Classification No.	Improvement items (Itemized corresponding to an appended observation list)	Expected effects			
			Category	Kind of Energy	The amount of energy conservation (toe/year, kWh/year etc.)	Amount of energy saving (1000 TK/year)
1			No cost			
2			Low cost			
3			High cost			
Total of expected results			Fuel (total)		toe/year	
			Electric power (total)		kWh/year toe/year	
Expected results in oil equivalent of fuel and electric power (total)					toe/year	

Annual energy consumption	Fuel (total)	toe/year
	Electric power (total)	MWh/year toe/year
	Total in factory	toe/year
Energy conservation rate of the whole factory	Fuel (total)	%
	Electric power (total)	%
	Total in factory	%

(2) The amount of the annual energy consumption, the energy cost ratio and energy intensity of the whole factory in the last year

a. The Amount of annual energy consumption

Amount of electric power C= MWh (Purchased electric power E= (1000kWh)

(Conversion factor: 1 kWh = 2,867 kcal, 1 GWh = 287 toe)

Amount of all fuel consumption D= toe

(Oil equivalent of fuel: toe = 10,000,000 kcal)

Details (before conversion) Heavy oil ( ): toe

Natural gas: m3

Kerosene: toe

LPG: ton

Light oil: toe

b. Energy cost ratio (Energy cost per annual shipment amount F=

Annual production (P) = ton

Annual electric power charge (G): Tk

Power cost ratio: % (G/F x 100)

Annual fuel cost (H): Tk

Fuel cost ratio: % (H/F x 100)

c. Energy intensity (Energy consumption per annual shipment amount etc.)

Electric power intensity per production (E / P) = kWh/ton

Fuel intensity per production (D / P) = kcal/ton

(3) Remarks

a. Plant operation hours

Annual operation days: days

Daily operation hours: hours, shifts

b. Energy price

Natural gas: Tk/m^3N

Diesel oil: Tk/liter

Electric power: Tk/kWh

c. Main equipment

d. Energy consumption by month

e. Daily load curve of electricity consumed

4. Detailed Audit Result

4.1 General Management Items

Management Item	Description
1. Energy Management Organization	(Present condition and problems) (Measures for improvement)
2. Implementation of Measurement and Record	Ditto
3. Equipment Maintenance Management	Ditto
4. Energy consumption management	Ditto
5. Energy consumption intensity management	Ditto
6. PDCA management cycle	Ditto

4.2 Air Conditioning and Freezing Equipment

Management Item	Description
1. Operation Management of Air-conditioning	(Present condition and problems) (Measures against improvement, and the expected effect per year (toe, kWh, 1000 Tk))
2. Energy Conservation Measures of Air-conditioning	Ditto
3. Operation Control of Cooling Equipment	Ditto
4. Operation Control of Auxiliary Chilling Equipment	Ditto
5. Cold Keeping and Chilling Equipment	Ditto

4.3 Pump Fan, Compressor, etc.

Management Item	Description
1. Operation Management of Pump and Fan	(Present condition and problems) (Measures against improvement, and the expected effect per year (toe, kWh, 1000 Tk))
2. Operation Management of Air Compressor	Ditto

4.4 Boiler, Industrial Furnace, Steam System, Heat Exchanger, Waste Heat, Waste Water, etc.

Management Item	Description
1. Combustion Control	(Present condition and problems) (Measures against improvement, and the expected effect per year (toe, kWh, 1000 Tk))
2. Operation and Efficiency Control of furnace	Ditto
3. Heat Insulation, and Heat Dissipation Prevention	Ditto

Management Item	Description
4. Exhaust Gas Temperature Control and Exhaust Heat Recovery	Ditto
5. Operation Control of Steam System	Ditto
6. Management of Steam Leakage and Heat Insulation	Ditto
7. Optimization of Steam Piping System	Ditto
8. Load Leveling of Steam System	Ditto
9. Steam Condensate Recovery	Ditto
10. Operation Control of Heat Exchanger	Ditto
11. Waste Heat and Waste Water Reduction	Ditto

4.5 Receiving and Transformation Equipment, Electric Motor, Lighting, Electric Heating Equipment

Management Item	Description
1. Receiving and Transformation Facility Management	(Present condition and problems) (Measures against improvement, and the expected effect per year (toe, kWh, 1000 Tk))
2. Operation Management of Electric Motor	Ditto
3. Operation Management of Lighting Equipment	Ditto
4. Operation Management of Electric Heating Equipment	Ditto

4.6 Process Improvement

Management Item	Description
1. Operation Improvement	(Present condition and problems) (Measures against improvement, and the expected effect per year (toe, kWh, 1000 Tk))
2. Review of Process Line	Ditto
3. High Efficiency, continuous operation, etc.	Ditto

Attachment 4: Criteria of Specific Technology Requirement.

Source is Standards and Target Values for Operating Equipment in Factories etc., Energy conservation Acts, Japan

(1) Air ratios for boilers

Classification				Air ratio				
Item			Load factor (%)	Solid fuel		Liquid fuel	Gas fuel	By-produced gas such as blast furnace gas
				Fixed bed	Fluidized bed			
Standard	For electric utility *		75-100	-	-	1.05-1.2	1.05-1.1	1.0
	General boilers (steam volume)	30t/h or more	50-100	1.3-1.45	1.2-1.45	1.1-1.25	1.1-1.2	1.2-1.3
		10 to less than 30t/h	50-100	1.3-1.45	1.2-1.45	1.15-1.3	1.15-1.3	-
		5 to less than 10/t	50-100	-	-	1.2-1.3	1.2-1.3	-
		Less than 5t/h	50-100	-	-	1.2-1.3	1.2-1.3	-
	Small once-through boilers		100	-	-	1.3-1.45	1.25-1.4	-
Target	For electric utility *		75-100	-	-	1.05-1.1	1.05-1.1	1.15-1.2
	General boilers (steam volume)	30t/h or more	50-100	1.2-1.3	1.2-1.25	1.05-1.15	1.05-1.15	1.2-1.3
		10 to less than 30t/h	50-100	1.2-1.3	1.2-1.25	1.15-1.25	1.15-1.25	-
		5 to less than 10/t	50-100	-	-	1.15-1.3	1.15-1.25	-
		Less than 5t/h	50-100	-	-	1.15-1.3	1.15-1.25	-
	Small once-through boilers		100	-	-	1.25-1.4	1.2-1.35	-

* The classification "for electric utility" above refers to boilers installed by electric power companies for power generation.

(2) Waste gas temperatures for boilers

Classification				Wastegastemperature				
Item			Load factor (%)	Solidfuel		Liquidfuel	Gasfuel	Byproduct gas such as blast furnace gas
				Fixedbed	Fluidized bed			
Standard	For electric utility*		75-100	-	-	145	110	200
	General boilers (steam volume)	30t/h or more	50-100	200	200	200	170	200
		10 to less than 30t/h	50-100	250	200	200	170	-
		5 to less than 10/t	50-100	-	-	220	200	-
		Less than 5t/h	50-100	-	-	250	220	-
	Small once-through boilers		100	-	-	250	220	-
Target	For electric utility*		75-100	-	-	135	110	190
	General boilers (steam volume)	30t/h or more	50-100	180	170	160	140	190
		10 to less than 30t/h	50-100	180	170	160	140	-
		5 to less than 10/t	50-100	-	300	180	160	-
		Less than 5t/h	50-100	-	320	200	180	-
	Small once-through boilers		100	-	-	200	180	-

* The classification "for electric utility" above refers to boilers installed by electric power companies for power generation.

(3) Air ratios for industrial furnaces

Item		Gas fuel		Liquid fuel		
		Continuous type	Intermittent type	Continuous type	Intermittent type	
Standard	Melting furnace for metal forging	1.25	1.35	1.3	1.4	
	Continuous reheating furnace (billet, bloom, slab)	1.20	-	1.25	-	
	Metal heating furnace other the above	1.25	1.35	1.25	1.35	
	Metal heat treatment furnace	1.20	1.25	1.25	1.3	
	Oil heating furnace	1.20	-	1.25	-	
	Thermal decomposition furnace and reforming furnace	1.20	-	1.25	-	
	Cement kiln	1.30	-	1.3	-	*1
	Coal kiln	1.30	1.35	1.3	1.35	*1
	Drying furnace	1.25	1.45	1.3	1.5	*2
Target	Melting furnace for metal forging	1.05-1.20	1.05-1.25	1.05-1.25	1.05-1.30	
	Continuous reheating furnace (billet, bloom, slab)	1.05-1.15	-	1.05-1.20	-	
	Metal heating furnace other than the above	1.05-1.20	1.05-1.30	1.05-1.20	1.05-1.30	
	Metal heat treatment furnace	1.05-1.15	1.05-1.25	1.05-1.20	1.05-1.30	
	Oil heating furnace	1.05-1.20	-	1.05-1.25	-	
	Thermal decomposition furnace and reforming furnace	1.05-1.20	-	1.05-1.25	-	
	Cement kiln	1.05-1.25	-	1.05-1.25	-	*1
	Coal kiln	1.05-1.25	1.05-1.35	1.05-1.25	1.05-1.35	*1
	Drying furnace	1.05-1.25	1.05-1.45	1.05-1.30	1.05-1.50	*2

*1 Value of liquid fuel in case of pulverized coal firing
*2 Burner portion only

(4) Standard and target rates of waste heat recovery for industrial furnaces (including waste gas temperatures for reference)

Exhaust gas temperature (℃)	Capacity category	Standard waste heat recovery rate (%)	Target waste heat recovery rate (%)	Reference	
				Waste gas temperature (℃)	Preheated air (℃)
Less than 500	A・B	25	35	275	190
500 - 600	A・B	25	35	335	230
600 - 700	A	35	40	365	305
	B	30	35	400	270
	C	25	30	435	230
700 - 800	A	35	40	420	350
	B	30	35	460	310
	C	25	30	505	265
800 - 900	A	40	45	435	440
	B	30	40	480	395
	C	25	35	525	345
900-1,000	A	45	55	385	595
	B	35	45	485	490
	C	30	40	535	440
1,000 or more	A	45	55	-	-
	B	35	45	-	-
	C	30	40	-	-

In the above table, A refers to the furnaces with the rated capacity of 84,000 MJ per hour or more. And B includes the furnaces with the rated capacity from 21,000MJ per hour or more to less than 84,000MJ. Finally, C refers to the furnaces that have the hourly rated capacity from 840MJ or more to less than 21,000MJ.

Attachment 5: Specific Provisions for EM, EA and ACEA Certification

Table A5-1 Contents of Reference Book for Energy Management

Subject and Contents
1. GENERAL 1.1 Primary energy resources in the world and in Bangladesh 1.2 Sectional energy consumption and tariffs in the world and in Bangladesh 1.3 SREDA Acts, Energy Efficiency Rules and secondary legislation 1.4 Related agencies and institutions
2. ENERGY EFFICIENCY 2.1 Energy saving and energy efficiency 2.2 Energy saving potential, energy intensity – concept, calculation, trends 2.3 Energy efficiency measures in the industry – technical and economical 2.4 Energy and environment/environmental legislation
3. ENERGY MANAGEMENT / GENERAL 3.1 Duties of Energy Manager (EM) (target setting, awareness raising, planning, monitoring, data collection and reporting) 3.2 Economic analysis methodologies 3.3 Measurement techniques and equipment 3.4 Standards 3.5 Feasibility studies
4. ENERGY MANAGEMENT / HEAT – MECHANICS 4.1 Energy and mass equivalences (basic concepts, applied example) 4.2 Combustion facilities, fuels and combustion (burners, flues, boilers, efficiency calculations, fuels, conversion of fuels to toe value, and flue gas analyses,) 4.3 Steam systems (steam systems, condensate recovery, steam traps, losses & leakages) 4.4 Heat insulation (calculation formula; insulation materials, selection of material) 4.5 Industrial furnaces (furnace types, energy and/or mass balance in furnaces, operation and modernization, energy efficiency measures.) 4.6 Heating, ventilation and air-conditioning (concepts, calculation and design) 4.7 Compressed air systems (compressors, control systems, distribution lines) 4.8 Drying systems (drying concept/ drying processes and psychometric calculations) 4.9 Use of waste heat (waste heat concept, waste heat recovery systems,) 4.10 Cooling
5. ENERGY MANAGEMENT / ELECTRICITY 5.1 Electric energy – concepts and sizes (ampere, voltage, power and power factor) 5.2 Efficiency in electric energy generation, transmission, distribution, end user and demand side management 5.3 Metering and monitoring of electric energy 5.4 Types, losses and efficiencies of power transformers 5.5 Reactive power, power factor and compensation practices, harmonics and filters 5.6 Types, losses and efficiencies of electric motors (fan, pump, comp.) 5.7 Variable speed drivers, soft starters, inverter control and application areas 5.8 Efficient use of electric energy in lightening (efficient fittings, control systems) 5.9 Combined heat-power systems (cogeneration), types and efficiencies 5.10 Electric heating 5.11 Electric chemistry (electrolysis, caustic soda,) 5.12 Air conditioning (theory and facilities, energy conservation) 5.13 Automation systems

Table A5-2 Contents of Reference Book for Energy Audit Service

Subject and Contents
1. ENERGY AUDIT
1.1 Energy audit (building, energy-intensive industry sectors, thermo-dynamic and electricity categories)
1.2 Measurement devices, measurement techniques and standards
1.3 Case study of energy audit
1.4 Economical assessment of energy conservation investment
1.5 Energy audit report (Format and check point)
2. EXAMPLES OF CALCULATION OF ENERGY SAVING EFFECTS
2.1 Industry sector
2.2 Building
3. PRODUCTS AND SPECIFICATIONS OF ENERGY EFFICIENT EQUIPMENT
3.1 Industry sector
3.2 Building

Table A5-3 Subjects of Written Test for Energy Manager (EM)

Paper	Contents
Paper-1	• General aspects of Energy Management • The energy situation, policy and energy outline • The basics of energy management technology
Paper-2	• Energy Efficiency in thermal utilities (boiler, gas turbine, heat exchanger, etc.) • Combustion management and calculation
Paper-3	• Energy Efficiency in electrical utilities (inverter, lighting, HVAC, etc.) • Electrical measurement and electronic theory

Table A5-4 Subjects of Written Test of CEA

Paper	Contents
Paper-1	• General aspects of Energy Management • The energy situation, policy and energy outline • The basics of energy management technology
Paper-2	• Energy efficiency in thermal utilities (boiler, gas turbine, heat exchanger, etc.) • Combustion management and calculation
Paper-3	• Energy efficiency in electrical utilities (inverter, lighting, HVAC, etc.) • Electrical measurement and electronic theory
Paper-4	• Energy performance assessment for equipment & utility system • Energy audit simulation and economic assessment

Table A5-5 Subjects of Practical Training or Hands-on Training Course

Category	Contents
1. Heat management	1) Measurement of temperature, pressure and flow rate
	2) Heat balance of boiler including flue gas analysis
2. Electricity management	1) Measurement of electricity including voltage, current, power and power factor
	2) Pumps or fans load, including inverter control
	3) Lighting load

Table A5-6 Measurement Devices for Practical Training Course

Item	Quantity
1. Thermometer	
1.1 Infrared thermometer	2
1.2 Infrared thermometer (high temperature)	1
1.3 Thermocouple type thermometer	2
1.4 Humidity and thermometer	2
2. Pressure gage	
2.1 Pressure gage	2
2.2 Mano-meter	1
3. Flow meter	
3.1 Thermal wire-anemometer	1
3.2 Ultrasonic flow meter	1
3.3 Pitot tube	1
4. Flue gas analyze and electric recording units	1
5. Illuminometer	3
6. Electricity measurement devices	
6.1 Power analyzer	1
6.2 Clamp type power-meter	2
6.3 Clamp type current meter	3
6.4 Multi meter	2

Table A5-7 Items for Evaluation of Energy Audit Report

No.	Evaluation Items
1	Quality of field studies-Probing skill, collection & generation of data, depth of technical knowledge and analytical abilities.
2	Quality of recommendations for improving energy efficiency.
3	Cost benefits analysis of recommended measures and preparation of action plan for implementation of recommendations.
4	Quality of report writing-flow of report & structure.
5	Quality of feedback on the energy audits conducted in the industry/establishments.

Table A5-8 Items for Evaluation in Oral Interviewing for CEA and ACEA

No.	Evaluation Items
1	Evaluation of three detailed energy audit reports submitted along with the application
2	The number of and the kind of Energy Intensive Industries in which detailed energy audits have been made
3	Association of applicant with number of and kind of experts including full time CEAs or part time CEAs or consultants with expertise in thermal, electrical utilities and processes, and nature of such association
4	Possession of at least four up-to-date basic instruments namely, clip-on-type, power measuring instruments, flue gas analyzer, temperature and lux measuring instruments which are duly calibrated by a laboratory accredited by the National Accreditation Board for Testing and Calibration Laboratories and expertise in using such instruments to conduct energy audit
5	Procedure of work followed in energy audit
6	Training experience;
7	Quality of field studies including observations, probing skills, collection and generation of data, depth of technical knowledge and analytical abilities
8	Capacity to undertake cost benefit analysis of recommended measures for improving energy efficiency or for conserving energy and preparation of action plan for implementation of recommendations for reduction of energy consumption; and quality of energy audit reports.

Attachment 6: Written Test Form for Paper 1, 2 and 3 for EM, CEA and ACEA (Choose 1 Correct Answer from 4 Candidates), Example in BEE, India

http://beeindia.in/content.php?page=miscellaneous/useful_download.php

NATIONAL CERTIFICATION EXAMINATION 2005

FOR

ENERGY MANAGERS & ENERGY AUDITORS

Question Papers & Model solutions to the Question Papers

PAPER – 1: General Aspects of Energy Management & Energy Audit			
Date: 28.05.2005	**Timings: 0930-1230 HRS**	**Duration: 3 HRS**	**Max. Marks: 150**

General instructions:

- *Please check that this question paper contains **7** printed pages*
- *Please check that this question paper contains **65** questions*
- *The question paper is divided into three sections*
- *All questions in all three sections are compulsory*
- *All parts of a question should be answered at one place*

Section – I: OBJECTIVE TYPE Marks: 50 x 1 = 50

(i) Answer all **50** questions
(ii) Each question carries **one** mark
(iii) Put a (√) tick mark in the appropriate box in the answer book

1.	Primary energy sources are, a) electricity **b) converted into secondary energy sources** c) used in diesel generator sets d) LPG, petrol & diesel
2.	Eighty percent of the worlds' population lives in developing countries and consumes approximately ……. of the world's total energy consumption a) 80 % b) 60 % **c) 40 %** d) 20 %
3.	Energy consumption per unit GDP is called a) energy ratio **b) energy intensity** c) per capita consumption d) all of the above
4.	Identify the wrong statement for a measure to reduce energy costs in a furnace by substitution of a fuel. a) fuel switching may improve energy efficiency. b) fuel switching may reduce energy efficiency. c) fuel switching may reduce energy costs. **d) fuel switching always reduces energy consumption.**
5.	The Energy Conservation Act 2001 does not require designated consumers to a) appoint/designate certified energy manager b) conduct an energy audit through an accredited energy auditor c) comply with energy consumption norms & standards **d) invest in all energy conservation measures**

Attachment 7: Written Test Form of CEA for Paper 4 (Description and Calculation), Example in BEE, India

http://beeindia.in/content.php?page=miscellaneous/useful_download.php

NATIONAL CERTIFICATION EXAMINATION 2005

FOR

ENERGY AUDITORS

Question Papers & Model solutions to the Question Papers

PAPER – 4: ENERGY PERFORMANCE ASSESSMENT FOR EQUIPMENT AND UTILITY SYSTEMS

Date: 29.05.2005 Timings: 1400-1600 HRS Duration: 2 HRS Max. Marks: 100

General instructions:

- *Please check that this question paper contains **4** printed pages*
- *Please check that this question paper contains **16** questions*
- *The question paper is divided into three sections*
- *All questions in all three sections are compulsory*
- *All parts of a question should be answered at one place*

Section - I: SHORT DESCRIPTIVE QUESTIONS Marks: 10 x 1 = 10

(i) Answer all **Ten** questions
(ii) Each question carries **One** marks

S-1 What have all boiler efficiency testing standards in common?

They do not include blowdown as a loss in the efficiency determination process.

S-2 For which fuel the difference between GCV and LCV will be smaller, Coal or Natural Gas?

Coal

S-3 The overall gas turbine efficiency is defined as η = ?
(Express the equation in units of kW and kWh)

$$\eta = \frac{\text{power output, kW}}{\text{fuel input to gas turbine in kg/h x GCV of fuel in kWh/kg}}$$

In case GCV is expressed in kcal/kg – give ½ mark.

S-4 The more fouling fluid should be on which side of a shell & tube heat exchanger?

Tube side (because it is easier to clean)

S-5 Which loss is considered the most unreliable or complicated to measure in electric motor efficiency testing?

(i) Tones of paddy husk fired per year if the power plant has an efficiency of 25% measured by the direct method.

(ii) The storage area required in square meters to store an inventory of paddy husks 30 cm high for 4 days of operation. Assume paddy husks bulk density of 100 kg/m^3.

(iii) Power plant capital cost is Rs. 20 crore and paddy husks cost as delivered is Rs. 1200/ ton. Annual repair, maintenance and operation costs are 10% of capital cost. What is the simple payback period, if power is sold at Rs.3/kWh.

Reference 2
Framework of EE Labeling Program

Reference 2-1

FRAMEWORK
OF
ENERGY EFFICIENCY LABELING PROGRAM

PART 1: GENERAL
(DRAFT)

March, 2015

Prepared by;

EE Labeling Program Committee

EE&C Master Plan Project in Bangladesh

Contents

Introduction

Energy Efficiency Labeling Program (EE Labeling Program) has been under preparation by the Government of Bangladesh. This document named “Framework” has been made summarizing up opinion and idea of stakeholders concerning on Energy Efficiency Labeling Program. “EE Labeling Program Committee” was organized as a stakeholders meeting to discuss the issues and to accomplish the framework.

The framework is the basic structure of the regulation for the voluntary/mandatory labeling program showing how to apply and maintain energy efficiency label on the home appliances and equipment. Therefore, the documents should be used as recommendation to the Government on making nationwide regulation for the program.

EE Labeling Program Committee

Position	Name	Status
Chairperson	Mr. Siddique Zobair,	Member, SREDA, Power Division
Member	Mr. Md. Aminur Rahman	Deputy Secretary, Ministry of Industries
Member	Professor Dr. Mahbubul Alam	Professor, Mechanical Department, BUET.
Member	Abdur Rauf Miah	Director, Sustainable Energy, Power cell.
Member	Md. Anisur Rahman Mollik	Senior Assistant Director, R&D, Refrigerator, Walton
Member	Mr. Kamrul Hasan	Assistant Director, R&D, Refrigerator, Walton
Member	Mr. Nurul Aktar	Director & CEO, Energy Pac Ltd.
Member	Mr. Md. Abdul Manan	Deputy Director, BSTI
Advisor	Dr. Kimio Yoshida	JICA Project Team (Leader)
Advisor	Mr. Kiyoshi Takashima	JICA Project Team (Sub-leader)
Advisor	Mr. Yoshio Hirayama	JICA Project Team

1. Purpose

The purpose of the labeling program is to advise consumers to buy energy efficient product showing comparative indicator on the product. Furthermore labeling encourages the manufacturers and importers to manufacture and trade higher energy efficiency products in the market.

2. Operation of Labeling Program

EE Labeling Program should be conducted by SREDA, cooperating stakeholders including manufacturers and importers, laboratories, retailers and consumers. The program should be initially voluntary and will shift to mandatory.

Note.
Mandatory program; Manufacturers and importers cannot sale products, which have no energy efficiency (EE) label in the market. The labeling should be applied under relevant regulation issued by the Government. Violation to the regulation should be punished.

Voluntary program; Manufacturers and importers can sell the products, which have no EE label on the market. When the manufacturers and importers intend to put EE label on their products, they have to follow the relevant regulation. Violation to the regulation should be punished as well.

3. Definitions

3.1 Label

“Label” is the energy efficiency label with maximum 5 stars rating. The design has been issued as BDS xxxxxx. (BDS specifying common design for Bangladesh EE label should be isolated from other BDSs which are issued respectively by appliance.)

3.2 Product

“Product” means a home appliance, for which EE labeling is to be applied.

3.3 Manufacturers and Importers

“Manufacturers and importers” are the individuals or the organization, which manufacture, assemble the products locally or import the products from abroad, and supply them into Bangladesh market.

3.4 Consumers

“Consumers” are the individuals or the organization, which purchase the products in the domestic market and use them for their own purpose.

3.5 Retailers

"Retailers" are the individuals or the organization, who sell the products in the domestic market to the consumers.

3.6 Label Certification Body

"Label certification body" is the administrative body, who issues label certificates to the manufacturers and importers. Label certification body will be established in SREDA or outsourced to the other governmental agency. (In some cases abroad, it can be outsourced to a private sector.)

3.7 Accredited Laboratory

"Accredited laboratory" is the laboratory, which is accredited by BAB and assigned by the label certification body to carry out tests for energy efficiency measurements of the products.

3.8 Equivalent Laboratory

"Equivalent laboratory" is the laboratory, which is not accredited by BAB, but is recognized that it has an enough competency to carry out energy efficiency measurements tests. Criteria for the recognition will be specified respectively in PART 2 to 8 in the following series documents.

3rd party laboratories and manufacturer's in-house laboratories, which are located abroad and accredited by the foreign authorities, can be the candidate of "Equivalent laboratory"

3.9 Energy Efficiency Indicator

"Energy efficiency indicator" is a specified unit to evaluate the energy efficiency. Actual energy efficiency indicators for the products will be specified respectively in PART 2 to 8in the following series documents.

3.10 Designated (EE) Measurement Method

"Designated (EE) measurement method" is the unified test, calculation method and condition for energy efficiency measurement of the products, particularly designated for the labeling program. The designated measurement method is often given by the existing industrial standards such as ISO/IEC, BDS and foreign countries' standards.

3.11 Star Rating

"Star rating" is the term, expressing relative energy efficiency among the products. Star rating is indicated in the label as the number of star. Minimum star rating is 1 star for the lowest EE grade, and maximum 5 stars for the highest EE grade.

3.12 Star Rating Criteria

"Star rating criteria" is the criteria, which define grading of 1 star to 5 star labels relating to the energy efficiency of the products. The star rating criteria is fixed basing on not only product energy efficiency, but also EE&C implementation situation and other economic and social condition. Actual star rating criteria is stipulated in PART 2 to 8in the following series documents.

3.13 Test and Test Report

"Test" is the test for energy efficiency measurement of the products conducted under the designated measurement method. "Test report" is the documentation of the test results issued by the accredited laboratories or the equivalent laboratories.

3.14 Label Certificate

"Label certificate" is the certificate issued by the label certification body to the manufacturers and importers. The label certificate certifies the energy efficiency, the star rating, validity period, issue date and expiration date.

3.15 Challenge Test

"Challenge test" is the test, which is conducted after a labeled product appears in the market. Purpose of the challenge test is to check conformity of the product EE performance to the label affixed. The challenge test is curried out as requested by label certification body, consumers, competitors of the product and other parties and/or individuals.

3.16 Labeling Program Committee

"Labeling Program Committee" is the committee formulated by SREDA in order to establish and review the labeling program and give recommendation for the improvement of the program.

4. Roles

4.1 Manufacturers and Importers

4.1.1 Application for Label Certificate

- The manufacturers and importers should submit label certification application forms to the label certification body.
- When manufacturers and importers want to use their in-house laboratory test data for the labeling, they have to submit the data to the label certification body. In that case, the laboratories should be "Accredited laboratory" or "Equivalent laboratory". The manufacturers and importers should submit the relevant documents, which proofs it.
- The manufacturers and importers who want to outsource EE measurement tests to the accredited laboratory should submit samples to the accredited test laboratory together with application documents. A copy of the application should be forwarded to the label certification body. The

manufacturers and importers should bear the testing fee including transportation cost of the samples.

4.1.2 Affix of Label

- On receiving the label certificate from the label certification body, the manufacturers and importers should affix the label as per the given format and the dimensions, stipulated in BDS xxxxx on the product or the package of the product.
- The manufacturers and importers can also mention about the label on catalogs or other information of the products.
- The manufacturers and importers should renew the label certificate on the termination of its validity period, which is mentioned on the product or the package of the product.
- Apart from the label, the manufacturers and importers should display/mark necessary information of the product on the product and/or the package as mentioned in PART 2 to 8 in the following series documents. (Mandatory display)

4.1.3 Other

- The manufacturers and importers should not mislead the consumers by affixing similar label, which is not certified by the label certification body or displaying incorrect information of the product.
- The manufacturers and importers should make efforts to produce or import higher energy efficiency products.
- The manufacturers and importers should make efforts to indicate the energy efficiency value of the product on catalogs, web pages, and other media.
- The manufacturers and importers should submit sales/production data of the labeled products to the label certification body.

4.2 Retailer

4.2.1 Instruction to Consumers

- The retailers are expected to understand of the labeling program in detail and accurately explain it to the consumers.
- The retailer should not mislead the consumers by providing inaccurate information of the energy performance of the product.

4.2.2 Other

- The retailer should make efforts to sell higher energy efficiency products.
- The retailers are expected to disclose sales data of the labeled products to SREDA or label certification body.

4.3 Label Certification Body

4.3.1 Certification

- The label certification body should issue certificate of label to the manufacturers and importers after enough evaluation of manufacturer's relevant documents and accurate assessment of the star rating, based on the tested data and conforming to the star rating criteria.
- The label certification body should issue certificate to the manufacturers and importers by two weeks after receiving application from them.
- When the label certification body cannot issue certification, it should inform the reason to the manufacturers and importers by two weeks, after receiving application from them, or ask them for additional documents needed for further evaluation and the issue.

4.3.2 Monitoring and Inspection

- The label certification body should monitor the labeling program implementation by watching the market. When it finds any illegal labeling, it should report the fact to SREDA.
- The label certification body should issue annual report of the labeling program implementation including number of labels, penetration in the market.

4.3.3 Challenge Test

- Label certification body should conduct the challenge test as requested by consumers, products competitors and other parties.
- Label certification body can conduct the challenge test for verification of the labels affixed on the products by label certification body's own necessity.
- Challenge test is expected to be done by the other laboratory of the laboratory which has tested the product for its initial application for the label certificate.

4.3.4 Accreditation

- Label certification body is expected to be accredited with ISO17065.

4.4 Accredited Laboratory and Equivalent Laboratory

4.4.1 Accreditation

- The candidates of accredited laboratory should submit application to BAB and should be accredited by BAB as an "accreditation laboratory" after BAB's evaluation.
- The laboratories should not do EE measurement tests and report the result to the manufacturers and importers before attaining BAB's accreditation.
- The laboratory which is accredited by foreign accreditation body and can be recognized as an "equivalent laboratory" as specified in Part 2 to 8 of the series documents respectively, can conduct EE measurement test.

4.4.2 EE Measurement

- The accredited laboratory and the equivalent laboratory should conduct tests accurately as per the designated measurement method and submit test report to the manufacturers and importers and/or the label certification body.
- The accredited laboratory and the equivalent laboratory should maintain and calibrate the test facility and instruments for conducting tests as per the designated measurement method. Also the test staffs should maintain testing skill in order to conduct accurate tests.
- The accredited laboratory should conduct tests as per the designated measurement method in case that the label certification body requests.
- The accredited laboratory should get agreement of price and duration of the test with the manufacturers and importers, the certification body, before conducting test.

4.5 MPEMR and SREDA

4.5.1 Legislation

- MPEMR should issue and enforce the regulation on the labeling program. The regulation should include the following items.

Regulation Content

Item	Remarks
Procedure	Application, test, label certification, inspection, maintenance, data verification
Accreditation	Accreditation of laboratory
EE indicator	Definition of the EE indicator
Measurement method	Designation of the measurement method (Citation of existing standards)
Star rating criteria	Definition of the criteria If necessary, setting of MEPS (Minimum Energy Performance Standard)
Mandatory display	Display of EE data and other information
Penalty	Penalty to illegal labeling and false display or announcement
Review of the labeling program	Periodical review of the program
Fee	Application, test

4.5.2 Formulation of EE Labeling Committee

- SREDA should formulate EE Labeling Committee, inviting members from stakeholders, and commission advisory for improvement of the labeling program.
- SREDA should prepare annual report of the labeling program for the discussion in the committee.
- SREDA should record of the discussion in the committee.

4.5.3 Administration and Penalty

- SREDA should announce the labeling program to the manufacturers and importers, retailers and also the consumers and make them join to the program.
- SREDA should give administrative recommendation, direction and order to the manufacturers and importers or retailers if necessary.
- SREDA should give penalty to the manufacturers and importers or retailers on their contravention activities.
- SREDA should take action of prosecution, if necessary.

4.5.4 Monitoring and Review

- SREDA should conduct a market survey in order to discover the market penetration of those products with high energy efficiency. The information thus collected should be used for the review of EE Labeling Program. Such reporting can be cited from the report submitted by the label certification body.
- SREDA should review the labeling program, including regulations periodically, and improve the program by issuing revised regulation.

4.5.5 EE Measurement Service

- SREDA must provide EE measurement service to the manufacturers and importers which need outsourcing of EE measurement, when SREDA applies a “mandatory” labeling program on the product.

4.6 EE Labeling Program Committee

4.6.1 Formation

- The members of EE Labeling Program Committee should consist of manufacturers and importers, accredited labolatory, label certification body, consumers, related associations and other stakeholders.
- The chairman of the committee should be selected among the members.

4.6.2 Recommendation to SREDA

- EE Labeling Program Committee should review the labeling program and report to SREDA as the recommendation.

4.7 BAB (Bangladesh Accreditation Board)

4.7.1 Accreditation of Accredited Laboratory

- BAB should issue certification of “accredited laboratory” by three weeks after receiving application from the candidate laboratory.
- BAB should disclose evaluation criteria for the accreditation.

4.8 BSTI (Bangladesh Standard and Testing Institute)

4.8.1 Standardization

- BSTI should issue standards on the designated measurement method, which is requested by the Government or industrial parties for convenience of the labeling program.
- The standards on the designated measurement method should be made considering laboratories testing ability and other circumstances.
- The standards for EE measurement method is to be structured, considering of the current international or regional movement on the standardization and harmonization.

4.8.2 EE Measurement Test

- BSTI should attain accreditation of "Accredited laboratory" on the designated measurement method.
- BSTI should carry out EE measurement tests as requested by the manufacturers and importers and the label certification body.

5. Incentive and Disincentive

5.1 Incentive

- SREDA should provide incentive programs for the highly labeled product and the manufacturers and importers, who deal with such products.
- Following incentive should be provided.
  - Official announcement of highly labeled product to consumers
  - Incentives to purchase highly labeled product by consumers and the Government works and projects

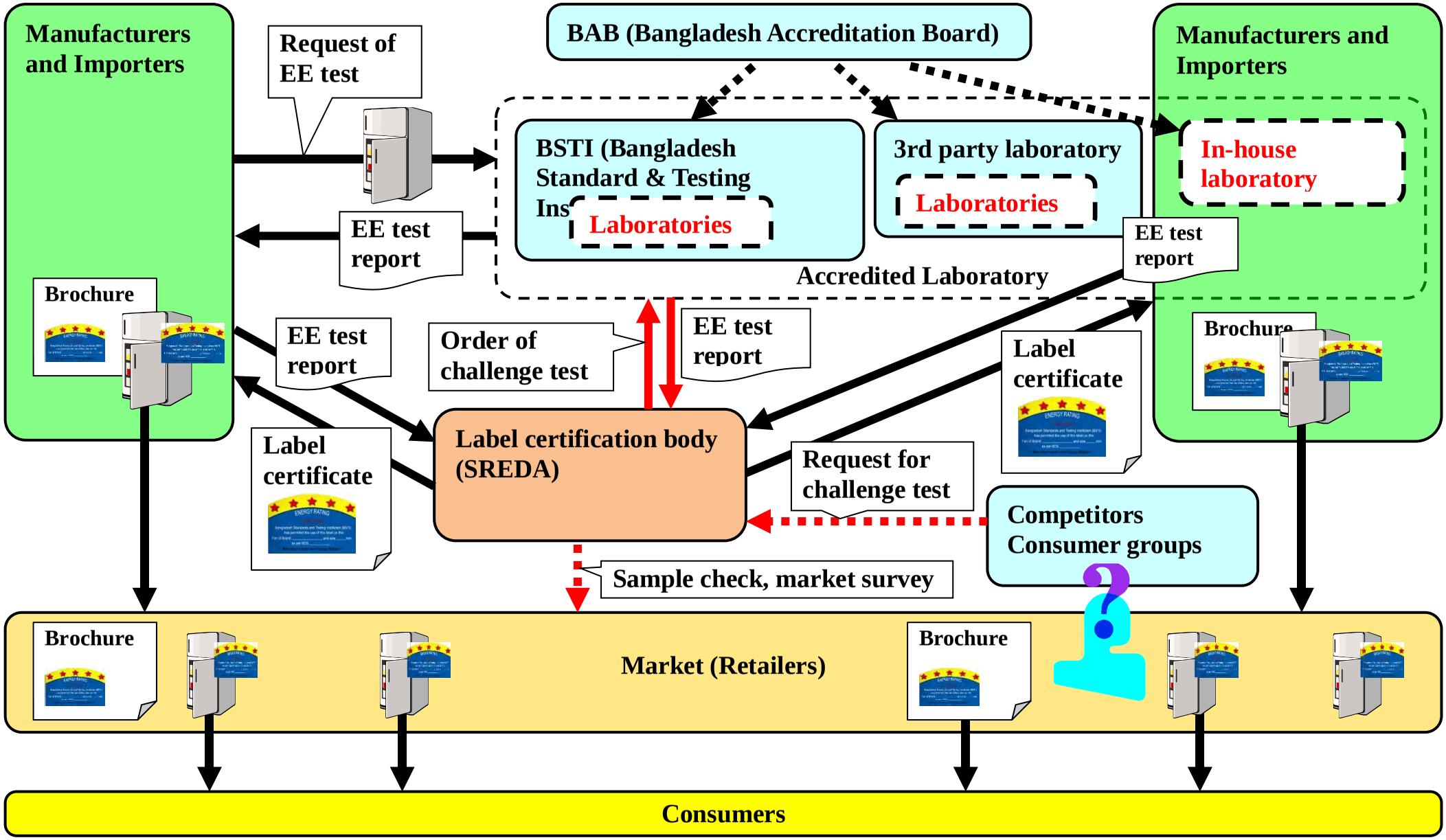
5.2 Disincentive

- SREDA can provide MEPS on the products
- SREDA should give penalty on the manufacturers and importers who deal the products attached with false labels or give wrong information to the consumers
- Following administrative action should be provided
  - Administrative recommendation and order to the manufacturers and importers mentioned above
  - Disclosure of the name of the manufacturers and importers mentioned above
  - Monetary punishment on the manufacturers and importers mentioned above

6. Procedure of Labeling Program

- See "Schematic Diagram of EE Labeling Program"

Schematic Diagram of EE Labeling Program



Reference 2-2

FRAMEWORK
OF
ENERGY EFFICIENCY LABELING PROGRAM

PART 2: TECHNICAL PROVISION FOR
CFL (Compact Fluorescent Lamp)
(DRAFT)

March, 2015

Prepared by;

EE Labeling Program Committee

EE&C Master Plan Project in Bangladesh

1. Type and Scope of Products

Compact fluorescent lamps (CFLs) with EE label should satisfy the requirement of performance stipulated in BDS (Bangladesh Standard) as listed below:

- BDS-1734: 2003 or its revision
- BDS-1735: 2003 or its revision
- BDS-1761: 2006 or its revision

2. Classification

Classification should be provided if necessary.

3. Energy Efficiency Indicator

Indicator of energy efficiency is the "Performance Grading (PG)", which is defined in BDS-1761: 2006.

4. Energy Efficiency Measurement Method

The measurement and calculation methods of the energy efficiency and all the other necessary measurement items should be in accordance with BDS-1761: 2006.

5. Criteria of Energy Efficiency Rating

The star rating criteria should be in accordance with BDS-1761: 2006.

6. Data Verification

6.1 Test and Laboratory

Energy efficiency data for the certification of energy efficiency labels must be obtained by an accredited/equivalent laboratory. Accreditation of the Governmental laboratories, third party laboratories and manufacturer's in-house laboratories should be given by BAB (Bangladesh Accreditation Board). Qualification of the accredited/equivalent laboratory should be as shown in the following table.

Qualification of Laboratories in Bangladesh

Laboratory	Test competence	Certificate
Governmental	BDS 1761: 2006	ISO 17025 issued by BAB
3rd party	BDS 1761: 2006	ISO 17025 issued by BAB
Manufacturer's in-house	BDS 1761: 2006	ISO 17025 issued by BAB

3rd party laboratories and manufacturer's in-house laboratories located in other countries should have the following competence and certification

Qualification of Laboratories Located in Other Countries

Laboratory	Test competence	Certificate
3rd party	IEC 60598-1 (1996) or equivalent local standards	ISO 17025 issued by the authorities in the following countries (see note)
Manufacturer's in-house	IEC 60598-1 (1996) or equivalent local standards	ISO 17025 issued by the authorities in the following countries (see note)
Note; Japan, Korea, China, Thailand, Malaysia, India, US, EU countries		

6.2 Manufacturer's In-house Laboratory

In case that the manufacturer's in-house laboratories have not yet obtained accreditation for the "Accredited laboratory" by BAB (Bangladesh Accreditation Board), tests at the manufacturer's in-house laboratories witnessed by the staff of the accredited laboratories can substitute the "Accreditation by BAB".

6.3 Validity Period of Data

Test results data are valid for products sold in Bangladesh market, excluding sales of the second-handed.

6.4 Tolerance of EE Data

Energy efficiency data reported by the manufacturer at the time of applying for energy efficiency labels, or data displayed on products, packaging, and catalogs need to receive tolerance from the tested data resulted from accredited testing laboratory or the data with a testimony, performed at manufacturer's in-house laboratory, as tolerance value below:

Tolerance Data of Energy Efficiency Test

Item	Test data	
	Label certification	Sample test in the market, challenge test
Efficacy, power factor	95%-105% x Declared data	95%-105% x Declared data

6.5 Test Reports

The entire test results must be stored for 10 years in the laboratories, where the test ware carried out.

7. Label Affixing Rules

7.1 Label Design

Unified label design must be used. Master design of the label should be officially issued by BDS.

Source: BSTI

Bangladesh EE Label

7.2 Location

Labels must be displayed on the package of the product. The label can be also displayed in catalogs, web site pages, and other media without any size restriction.

8. Product Information

Besides EE labeling mentioned above, product information as listed below should be stated on the product packages, operation/maintenance document, catalogues, webpages, etc.

- Manufacturer's name / brand
- Model / type
- Power
- Efficacy
- Power factor

Reference 2-3

FRAMEWORK
OF
ENERGY EFFICIENCY LABELING PROGRAM

PART 3: TECHNICAL PROVISION FOR REFRIGERATOR
(DRAFT)

March, 2015

Prepared by;

EE Labeling Program Committee

EE&C Master Plan Project in Bangladesh

1. Type and Scope of Products

Refrigerators with EE label should satisfy the requirement of performance, which is stipulated in BDS (Bangladesh Standard) -1849 (2011) and BDS-1850 (2012) or its revision

2. Classification

The refrigerator which can be applied with the labeling program should include “Refrigerator”, “Refrigerator-freezer” and “Freezer”. The classification is given in BDS-1850 (2012).

3. Energy Efficiency Indicator

Indicator of energy efficiency is the “energy consumption in each year per adjusted inner volume”. (kWh / year / liter)

4. Energy Efficiency Measurement Method

The measurement and calculation methods of the energy consumption, adjusted inner volume and all the other necessary measurement should be in accordance with BDS-1850 (2012).

5. Criteria of Energy Efficiency Rating

The star rating criteria should be in accordance with BDS-1850 (2012).

6. Data Verification

6.1 Test and Laboratory

Energy efficiency data for the certification of energy efficiency labels must be obtained by an accredited/equivalent laboratory. Accreditation of the governmental laboratories, third party laboratories and manufacturer’s in-house laboratories should be given by BAB (Bangladesh Accreditation Board). Qualification of the accredited/equivalent laboratory should be as shown in the following table.

Qualification of Laboratories in Bangladesh

Laboratory	Test competence	Certificate
Governmental	BDS 1850: 2012	ISO 17025 issued by BAB
3rd party	BDS 1850: 2012	ISO 17025 issued by BAB
Manufacturer’s in-house	BDS 1850: 2012	ISO 17025 issued by BAB

3rd party laboratories and manufacturer’s in-house laboratories located in other countries should have the following competence and certification

Qualification of Laboratories Located in Other Countries

Laboratory	Test competence	Certificate
3rd party	IEC 62552 (2007), ISO 15502 (2005), AS/NZS 4474.1 (1997), AHAMHRF-1 (2004), KSC 9305 (1999), CNS 2062 (1995), CNS 9577 (1989), JIS C 9801 (2006)	ISO 17025 issued by the authorities in the following countries (see note)
Manufacturer's in-house	Ditto	ISO 17025 issued by the authorities in the following countries (see note)
Note; Japan, Korea, China, Thailand, Malaysia, India, US, EU countries		

6.2 Manufacturer's In-house Laboratory

In case that the manufacturer's in-house laboratories have not yet obtained accreditation for the "Accredited laboratory" by BAB (Bangladesh Accreditation Board), tests at the manufacturer's in-house laboratories witnessed by the staff of the accredited laboratories can substitute the "Accreditation by BAB".

6.3 Validity Period of Data

Test results data are valid for products sold in Bangladesh market, excluding sales of the second-handed.

6.4 Tolerance of EE Data

Energy efficiency data reported by the manufacturer at the time of applying for energy efficiency labels, or data displayed on products, packaging, and catalogs need to receive tolerance from the tested data resulted from accredited testing laboratory or the data with a testimony, performed at manufacturer's owned laboratory, as tolerance value below:

Tolerance Data of Energy Efficiency Test

Item	Test data	
	Label certification	Sample test in the market
Adjusted Inner Volume (Litter)	95%-105% x Declared data	95%-105% x Declared data
Maximum Power (kW)	110% x Declared data	110% x Declared data
Annual Power Consumption (kWh/year)	90% x Declared data	90% x Declared data

Note: there is a opinion that the above table is a bit severe.

6.5 Test Reports

The entire test results must be stored and documented as Assessment Report, which contains the results of measurement data, performance characteristics and other details including necessary retest reports. Copies of reports should be stored in a testing laboratory as a reference.

7. Label Affixing Rules

7.1 Label Design

Unified label design must be used.

Source: BSTI

Bangladesh EE Label

7.2 Location

Labels must be placed on the front surface of refrigerator door, can also be displayed on the packaging, catalogs, web site pages, and other media without any size restriction.

8. Product Information

Besides EE labeling mentioned above, product information as listed below should be stated on the product, operation/maintenance document, catalogues, webpages, etc.

- Manufacturer's name / brand
- Model / type
- Batch Number
- Outside dimension
- Gross Volume
- Voltage
- Power
- Electricity flow
- Total *Gross Volume*
- Annual energy consumption
- Performance Frequency
- Refrigerant type

Reference 2-4

FRAMEWORK
OF
ENERGY EFFICIENCY LABELING PROGRAM

PART 4: TECHNICAL PROVISION FOR
AC (Air Conditioner)
(DRAFT)

March, 2015

Prepared by;

EE Labeling Program Committee

EE&C Master Plan Project in Bangladesh

1. Type and Scope of Products

The split air conditioners with EE label should satisfy the requirement of performance, which is stipulated in BDS (Bangladesh Standard) -1852 (2012).

2. Classification

Star rating criteria and measurement methods should be based on the following categories:

Labeling Category on AC

	Measurement methods	Star rating criteria
Category	1. Non-inverter type 2. Inverter type	1. Non-inverter type 2. Inverter type

3. Energy Efficiency Indicator

Indicator of energy efficiency is "SRI (Star Rating Index)" as defined in BDS-1852 (2012)

4. Energy Efficiency Measurement Method

Measurement method of energy efficiency indicators for air conditioners should be in accordance with BDS-1852 (2012).

5. Criteria of Energy Efficiency Rating

Star rating criteria must be provided. The following table is a sample, which is made basing on TABLE 2.1 "DERIVATION OF STAR RATING" in BDS-1852 (2012).

Energy Efficiency Rating (Star Rating)

Star Rating Index (SRI) BDS-1852 (2012)	Star rating
$1.5 \leq SRI < 2.5$	1
$2.5 \leq SRI < 4.0$	2
$4.0 \leq SRI < 5.0$	3
$5.0 \leq SRI < 8.0$	4
$8.0 \leq SRI$	5

6. Data Verification

6.1 Test and Laboratory

Energy efficiency data for the certification of energy efficiency labels must be obtained by an accredited/equivalent laboratory. Accreditation of the governmental laboratories, third party laboratories and manufacturer's in-house laboratories should be given by BAB (Bangladesh Accreditation Board). Qualification of the accredited/equivalent laboratory should be as shown in the following table.

Qualification of Laboratories in Bangladesh

Laboratory	Test competence	Certificate
Governmental	BDS 1852: 2012	ISO 17025 issued by BAB
3rd party	BDS 1852: 2012	ISO 17025 issued by BAB
Manufacturer's in-house	BDS 1852: 2012	ISO 17025 issued by BAB

3rd party laboratories and manufacturer's in-house laboratories located in other countries should have the following competence and certification

Qualification of Laboratories Located in Other Countries

Laboratory	Test competence	Certificate
3rd party	ISO 5151 (2010), JIS 8615-1, 2 (2013)	ISO 17025 issued by the authorities in the following countries (see note)
Manufacturer's in-house	ISO 5151 (2010), JIS 8615-1, 2 (2013)	ISO 17025 issued by the authorities in the following countries (see note)
Note; Japan, Korea, China, Thailand, Malaysia, India, US, EU countries		

6.2 Manufacturer's In-house Laboratory

In case that the manufacturer's in-house laboratories have not yet obtained accreditation for the "Accredited laboratory" by BAB (Bangladesh Accreditation Board), tests at the manufacturer's in-house laboratories witnessed by the staff of the accredited laboratories can substitute the "Accreditation by BAB".

6.3 Validity Period of Data

Test results data are valid for products sold in the markets of Bangladesh. This does not include products sold in secondhand goods shops.

6.4 Tolerance of EE data

Energy-efficiency data reported by the manufacturer at the time of applying for energy-saving labels, or data displayed on products, packaging, and catalogs need to receive tolerance from the tested data resulted from accredited testing laboratory or the data with a testimony performed at manufacturer's owned laboratory, as tolerance value below:

Tolerance Data of Energy Efficiency Test

Item	Test data	
	Label certification	Sample test in the market
Minimum Cooling Capacity (kW)	95% x Declared data	90% x Declared data
Maximum Power (kW)	110% x Declared data	110% x Declared data
Minimum COP listed value	90% x Declared data	90% x Declared data
Weighted COP value/ minimum (EER)	90% x Declared data	90% x Declared data

6.5 Test Reports

The entire test results must be stored and documented as Assessment Report, which contains the results of measurement data, performance characteristics and other details including necessary retest reports. Copies of reports should be stored in a testing laboratory as a reference.

7. Label Affixing Rules

7.1 Label Design

Unified EE label design must be used.

Source: BSTI

Bangladesh EE Label

7.2 Location

Labels must be placed on the front surface of indoor unit, can also be displayed on the packaging, catalogs, web site pages, and other media without any size restriction.

8. Product Information

Besides EE labeling mentioned above, product information as listed below should be stated on the product, operation/maintenance document, catalogues, webpages, etc.

- Manufacturer's name / brand
- Model / type
- Batch Number
- Outside dimension
- Voltage
- Power
- Electricity flow
- COP (or EER)
- Refrigerant type

9. Reference

As a reference, a questionnaire sheet for further discussion about EE measurement and star rating of AC is attached hereinafter.

Attachment: Questionnaire on AC Star Rating Criteria

If you are a dealer of several manufacturers (brands), please make the answer sheet by manufacturer (brand).

Respondent Information

□■

Name of company, Brand	
	□ Manufacturer □ Dealer □ Importer
Office address	

Question/Answer

1. Do you have experience of EE labeling (star rating) program? □■

Experience	□ Yes, we have □ No, we don't have
Which country?	□ India □ Singapore □ Thailand □ Malaysia □ Vietnam □ China □ Other ( )
How long?	year

2. Do you have EE measurement laboratory? □■

Laboratory	□ Yes, we have □ No, we don't have Where? ( )
Test equipment	□ Psychrometric calorimeter (Air-enthalpy measurement chamber) □ Balanced room type chamber □ Other ( )
Accreditation	□ ISO17025 □ Other ( ) □ No Accredited by ( )
Measurement standard	□ ISO 5151 □ ISO 16358 □ Other ( )

3. EE labels to be put on your products □■

How many products do you launch into Bangladesh market newly in a year?	types
Do you want to put EE labels on all your products?	□ Yes □ No

4. Four countries AC star rating criteria are attached. Please give your opinion on them, in case that they are applied on your products sold in Bangladesh □■

Option 1 BDS 1852: 2012 (AS/NZS 3823.2: 2009)	Is the standard suitable in Bangladesh? □ Yes, suitable □ No, not suitable
	How is the rating? □ Too low □ A bit low □ Good □ A bit high □ Too high
	What will be the star rating on your products? (multiple response OK) □ Below 1 star □ 1 star □ 2 star □ 3 star □ 4 star □ 5 star
Option 2 Indian star rating	Is the standard suitable in Bangladesh? □ Yes, suitable □ No, not suitable
	How is the rating? □ Too low □ A bit low □ Good □ A bit high □ Too high
	What will be the star rating on your products? (multiple response OK) □ Below 1 star □ 1 star □ 2 star □ 3 star □ 4 star □ 5 star
Option 3 Singapore star rating	Do you sale inverter type (variable speed compressor) in Bangladesh? □ Yes, we sell □ No, we don't sell
	Is the standard suitable in Bangladesh? □ Yes, suitable □ No, not suitable
	How is the rating? □ Too low □ A bit low □ Good □ A bit high □ Too high
	What will be the star rating on your products? (multiple response OK) □ Below 1 star □ 1 star □ 2 star □ 3 star □ 4 star □ 5 star
Option 4 Vietnamese star rating	Do you sale inverter type (variable speed compressor) in Bangladesh? □ Yes, we sell □ No, we don't sell
	Is the standard suitable in Bangladesh? □ Yes, suitable □ No, not suitable
	How is the rating? □ Too low □ A bit low □ Good □ A bit high □ Too high
	What will be the star rating on your products? (multiple response OK) □ Below 1 star □ 1 star □ 2 star □ 3 star □ 4 star □ 5 star

5. If you have any opinion, please give us. (If you know other suitable criteria (standard), please inform us)

Option 1: BDS 1852: 2012 (AS/NZS 3823.2: 2009)

2.5 ANNUAL EFFICIENCY

The **AEER** of an air conditioner is defined as follows:

$$AEER = \frac{[\text{Tested cooling output} \times 2000]}{[\text{Tested cooling effective power input} \times 2000] + [P_{noc} \times 6.76]} \quad \ldots 2.5a$$

where

Tested cooling output is the measured value in kW.

Tested cooling effective power input is the measured value in kW.

2000 is a factor that is the assumed hours of operation per year in cooling mode.

P_{noc} is the non-operating power in watts in cooling mode as defined in Clause 2.4.

6.76 is a factor that converts power (watts) to energy (kWh) for (8760 – 2000) h per year.

2.6 STAR RATING INDEX (SRI)

2.6.1 General

The **SRI** for a model of air conditioner for cooling and heating, as applicable, **shall** be determined in accordance with Clauses 2.6.2 and 2.6.3 respectively, using the **(AEER)** and **(ACOP)** for the unit(s) as defined in Clause 2.5. The value for **AEER** and **ACOP shall** be in watts/watt.

NOTE: The equations for **SRI** in the following clauses were derived from a market analysis in 2005. The original air conditioner **star rating** equations were introduced in 1987 and these were revised in 2000 in previous editions of this Standard.

2.6.2 SRI cooling

The **SRI** for cooling is calculated by the following equation:

$$\text{SRI cooling} = \frac{[(AEER \times 8) - 18]}{4} \quad \ldots 2.6(1)$$

2.6.3 SRI heating

The **SRI** for heating is calculated by the following equation:

$$\text{SRI heating} = \frac{[(ACOP \times 8) - 18]}{4} \quad \ldots 2.6(2)$$

2.7 STAR RATING

The **star rating** is based on the **SRI** and is obtained from Table 2.1.

TABLE 2.1

DERIVATION OF STAR RATING

	Star Rating Index (SRI)	Star rating	
AEER < 3.0	SRI <1.5	1.0	
3.0 ≤ AEER < 3.25	1.5 ≤ SRI < 2.0	1.5	1 star
3.25 ≤ AEER < 3.5	2.0 ≤ SRI < 2.5	2.0	
3.5 ≤ AEER < 3.75	2.5 ≤ SRI < 3.0	2.5	2 star
3.75 ≤ AEER < 4.0	3.0 ≤ SRI < 3.5	3.0	
4.0 ≤ AEER < 4.25	3.5 ≤ SRI < 4.0	3.5	
4.25 ≤ AEER < 4.5	4.0 ≤ SRI < 4.5	4.0	3 star
4.5 ≤ AEER < 4.75	4.5 ≤ SRI < 5.0	4.5	
4.75 ≤ AEER < 5.0	5.0 ≤ SRI < 5.5	5.0	
5.0 ≤ AEER < 5.25	5.5 ≤ SRI < 6.0	5.5	4 star
5.25 ≤ AEER < 5.75	6.0 ≤ SRI < 7.0	6.0	
5.75 ≤ AEER < 6.25	7.0 ≤ SRI < 8.0	7.0	
6.25 ≤ AEER < 6.75	8.0 ≤ SRI < 9.0	8.0	5 star
6.75 ≤ AEER < 7.25	9.0 ≤ SRI < 10.0	9.0	
7.25 ≤ AEER	10.0 ≤ SRI	10.0	

In the case that non-operating power is zero

Conversion to 5 star rating

Option 2: Indian AC Star Rating Criteria

2.2 STAR RATING

The star level of the room air conditioners shall be determined by Energy Efficiency Ratio which, for unitary type air conditioners shall be obtained from Table 2.1 or Table 2.2, and for split type air conditioners shall be obtained from Table 2.2 or Table 2.3 for the purpose of their manufacture or import or purchase or sale, namely:-

SL. No.	Manufacturing or Import or purchase or Sale of	Table to be used
1	**Unitary type air conditioners –**	
	(i) From 01-01-2012 to 31-12-2013	2.1
	(ii) From 01-01-2014 to 31-12-2015	2.2
2	**Split type air conditioners-**	
	(i) From 01-01-2012 to 31-12-2013	2.2
	(ii) From 01-01-2014 to 31-12-2015	2.3

Table 2.2: Star level valid for unitary type air conditioners (From 01-01-2014 to 31-12-2015)

Star level valid for Split type air conditioners (From 01-01-2012 to 31-12-2013)

	Energy Efficiency Ratio (Watt/Watt)	
Star level	Minimum	Maximum
1 Star *	2.50	2.69
2 Star **	2.70	2.89
3 Star ***	2.90	3.09
4 Star ****	3.10	3.29
5 Star *****	3.30	

Table 2.3: Star level valid Split type air conditioners From 01-01-2014 to 31-12-2015

	Energy Efficiency Ratio (Watt/Watt)	
Star level	Minimum	Maximum
1 Star *	2.70	2.89
2 Star **	2.90	3.09
3 Star ***	3.10	3.29
4 Star ****	3.30	3.49
5 Star *****	3.50	

Option 3: Singapore AC Star Rating Criteria

Star Rating Criteria of Single-split Type

	Non-inverter	Inverter
1 tick	Capacity: less than 10 kW 3.34 ≤ COP100% < 3.78	Capacity: less than 10 kW Weighted COP ≥ 3.34 and COP100% ≥ 3.06
	Capacity: 10 kW or more 2.78 ≤ COP100% < 3.78	Capacity: 10 kW or more Weighted COP ≥ 2.78
2 tick	3.78 ≤ COP100% < 4.29	Weighted COP ≥ 3.78 and COP100% ≥ 3.34
3 tick	4.29 ≤ COP100% < 4.86	Weighted COP ≥ 4.29 and COP100% ≥ 3.78
4 tick	4.29 ≤ COP100% < 4.86	Weighted COP ≥ 4.86 and COP100% ≥ 4.29
5 tick	COP100% ≥ 5.50 and Standby power ≤ 4	Weighted COP ≥ 5.50 , COP100% ≥ 4.86 and Standby power ≤ 4
Notes	1. COP100% is defined as the ratio of total cooling capacity to effective power input at full load cooling capacity 2. For split (inverter) type air-conditioners, the model shall meet both the minimum COP100% and weighted COP 3. Weighted COP = 0.4 x COP100% + 0.6 x COP50% 4. Standby power is expressed in Watts	

http://app2.nea.gov.sg/energy-waste/energy-efficiency/household-sector/tick-rating

Option 4: Vietnamese AC Star Rating Criteria

5 Energy efficiency grades

Energy efficiency of air conditioners is divided into 5 grades. Corresponding to energy efficiency grades from 1 to 5, energy efficiency by EER and energy efficiency by CSPF of the appliances shall not be lower than values specified in Table 3 and Table 4, respectively. Grade 1 is the minimum, grade 5 is the best.

Table 3 – Energy efficiency grades by EER

Type of appliance	Rated capacity (ϕ) W (BTU/h)	Grades				
		1	2	3	4	5
Single	–	2,30	2,50	2,70	2,90	3,10
Split	ϕ < 4 500 ϕ < 15 000	2,60	2,80	3,00	3,20	3,40
	4 500 ≤ ϕ < 7 000 (15 000 ≤ ϕ < 24 000)	2,50	2,70	2,90	3,10	3,30
	7 000 ≤ ϕ < 14 000 (24 000 ≤ ϕ < 48 000)	2,40	2,60	2,80	3,00	3,20

Table 4 – Energy efficiency grades by CSPF

Type of appliance	Rated capacity (ϕ) W (BTU/h)	Grades				
		1	2	3	4	5
Single	–	2,60	2,80	3,00	3,20	3,40
Split	ϕ < 4 500 ϕ < 15 000	3,00	3,20	3,40	3,60	3,80
	4 500 ≤ ϕ < 7 000 (15 000 ≤ ϕ < 24 000)	2,80	3,00	3,20	3,40	3,60
	7 000 ≤ ϕ < 14 000 (24 000 ≤ ϕ < 48 000)	2,60	2,80	3,00	3,20	3,40

Reference 2-5

FRAMEWORK
OF
ENERGY EFFICIENCY LABELING PROGRAM

PART 5: TECHNICAL PROVISION FOR
TV (Television)
(DRAFT)

March, 2015

Prepared by;

EE Labeling Program Committee

EE&C Master Plan Project in Bangladesh

The star rating criteria (draft) is derived from Singapore regulation. (See Attachment 1)

1. Type and Scope of Products

Type and scope of products are described in the following table.

Type	Definition
LCD-LED	Television refers to a television which uses LED-backlight to illuminate a LCD screen to produce images.
LCD-CCFL	Television refers to a television which uses CCFL-backlight to illuminate a LCD screen to produce images.
OLED	Television refers to a television which uses organic materials to illuminate pixels across the screen to produce images.
Plasma	Plasma television refers to a television which uses thousands of tiny colored fluorescent lights to illuminate pixels across the screen to produce images.
CRT	CRT television refers to a television which uses a CRT to produce images.
Notes	LCD: Liquid Crystal Display, LED: Light Emitting Diode, CCFL: Cold Cathode Fluorescent Lamp, OLED: Organic Light Emitting Diode, CRT: Cathode Ray Tube.

2. Classification

Measurement method and star rating criteria should be decided by the type of TV.

Labeling Category on TV

	Measurement method	Star rating criteria
Type	To be discussed	To be discussed

3. Energy Efficiency Indicator

Energy efficiency indicator shall be “Annual electricity consumption per screen area” united by kW/cm2.

E = EC (kWh) / SA (cm2)

E: Energy efficiency (kWh/year)

EC: Annual electricity consumption (kWh/year)

SA: Screen area (cm2)

4. Energy Efficiency Measurement Method

Measurement method for the energy efficiency indicator shall be as shown in the following table.

No.	Category (type)	Designated measurement method
1	Common	IEC 62087: 2008 or IEC 62087: 2011 Section 11.6: On (average) mode testing using dynamic broadcast-content video signal

5. Criteria of Energy Efficiency Rating

Star rating criteria will be given in the following table.

Energy Efficiency Rating (Star Rating)

1 Star	$P > 0.60 \times (20 + 4.3224 \times \text{screen area})$
2 Star	$0.60 \times (20 + 4.3224 \times \text{screen area}) \geq P > 0.42 \times (20 + 4.3224 \times \text{screen area})$
3 Star	$0.42 \times (20 + 4.3224 \times \text{screen area}) \geq P > 0.30 \times (20 + 4.3224 \times \text{screen area})$
4 Star	$0.30 \times (20 + 4.3224 \times \text{screen area}) \geq P > 0.16 \times (20 + 4.3224 \times \text{screen area})$
5 Star	$P \leq 0.16 \times (20 + 4.3224 \times \text{screen area})$
Notes	■ On-Mode Power Consumption or P means the power consumed by the television when it produces sound and picture ■ Screen area is expressed in square decimeter

6. Data Verification

6.1 Test and Laboratory

Energy efficiency data for the certification of energy efficiency labels must be obtained by an accredited/equivalent laboratory. Accreditation of the governmental laboratories, third party laboratories and manufacturer's in-house laboratories should be given by BAB (Bangladesh Accreditation Board). Qualification of the accredited/equivalent laboratory should be as shown in the following table.

Qualification of Laboratories in Bangladesh

Laboratory	Test competence	Certificate
Governmental	IEC 62087: 2008 or IEC 62087: 2011)	ISO 17025 issued by BAB
3rd party	IEC 62087: 2008 or IEC 62087: 2011)	ISO 17025 issued by BAB
Manufacturer's in-house	IEC 62087: 2008 or IEC 62087: 2011)	ISO 17025 issued by BAB

3rd party laboratories and manufacturer's in-house laboratories located in other countries should have the following competence and certification

Qualification of Laboratories in Other Countries

Laboratory	Test competence	Certificate
3rd party	IEC 62087 (2008 or 2011)or equivalent local standards	ISO 17025 issued by the authorities in the following countries (see note)
Manufacturer's in-house	IEC 62087 (2008 or 2011)or equivalent local standards	ISO 17025 issued by the authorities in the following countries (see note)
Note; Japan, Korea, China, Thailand, Malaysia, India, US		

6.2 Manufacturer's In-house Laboratory

In case that the manufacturer's in-house laboratories have not yet obtained accreditation for the "Accredited laboratory" by BAB (Bangladesh Accreditation Board), tests at the manufacturer's in-house laboratories witnessed by the staff of the accredited laboratories can substitute the "Accreditation by BAB".

6.3 Validity Period of Data

Test results data are valid for products sold in Bangladesh market, excluding sales of the second-handed.

6.4 Tolerance of EE Data

Energy efficiency data reported by the manufacturer at the time of applying for energy efficiency labels, or data displayed on products, packaging, and catalogs need to receive tolerance from the tested data resulted from accredited testing laboratory or the data with a testimony, performed at manufacturer's in-house laboratory, as tolerance value below:

Tolerance Data of Energy Efficiency Test

Item	Test data	
	Label certification	Sample test in the market, challenge test
Power consumption	95%-105% x Declared data	95%-105% x Declared data

6.5 Test Reports

The entire test results must be stored and documented as Assessment Report, which contains the results of measurement data, performance characteristics and other details including necessary retest reports. Copies of reports should be stored in a testing laboratory as a reference. Test report format enclosed in Attachment 1.

7. Label Affixing Rules

7.1 Label Design

Unified label design must be used.

Bangladesh EE Label

7.2 Location

Labels must be placed on the front surface of the products, which can be also displayed on the packaging, catalogs, web site pages, and other media without any size restriction.

8. Product Information

Besides EE labeling mentioned above, product information as listed below should be stated on the products, product packages, operation/maintenance document, catalogues, webpages, etc.

- Manufacturer's name / brand
- Model / type
- Power
- Annual power consumption and measurement method

9. Reference

As a reference, test report form of Singapore and a questionnaire sheet for further discussion about EE measurement and star rating of TV is attached hereinafter.

http://app2.nea.gov.sg/energy-waste/energy-efficiency/household-sector/test-report#standards

Attachment 1: TEST REPORT TEMPLATE FOR TELEVISION MODELS

[COVER PAGE TO BE PRINTED ON TESTING LABORATORY'S COMPANY LETTERHEAD]

Test Report for Television [Model Number]
[Test report reference number]

Section 1: Testing Laboratory

a) Date of test (dd/mm/yy)	
b) Name of testing laboratory	
c) Location of testing laboratory	
d) Name and designation of testing officer	
e) Name and designation of approving officer	

Section 2: Product Specification (Nameplate/Catalogue)

a) Brand	
b) Phase	
c) Model no.	
d) Type of television (E.g CRT, LCD-CCFL, LCD-Edge LED, LCD-Full LED Backlight, Plasma, OLED, etc)	
e) Display Resolution (E.g 1920 x 1080 Full HD, 1366 x768 HD Ready, SD)	
f) No. of Tuner	
g) Voltage (V)	
h) Frequency (Hz)	
i) Current (A)	
j) Rated screen aspect ratio	
k) Rated screen size in diagonal (inches)	
l) Rated screen length (mm)	
m) Rated screen width (mm)	
n) Rated screen area (L x W) (mm^2)	
o) Overall dimensions with stand (h x w x d) mm x mm x mm	
p) Overall dimensions without stand (h x w x d) mm x mm x mm	
q) Weight (kg) with stand	
r) Weight (kg) without stand	
s) Rated power input On-mode as stated on the nameplate (W)	
t) Test standard adopted for rated power input (E.g. IEC 62087, IEC 60065)	
u) Rated standby power (W)	
v) Year of Manufacture	
w) Country of origin	

Section 3: Energy consumption test (On mode)

a) Test standard	
b) Video signal	
c) Terminal[1]	
d) Source	

	Measured value
e) Voltage (V)	
f) Frequency (Hz)	
g) Current (A)	
h) Ambient temperature (ºC)	
i) Screen length (mm)	
j) Screen width (mm)	
k) Screen area (L x W) (mm)	
l) Standard mode (E.g Normal, Dynamic, THX, Game, Cinema)	
n) Luminance – Standard mode (cd/m2)	
o) Brightest picture mode (E.g Normal, Dynamic, THX, Game, Cinema)	
p) Luminance (cd/m2)	
q) Luminance ratio of standard mode to brightest mode	
r) Peak luminance measuring method during Standard and Brightest mode (Full 100% white, 3 vertical bar)	
s) Power saving function (E.g on, off)	
t) Video aspect ratio (E.g 16:9, 4:3)	
u) Display Resolution (E.g 1920 x 1080 Full HD, 1366 x768 HD Ready)	
v) Sound level (mW)	
w) Duration of testing (for stabilization)	
x) Duration of testing (for dynamic broadcast-content video signal)	
y) Energy Consumption On-mode at Standard mode (W)	

Section 4: Energy consumption test (Standby mode)

a) Test standard	

	Measured value
b) Voltage (V)	
c) Frequency (Hz)	
d) Current (A)	
e) Ambient temperature (ºC)	
f) Passive Standby Power (W)	
g) Procedure for Passive Standby Power testing (E.g. 5.3.1 or 5.3.2 of IEC 62301:2005 and 5.3.2 or 5.3.3 or 5.3.4 of IEC 62301:2011)	
h) Active Standby Power - High (W) (Put N/A if there is no such function)	
i) Active Standby Power - Low (W) (Put N/A if there is no such function)	
j) Procedure for Active Standby Power testing (E.g. 5.3.1 or 5.3.2 of IEC 62301:2005 and 5.3.2 or 5.3.3 or 5.3.4 of IEC 62301:2011)	

1 HDMI cable must be used. In the event that there is no HDMI terminal on the TV, other suitable terminals can be used.

Section 5: Signatures

- Name and signature of testing and approving officers
- Date

Appendix A – Photos

- Color photos showing the exterior (E.g Front, Back, Left side and Right side) of the registered model in the available finishing and colors
- Color photos showing the connector panel
- Color photo of the nameplate
- Color photos of the Picture Setting for Standard and Brightest mode (E.g Picture mode, Brightness, Sharpness, etc)
- Color photos of the video aspect ratio during the dynamic broadcast-content testing
- Color photos of the Equipment used (E.g Player, Cables)
- Color photos of the how testing equipment connected to the tested television sample

Appendix B – Schematic Drawing

- Schematic drawing clearly indicating the model's key internal components

Appendix C – Component List

- Technical specification and description of the model's key internal components

Attachment 2: Questionnaire on TV Star Rating Criteria

If you are a dealer of several manufacturers (brands), please make the answer sheet by manufacturer (brand).

Respondent information □■

Name of company, Brand	
	□ Manufacturer □ Dealer □ Importer
Office address	

Question/Answer

1. Do you have experience of EE labeling (star rating) program? □■

Experience	□ Yes, we have □ No, we don't have
Which country?	□ India □ Singapore □ Thailand □ Malaysia □ China □ Other ( )
How long?	year

2. Do you have EE measurement laboratory? □■

Laboratory	□ Yes, we have □ No, we don't have Where? ( )
Test equipment	□ Psychrometric calorimeter (Air-enthalpy measurement chamber) □ Balanced room type chamber □ Other ( )
Accreditation	□ ISO17025 □ Other ( ) □ No Accredited by ( )
Measurement standard	□ IEC 62087 □ Other ( )

3. Bangladesh TV star rating criteria (Framework Draft) are attached. Please give your opinion on them, in case that they are applied on your products sold in Bangladesh □■

	Is the draft criteria suitable in Bangladesh? □ Yes, suitable □ No, not suitable
	How is the rating? □ Too low □ A bit low □ Good □ A bit high □ Too high
	What will be the star rating on your products? (multiple response OK) □ Below 1 star □ 1 star □ 2 star □ 3 star □ 4 star □ 5 star

4. If you have any opinion, please give us. (If you know other suitable criteria (standard), please inform us)

Reference 2-6

FRAMEWORK
OF
ENERGY EFFICIENCY LABELING PROGRAM

PART 6: TECHNICAL PROVISION FOR
ELECTRIC FAN
(DRAFT)

March, 2015

Prepared by;

EE Labeling Program Committee

EE&C Master Plan Project in Bangladesh

1. Type and Scope of Products

Electric fan with EE label should be propeller type electric circulating fan, including desk fan, box fan, wall fan, slide fan, floor fan and ceiling fan, which satisfy the requirement of performance stipulated in BDS (Bangladesh Standard) as listed below:

- BDS-818: 1998 or its revision
- BDS-843: 1977 or its revision
- BDS-844: 1977 or its revision

2. Classification

Classification will be provided, if necessary.

3. Energy Efficiency Indicator

Indicator of energy efficiency is the "Energy Efficiency Value (m3/min. W)", which is defined in BDS-1860: 2012.

4. Energy Efficiency Measurement Method

The measurement and calculation methods of the energy efficiency value and all the other necessary measurement items should be in accordance with BDS-1860: 2012 and BDS-818: 1998.

5. Criteria of Energy Efficiency Rating

The star rating criteria should be in accordance with BDS-1860: 2012.

6. Data Verification

6.1 Test and Laboratory

Energy efficiency data for the certification of energy efficiency labels must be obtained by an accredited/equivalent laboratory. Accreditation of the governmental laboratories, third party laboratories and manufacturer's in-house laboratories should be given by BAB (Bangladesh Accreditation Board). Qualification of the accredited/equivalent laboratory should be as shown in the following table.

Qualification of Laboratories in Bangladesh

Laboratory	Test competence	Certificate
Governmental	BDS-1860: 2012	ISO 17025 issued by BAB
3rd party	BDS-1860: 2012	ISO 17025 issued by BAB
Manufacturer's in-house	BDS-1860: 2012	ISO 17025 issued by BAB

3rd party laboratories and manufacturer's in-house laboratories located in other countries should have the following competence and certification

Qualification of Laboratories Located in Other Countries

Laboratory	Test competence	Certificate
3rd party	BDS-1860: 2012 or equivalent local standards	ISO 17025 issued by the authorities in the following countries (see note)
Manufacturer's in-house	BDS-1860: 2012 or equivalent local standards	ISO 17025 issued by the authorities in the following countries (see note)
Note; Japan, Korea, China, Thailand, Malaysia, India, US, EU countries		

6.2 Manufacturer's In-house Laboratory

In case that the manufacturer's in-house laboratories have not yet obtained accreditation for the "Accredited laboratory" by BAB (Bangladesh Accreditation Board), tests at the manufacturer's in-house laboratories witnessed by the staff of the accredited laboratories can substitute the "Accreditation by BAB".

6.3 Validity Period of Data

Test results data are valid for products sold in Bangladesh market, excluding sales of the second-handed.

6.4 Tolerance of EE Data

Energy efficiency data reported by the manufacturer at the time of applying for energy efficiency labels, or data displayed on products, packaging, and catalogs need to receive tolerance from the tested data resulted from accredited testing laboratory or the data with a testimony, performed at manufacturer's in-house laboratory, as tolerance value below:

Tolerance Data of Energy Efficiency Test

Item	Test data	
	Label certification	Sample test in the market, challenge test
Efficacy, power factor	95%-105% x Declared data	95%-105% x Declared data

6.5 Test Reports

The entire test results must be stored and documented as Assessment Report, which contains the results of measurement data, performance characteristics and other details including necessary retest reports. Copies of reports should be stored in a test laboratory as a reference.

7. Label Affixing Rules

7.1 Label Design

Unified Label design must be used.

Source: BSTI

Bangladesh EE Label

7.2 Location

Labels must be displayed on the package of the product. The label can be also displayed in catalogs, web site pages, and other media without any size restriction.

8. Product Information

Besides EE labeling mentioned above, product information as listed below should be stated on the product packages, operation/maintenance document, catalogues, webpages, etc.

- Manufacturer's name / brand
- Model / type
- Power
- Efficacy
- Power factor

Reference 2-7

FRAMEWORK
OF
ENERGY EFFICIENCY LABELING PROGRAM

PART 7: TECHNICAL PROVISION FOR ELECTRONIC BALLAST (DRAFT)

March, 2015

Prepared by;

EE Labeling Program Committee

EE&C Master Plan Project in Bangladesh

1. Type and Scope of Products

Electronic ballasts should be the electronic ballasts for tubular fluorescent lamps, which satisfy the requirement of performance stipulated in BDS (Bangladesh Standard) as listed below:

- BDS IEC 60921: 2005
- BDS IEC 60929: 2005

2. Classification

Classification will be provided if necessary.

3. Energy Efficiency Indicator

Indicator of energy efficiency of the electronic ballasts is the "Ballast lumen factor", which is defined in BDS in the future.

The ballast lumen factor is given as

$$\text{Ballast lumen factor} = \frac{\text{Optical output of the sample ballast}}{\text{Optical output of the reference ballast}}$$

4. Energy Efficiency Measurement Method

The measurement and calculation methods of the electronic ballast lumen factor, optical output and all the other necessary measurement items should be in accordance with relevant BDS IEC.

5. Criteria of Energy Efficiency Rating

The star rating criteria will be given in the following table.

Star Rating Criteria

Ballast lumen factor	Star rating
xxxx < BLF	5
xxxx ≤ BLF < xxxxx	4
xxxx ≤ BLF < xxxxx	3
xxxx ≤ BLF < xxxxx	2
BLF < xxxxx	1

6. Data Verification

6.1 Test and Laboratory

Energy efficiency data for the certification of energy efficiency labels must be obtained by an accredited/equivalent laboratory. Accreditation of the governmental laboratories, third party laboratories and manufacturer's in-house laboratories should be given by BAB (Bangladesh Accreditation Board). Qualification of the accredited/equivalent laboratory should be as shown in the following table.

Qualification of Laboratories in Bangladesh

Laboratory	Test competence	Certificate
Governmental	BDS IEC-xxxxx	ISO 17025 issued by BAB
3rd party	BDS IEC-xxxxx	ISO 17025 issued by BAB
Manufacturer's in-house	BDS IEC-xxxxx	ISO 17025 issued by BAB

3rd party laboratories and manufacturer's in-house laboratories located in other countries should have the following competence and certification

Qualification of Laboratories Located in Other Countries

Laboratory	Test competence	Certificate
3rd party	BDS IEC-xxxxx or equivalent local standards	ISO 17025 issued by the authorities in the following countries (see note)
Manufacturer's in-house	BDS IEC-xxxxx or equivalent local standards	ISO 17025 issued by the authorities in the following countries (see note)
Note; Japan, Korea, China, Thailand, Malaysia, India, US, EU countries		

6.2 Manufacturer's In-house Laboratory

In case that the manufacturer's in-house laboratories have not yet obtained accreditation for the "Accredited laboratory" by BAB (Bangladesh Accreditation Board), tests at the manufacturer's in-house laboratories witnessed by the staff of the accredited laboratories can substitute the "Accreditation by BAB".

6.3 Validity Period of Data

Test results data are valid for products sold in Bangladesh market, excluding sales of the second-handed.

6.4 Tolerance of EE Data

Energy efficiency data reported by the manufacturer at the time of applying for energy efficiency labels, or data displayed on products, packaging, and catalogs need to receive tolerance from the tested data resulted from accredited testing laboratory or the data with a testimony, performed at manufacturer's in-house laboratory, as tolerance value below:

Tolerance Data of Energy Efficiency Test

Item	Test data	
	Label certification	Sample test in the market, challenge test
Efficacy, power factor	95%-105% x Declared data	95%-105% x Declared data

6.5 Test Reports

The entire test results must be stored and documented as Assessment Report, which contains the results of measurement data, performance characteristics and other details including necessary retest reports. Copies of reports should be stored in a test laboratory as a reference.

7. Label Affixing Rules

7.1 Label Design

Unified label design must be used.

Source: BSTI

Bangladesh EE Label

7.2 Location

Labels must be displayed on the package of the product. The label can be also displayed in catalogs, web site pages, and the other media without any size restriction.

8. Product Information

Besides EE labeling mentioned above, product information as listed below should be stated on the product packages, operation/maintenance document, catalogues, webpages, etc.

- Manufacturer's name / brand
- Model / type
- Power
- Efficacy
- Power factor

Reference 2-8

FRAMEWORK
OF
ENERGY EFFICIENCY LABELING PROGRAM

PART 8: TECHNICAL PROVISION FOR MOTOR
(DRAFT)

March, 2015

Prepared by;

EE Labeling Program Committee

EE&C Master Plan Project in Bangladesh

1. Type and Scope of Products

Motors with EE label should be the single-speed, three-phase, cage-induction motors, which satisfy with the requirement of performance stipulated in BDS (Bangladesh Standards) as listed below:

- BDS IEC 60034-2: 2009
- BDS EN 60034-30: 2011

2. Classification

Classification is in accordance with 5.3.2 “Efficiency classification” BS EN 60034-30:2009

3. Energy Efficiency Indicator

Indicator of energy efficiency of the motor is the “efficiency”, which is defined in BS EN 60034-30:2009.

4. Energy Efficiency Measurement Method

The measurement and calculation methods of the efficiency should be in accordance with BS EN 60034-30:2009.

5. Criteria of Energy Efficiency Rating

The star rating criteria should be as followings:

Star Rating Criteria

Characteristic numeral	Brief description	Definition	Star rating
-	-	-	1
1	Standard	Motor with a rated efficiency at full-load (rated output) equal to or exceeding the limits listed in 5.4.2	2
2	High	Motor with a rated efficiency at full-load (rated output) equal to or exceeding the limits listed in 5.4.3	3
3	Premium	Motor with a rated efficiency at full-load (rated output) equal to or exceeding the limits listed in 5.4.4	4
4	Super-Premium	Under consideration	5

Table 1-IE-Efficiency classification (5.3.2 “Efficiency classification” BS EN 60034-30:2009)

6. Data Verification

6.1 Test and Laboratory

Energy efficiency data for the certification of energy efficiency labels must be obtained by an accredited/equivalent laboratory. Accreditation of the governmental laboratories, third party laboratories and manufacturer’s in-house laboratories should be given by BAB (Bangladesh Accreditation Board). Qualification of the accredited/equivalent laboratory should be as shown in the following table.

Qualification of Laboratories in Bangladesh

Laboratory	Test competence	Certificate
Governmental	BS EN 60034-30:2009	ISO 17025 issued by BAB
3rd party	BS EN 60034-30:2009	ISO 17025 issued by BAB
Manufacturer's in-house	BS EN 60034-30:2009	ISO 17025 issued by BAB

3rd party laboratories and manufacturer's in-house laboratories located in the other countries should have the following competence and certification

Qualification of Laboratories Located in Other Countries

Laboratory	Test competence	Certificate
3rd party	BS EN 60034-30:2009	ISO 17025 issued by the authorities in the following countries (see note)
Manufacturer's in-house	BS EN 60034-30:2009	ISO 17025 issued by the authorities in the following countries (see note)
Note; Japan, Korea, China, Thailand, Malaysia, India, US, EU countries		

6.2 Manufacturer's In-house Laboratory

In case that the manufacturer's in-house laboratories have not yet obtained accreditation for the "Accredited laboratory" by BAB (Bangladesh Accreditation Board), tests at the manufacturer's in-house laboratories witnessed by the staff of the accredited laboratories can substitute the "Accreditation by BAB".

6.3 Validity Period of Data

Test results data are valid for products sold in Bangladesh market, excluding sales of the second-handed.

6.4 Tolerance of EE Data

Energy efficiency data reported by the manufacturer at the time of applying for energy efficiency labels, or data displayed on products, packaging, and catalogs need to receive tolerance from the tested data resulted from accredited testing laboratory or the data with a testimony, performed at manufacturer's in-house laboratory, as tolerance value below:

Tolerance Data of Energy Efficiency Test

Item	Test data	
	Label certification	Sample test in the market, challenge test
Efficacy, power factor	95%-105% x Declared data	95%-105% x Declared data

6.5 Test Reports

The entire test results must be stored and documented as Assessment Report, which contains the results of measurement data, performance characteristics and the other details including necessary retest reports. Copies of reports should be stored in a test laboratory as a reference.

7. Label Affixing Rules

7.1 Label Design

Unified label design must be used.

Source: BSTI

Bangladesh EE Label

7.2 Location

Labels must be displayed on the package of the product. The label can be also displayed in catalogs, web site pages, and other media without any size restriction.

8. Product Information

Besides EE labeling mentioned above, product information as listed below should be stated on the product packages, operation/maintenance document, catalogues, webpages, etc.

- Manufacturer's name / brand
- Model / type
- Power
- Classification
- Efficiency
- Power factor

Reference 3

References for EE Building Program

Reference 3-1

Form

Notification (Draft)

To _____

Reporting Date: (day/month/year)

Name of Reporter (Owner or Administrator):

(Signature)

(Part 1: General)

1. Building	a) Name: b) Address: c) Use: d) Structure: e) Floor number: Aboveground ( ) Underground ( ) f) Total floor areas: Notified (m^2) Other (m^2) Total (m^2)
2. Owner	a) Name: b) Address: c) Tel: d) Fax: e) E-mail:
3. Designer	a) Name: b) Address: c) Tel: d) Fax: e) E-mail:
4. Contact Person	a) Name: b) Address: c) Tel: Cell No.: d) Fax: e) E-mail:

5. Expected data of construction start: (day/month/year)
6. Expected data of construction completion: (day/month/year)
7. Remark (The matters, which are not described in the above Section 1 to 6, are described in this Section 7.)

(Part 2: Energy Efficiency and Conservation (EE&C) Measures)

1. Construction Type	□ New construction □ Expansion □ Renovation □ Renovation or remodeling of building envelop □ Installation of air-conditioning and so on □ Renovation of air-conditioning and so on
2. Notified EE&C	□ Building envelop □ HVAC (Heating, Ventilation, and Air-conditioning) □ Hot water supply □ Lighting □ Elevator and escalator □ Others (Renewable energy option, water management)
3. Measures for Notified EE&C	
Building Envelop	
HVAC	
Hot Water Supply	
Lighting	
Elevator and Escalator	
Others	
4. Remark (The matters, which are not described in the above Section 1 to 3, are described in this Section 4.)	

Remark: Drawings and calculation sheets for EE&C measures are attached as separated sheets.

Reference 3-2

Form

Periodical Report (Draft)

To _____

Reporting Date: (day/month/year)

Name of Reporter (Owner or Administrator):

(Signature)

(Part 1: General)

Item	Description
1. Building	a) Name: b) Address: c) Use: d) Structure: e) Floor number: Aboveground ( ) Underground ( ) f) Total floor areas: Notified (m^2) Other (m^2) Total (m^2)
2. Owner	a) Name: b) Address: c) Tel: d) Fax: e) E-mail:
3. Administrator (Operation & Maintenance)	a) Name: b) Address: c) Tel: d) Fax: e) E-mail:
4. Surveyors	a) Name: b) Address: c) Tel: d) Fax: e) E-mail: f) Servey items:

Item	Description
	a) Name: b) Address: c) Tel: d) Fax: e) E-mail: f) Servey items:
5. Contact Person	a) Name: b) Address: c) Tel: Cell No.: d) Fax: e) E-mail:
6. Remark (The matters, which are not described in the above Section 1 to 5, are described in this Section 6.)	

(Part 2: Condition of Maintenance and Conservation)

1. Change on Energy Efficiency and Conservation (EE&C) Measures

Notified EE&C	yes / no	Outline of Changed EE&C Measures
Building Envelop	□ / □	
HVAC (Heating, Ventilation, and Air-conditioning)	□ / □	
Hot Water Supply	□ / □	
Lighting	□ / □	
Elevator and Escalator	□ / □	
Others (Renewable Energy Option, Water Management)	□ / □	

2. Condition of EE&C Performance (Check all boxes that apply. And, in case of "No" for the confirmation point of the applied item, unadapted conditions are described in separate sheets and are attached to this report.)

Notified EE&C	Item	Confirmation Point	Yes/No
Building Envelop	□ Layout of rooms	No change of room layout for increasing heat loss	□ / □
	□ Maintenance of building envelop.	No damage of outside walls, windows, etc. by visual checking	□ / □
	□ Cleaning of windows	No damage of sealing materials of doors and windows and Cleaning of glass	□ / □
	□ Maintenance of shading devices	No damage of shading devices	□ / □
		Normal operation of blinds and curtains	□ / □
HVAC	□ Heat source equipment control	Normal operation of unit number control of heat source equipment	□ / □
	□ Operation of heat source equipment with heat storage	Normal operation of heat source equipment with heat storage	□ / □
	□ Variable flow control of cool and heat water	Normal operation of variable floor control of cool and hot water	□ / □
	□ Variable air volume control of air-conditioning equipment	Normal operation of variable air volume control of air-conditioning equipment	□ / □
	□ Shutoff control of flesh air at preheating and precooling time	Normal operation of shutoff control of flesh air preheating and precooling time (Proper Operation of motor dumper)	□ / □
	□ Minimum flesh air control	Normal operation of minimum flesh air control	□ / □
	□ Air-conditioning equipment with heat pump system	No clogging and no grime of filters	□ / □
		No leak of refrigerant pipe	□ / □
		Proper air volume from air outlets	□ / □
		Proper temperature control	□ / □
	□ Filter of fans	No clogging and no grime of filters	□ / □
	□ Operation condition of damper	Normal operation of dumpers	□ / □
	□ Control of fans	Normal operation of ventilation start-stop (on-off) Control	□ / □
		Normal operation of air volume control	□ / □
Hot Water Supply	□ Energy efficiency of system	No blowing from safety devices (Safety valves, expansion pipes)	□ / □
	□ Operation condition of heat source equipment	Stop of heat source at no demand time of hot water supply (Except for night operation of heat water storage)	□ / □
	□ Insulation of heat source equipment	No high temperature parts, no color change, no deformation by heat, and no smoke and no unusual smell from boilers' surfaces	□ / □

Notified EE&C	Item	Confirmation Point	Yes/No
	□ Insulation of pipe line	No damage, no corrosion and no degradation (including fungal) of insulation for pipes, valves, and flanges	□ / □
		No water leak from pipes, valves, flanges, and their insulation (No degradation of water-proof for outside pipe lines)	□ / □
	□ Circulation pumps of pipe line	No water leak of circulation pumps	□ / □
		Stop of circulation pumps at downtime	□ / □
	□ Temperature setting of heat storage tank	Properly setting of regular temperature (Temperature of hot water supply is not too high.)	□ / □
	□ Insulation of heat storage tank	No leak from heat storage tank and no damage of insulation around heat storage tanks	□ / □
	□ Solar heat system	No water leak from solar energy collector or pipe lines	□ / □
Lighting	□ Conservation of lighting circumstance	Regular cleaning for lumps, lighting reflectors and covers	□ / □
	□ Operation condition of lighting control	Normal operation of control system by sensor	□ / □
		Normal operation of time schedule control	□ / □
		Normal operation of daylight control	□ / □
		Normal operation of zoning control	□ / □
		Normal operation of illuminance control	□ / □
Elevator and Escalator	□ Maintenance of elevator	No marginal mechanical attrition of hoists and no oil leak of headgears	□ / □
Others	□ Checking of equipment	No pollution and no damage of equipment	□ / □
	□ Condition of control operation	Normal operation of control	□ / □

3. Remark (The matters, which are not described in the above Section 1 and 2, are described in this Section 3.)
