

**The Master Plan Study for Energy Conservation
in the Power sector
in the Kingdom of Saudi Arabia**

**Final Report
(SUMMARY)**

February 2009

JAPAN INTERNATIONAL COOPERATION AGENCY

**Tokyo Electric Power Company, Inc. (TEPCO)
The Institute of Energy Economics, Japan (IEEJ)**

IDD
JR
08-086

【 Table of Contents 】

Chapter 1 Introduction

1.1	Background	1
1.2	Objective	1
1.3	Study Area and Scope.....	1
1.4	Counterpart.....	1
1.5	Overall Schedule	2
1.6	Overall Workflow.....	3

Chapter 2 Basic Energy Conservation Principle

2.1	Concept of Basic Energy Conservation Principle	
2.1.1	Structure of Basic Principle	4
2.1.2	Workflow	5
2.2	Objective and National Target	
2.2.1	Consideration Points.....	6
2.2.2	Proposal of Objective	10
2.2.3	Proposal of National Target	11
2.3	Government Action Policy and Sector-wise Action Strategy	
2.3.1	Consideration Points.....	14
2.3.2	Proposal of Government Action Policy	15
2.3.3	Proposal of Sector-wise Action Strategy	16
2.4	Sector-wise Guideline	
2.4.1	Consideration Points.....	18
2.4.2	Proposal of Sector-wise Guideline	18
2.5	Energy Conservation Measures (EC Measures)	
2.5.1	Consideration Points.....	19
2.5.2	Selection of High Priority Measures.....	22
2.5.3	Outline of High Priority Measures	23
2.5.4	Methodology for Formulation of High Priority Measures.....	26
2.6	Summary of Basic Energy Conservation Principle	27

Chapter 3 Review of Proposed National Target

3.1	Power Demand Forecasts	
3.1.1	Purpose of Power Demand Forecasts	29
3.1.2	Case Study Setting and Preconditions	29
3.2	Power Demand Forecast Results	
3.2.1	Countrywide Power Demand Forecasts.....	31
3.2.2	Regional Power Demand	32
3.2.3	EEC Factor Change Option Sensitivity Study	32
3.3	Review of Achievement of National Target from Power Demand Forecasts	
3.3.1	Electricity GDP Intensity.....	34
3.3.2	Peak Demand.....	35

Chapter 4 High Priority Measures

4.1	Implementation Structure	
4.1.1	Executing Agency.....	36
4.1.2	Schedule of Human Resources	36
4.1.3	Budget Required	37
4.1.4	Legislation Required.....	38
4.2	Recommendation for Formation of Each High Priority Measure	
4.2.1	Formation of Preparation Team	42
4.2.2	Recommended Actions Undertaken by Preparation Team	42
4.2.3	Recommended Actions Undertaken by Existing Agencies.....	46

Chapter 5 Proposal of Saudi Energy Efficiency Center (SEEC)

5.1	SEEC Overview	
5.1.1	Objective.....	48
5.1.2	Vision and Mission	48
5.1.3	Governance.....	49
5.1.4	Organization	50
5.2	Implementation Plan of SEEC	
5.2.1	Overall Implementation Plan.....	52
5.2.2	Human Resources and Organization Plan	54
5.2.3	Budget Plan	55

Chapter 6 Economic Analysis

6.1	Purpose of Economic Analysis.....	56
6.2	Expenses and Benefits	
6.2.1	Expenses in Economic Analysis	56
6.2.2	Benefits in Economic Analysis.....	57
6.3	Results of Economic Analysis.....	57
6.4	Consideration from the Economic Analysis	58

【 Abbreviation 】

AC	Air Conditioner
ADB	Asian Development Bank
AHU	Air Handling Unit
APEC	Asia Pacific Economic Cooperation
ARAMCO	Saudi Arabian Oil Company
BAU	Business As Usual
BEMS	Building Energy Management System
BOO	Built-Operate-Own
CC	Combined Cycle
CDM	Clean Development Mechanism
CFL	Compact Florescent Lamp
CHP	Combined Heat and Power Generation
COA	Central Operating Area
COC	Chamber of Commerce
COP	Coefficiency of Performance
COP13	Conference of Parties No.13
D/D	Detailed Design
DSM	Demand Side Management
DT	Direct Teaching
EC	Energy Conservation
ECCJ	Energy Conservation Center, Japan
ECRA	Electricity and Cogeneration Regulatory Authority
EDP	Eight Development Plan
EEC	Energy Efficeincy Case
EELS	Energy Efficiency Labels and Standards
EER	Energy Efficiency Ratio
EIRR	Economic Internal Rate of Return
EMS	Energy Audit and Management System
EOA	Eastern Operating Area
ESCO	Energy Service Company
EU	Europe Union
F/S	Feasibility Study
GCC	Gulf Cooperation Council
GDE	Gross Domestic Expenditure
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GT	Gas Turbine
HQ	Headquarters

IEA	International Energy Agency
IEEJ	Institute of Energy Economics, Japan
IPCC	Intergovernmental Panel on Climate Changes
IPP	Independent Power Producer
IWPP	Independent Water and Power Producer
JICA	Japan International Cooperation Agency
JIS	Japan Industrial Standards
KACST	King Abdulaziz City for Science and Technology
KSA	Kingdom of Saudi Arabia
LPG	Liquefied Petroleum Gas
LTS	Long-Term Strategy
MEPA	Metrological Environmental Protection Administration
MEPS	Minimum Energy Performance Standard
METI	Ministry of Economy, Trade and Industry (Japan)
M&Is	Manufacturers and Importers
MOCI	Ministry of Commerce and Industry
MOE	Ministry of Education
MOEP	Ministry of Economy and Planning
MOF	Ministry of Finance
MOIA	Ministry of Islamic Affairs
MOMRA	Ministry of Municipalities and Rural Affairs
MOPMR	Ministry of Petroleum and Mineral Resources
MOT	Ministry of Transportation
MOWE	Ministry of Water and Electricity
NEEP	National Energy Efficiency Program
NGO	Non Governmental Organization
NPD	National Project Director
O&M	Operation and Maintenance
OPEC	Organization of the Petroleum Exporting Countries
PME	Presidency of Meteorology and Environment
R&D	Research and Development
RPS	Renewable Portfolio Standard
RT	US Refrigirating Ton
SABIC	Saudi Arabian Basic Industries Corporation
SASO	Saudi Arabian Standards Organization
SBC	Saudi Building Code
SCE	Saudi Council of Engineers
SEC	Saudi Electricity Company
SEEC	Saudi Energy Efficeincy Center
SME	Small and Medium Enterprises
SOA	Southern Operating Area

SR	Saudi Riyal
ST	Steam Turbine
SWCC	Saline Water Conversion Corporation
TEPCO	Tokyo Electric Power Company
TOR	Terms of Reference
TOT	Training of Trainer
TOU	Time of Use
TPES	Total Primary Energy Supply
TQM	Total Quality Management
UK	United Kingdom
UNDP	United Nations Development Program
UNFCCC	United Nations Framework Convention on Climate Change
USA	United States of America
WACC	Weighted Average Capital Cost
WB	World Bank
WOA	Western Operating Area

Chapter 1 Introduction

1.1 Background

The Kingdom of Saudi Arabia (KSA) has one power utility covering all areas in the country. The power utility, Saudi Electricity Company (SEC), was established to manage generation, transmission, and distribution in April 2000, merging the national power utilities located in each area. The Ministry of Water and Electricity (MOWE) implements power sector administration and promotes energy conservation activities, power development, R&D, and information and data standardization.

Recently, since the population and economy has increased rapidly, power consumption has increased at a rate of 7 %. The current power capacity meets the demand. However, assuming that power demand will increase at the same rate in the future, a power crisis may occur due to the imbalance of capacity and demand. MOWE is now making efforts for privatization of the power supply, international connection, and supply-side management. Further demand-side management, such as penetration of energy conservation awareness and technical and political measures are also required. Against this background, KSA requested that Japan to assist in the formation of a national master plan for energy conservation, that is “The Master Plan Study for Energy Conservation in the Power Sector in the Kingdom of Saudi Arabia” (hereinafter the Study).

1.2 Objective

The objective of the Study is to make a master plan for comprehensive energy conservation reflecting the demand forecast, including the industrial, commercial, and residential sectors by 2030, and to propose practical energy conservation measures based on energy consumption patterns in Saudi Arabia. Through the Study, a technology transfer will also be carried out.

1.3 Study Area and Scope

The study area encompasses all of KSA. The Study is implemented based on the scope of work signed by MOWE and the Japan International Cooperation Agency (JICA) study preparation team in August 2006. The Study period is from February 2007 to November 2008 (22 months).

1.4 Counterpart

The counterpart in the Study in Saudi Arabia is MOWE. Steering committee and technical committee are also organized for this study.

1.5 Overall Schedule

The overall schedule of the Study is as follows.

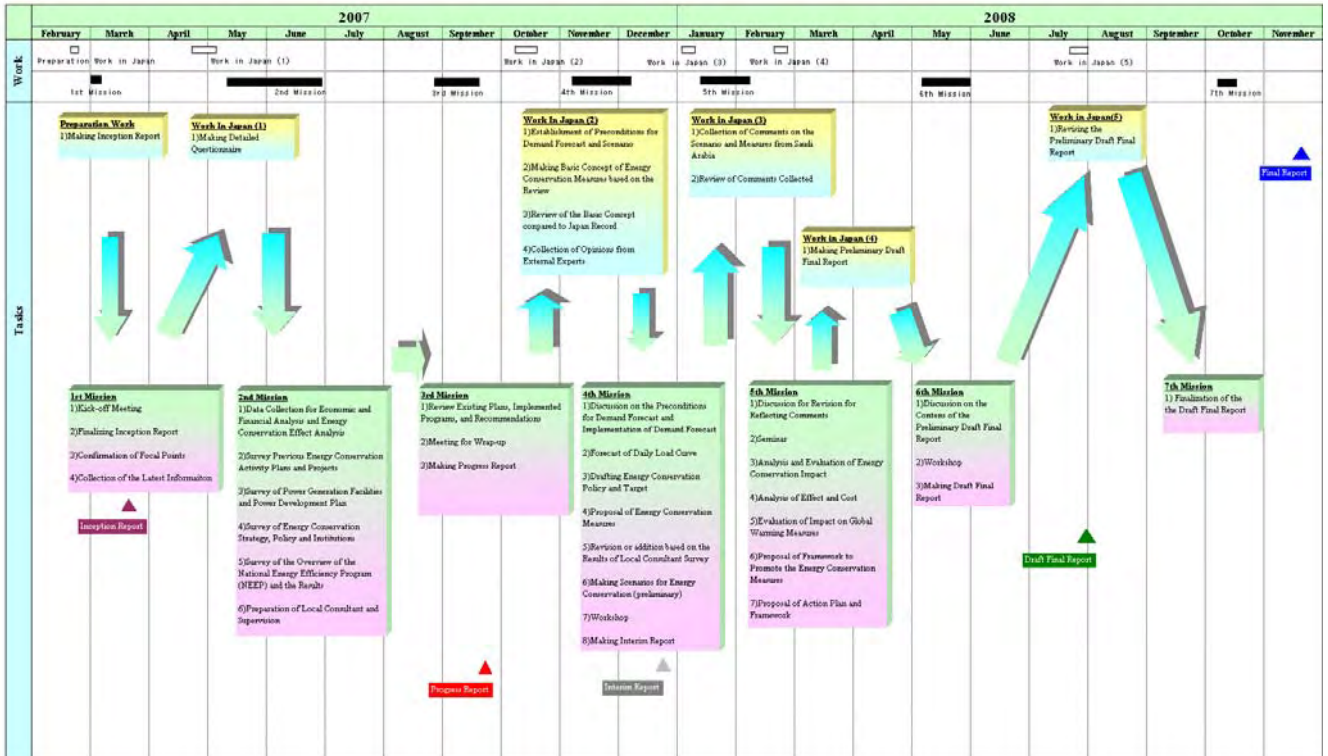


Figure 1-1 Overall Schedule

1.6 Overall Workflow

The overall workflow of the Study is as follows.

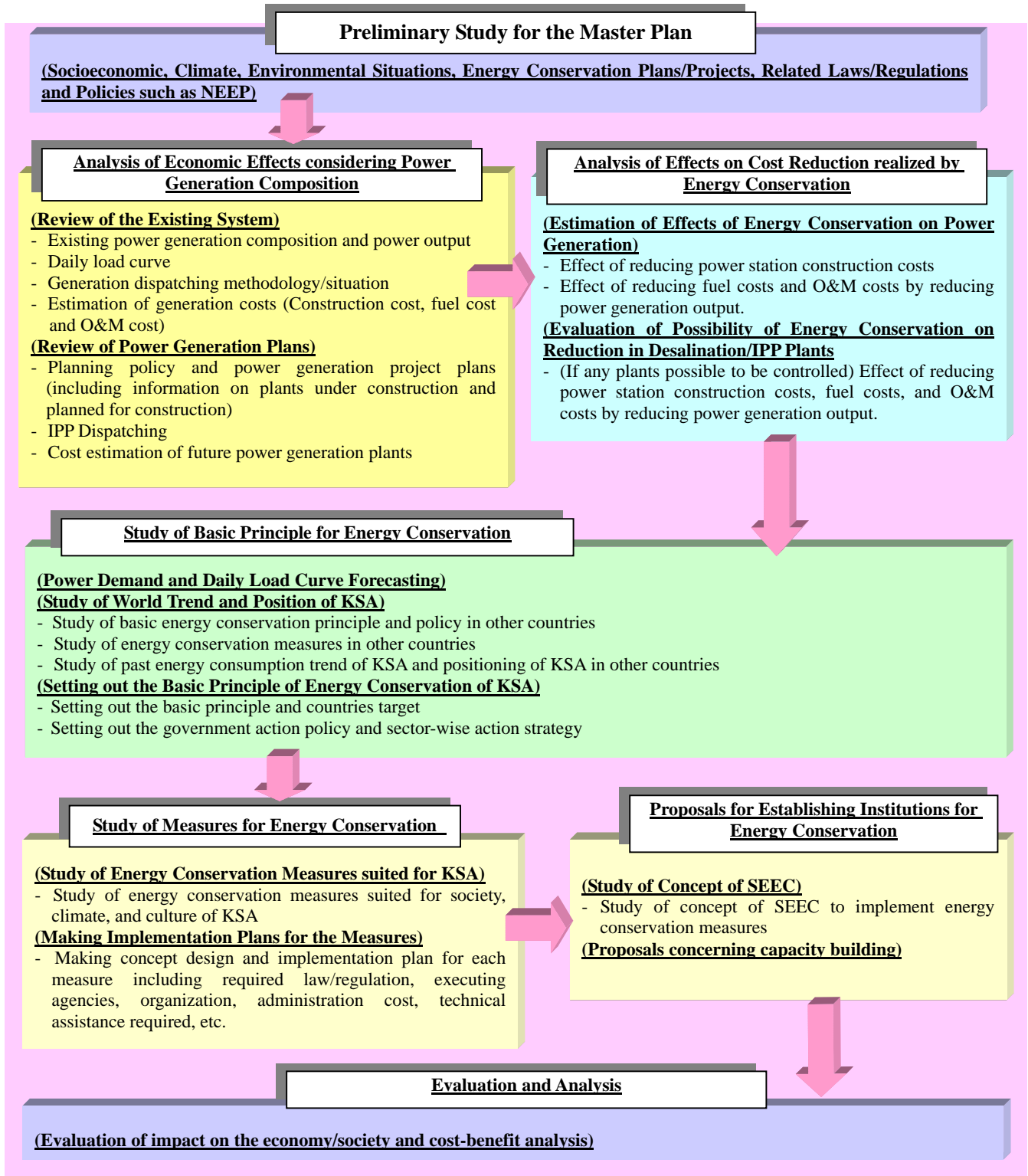


Figure 1-2 Overall Workflow

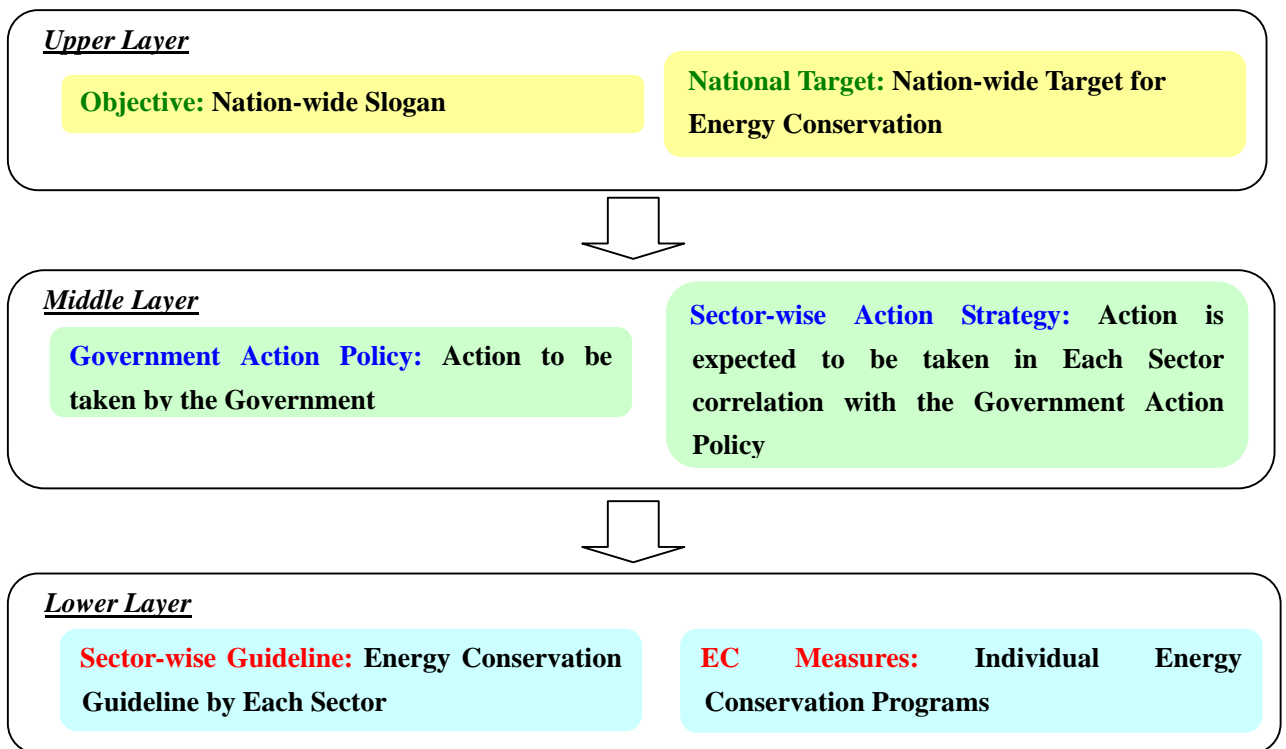
Chapter 2 Basic Energy Conservation Principle

2.1 Concept of Basic Energy Conservation Principle

2.1.1 Structure of Basic Principle

(1) Structure

The Basic Energy Conservation Principle (Basic EC Principle) is comprised of an objective and national target as the first layer, government action policy and sector-wise action strategy as the second layer, and a sector-wise guideline and energy conservation measures (EC measures) as the third layer. The expected structure is shown below.



The upper layer is viewed as a long-term policy towards 2030, and it should not be reviewed without a drastic change in policy. On the other hand, the middle layer should be reviewed once at the middle term (5 years) considering changes in the situation and the actual effect. The lower layer will be reviewed in a timely manner as the program progresses.

(2) Consideration Points regarding the Basic EC Principle

Points that should be considered regarding the Basic EC Principle are described as follows. At first, the following points should be considered for the upper layer.

- Compliance with the philosophy described in the Long Term Strategy 2025 (LTS 2025)
- The policy on energy conservation described in the Eight Development Plan (EDP),

“Continuing to encourage the conservation of energy and rationalization of electricity consumption”, is further developed.

- The national target should take world trends and past KSA trends into consideration.

The following points should be considered for the middle layer.

- Harmonization of existing energy conservation measures in the KSA.
- Tackling issues identified through discussion with relevant agencies and utilizing site survey results.
- Reflect upon lessons learned from other countries.

2.1.2 Workflow

To formulate the Basic EC Principle mentioned above, the workflow is outlined as follows.

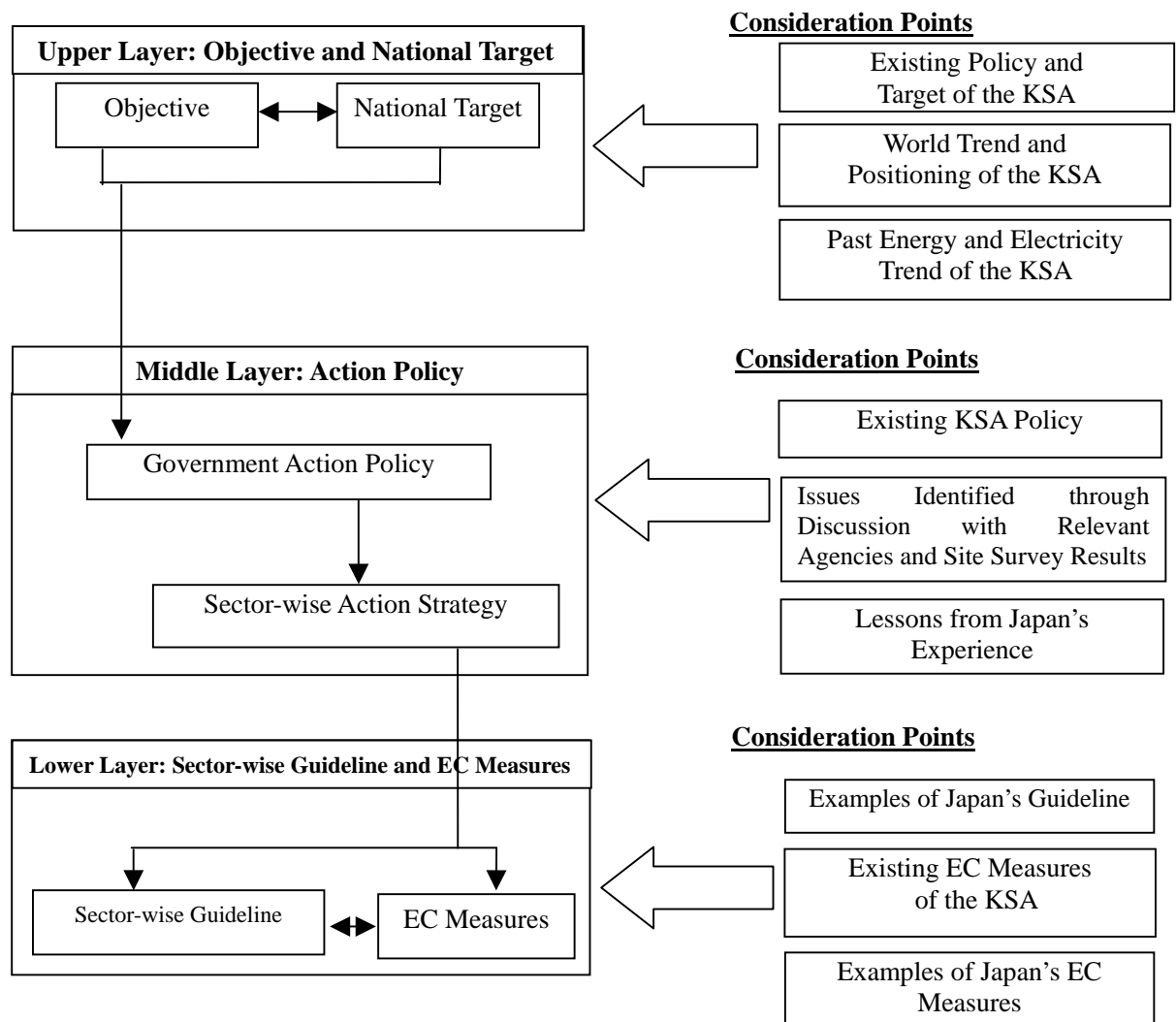


Figure 2-1 Flowchart of Formulation of EC Basic Principle

2.2 Objective and National Target

2.2.1 Consideration Points

(1) Existing Policy

There are 2 main papers that describe existing policy. The first one is the Long Term Strategy 2025 (LTS 2025) and the second one is the Eight Development Plan (EDP). Two basic policies are stipulated in the LTS 2025, “Doubling of Real per Capita GDP by 2025 (from the beginning of 2005)” and “Commensurate increase in the quality of life of Saudi Citizens”. To comply with these policies, the Basic EC Principle also considers not disturbing GDP growth or sacrificing the conveniences of life by implementing energy conservation measures that are too oppressive.

On the other hand, EDP stipulates “Continuing to encourage the conservation of energy and rationalization of electricity consumption” regarding energy conservation. However, there is no special description except the sentence above. This study aims to propose a more concrete basic principle.

A national target for the KSA has not been established yet. However, according to the study conducted by the World Bank (WB) in 2007 titled, “Draft Report on National Energy Conservation Strategy”, the following middle term target was proposed.

Ensure reliable power supply and improve efficiency in key end-use consuming sectors by scaling up a combination of energy conservation programs sufficient to reduce peak demand growth by 50 % within 5 years

(2) World Trends in Energy Conservation

The following table introduces national targets for energy conservation and the environment around the world. National targets are likely to be adopted via 2 methods, namely the “Intensity Method” which manages by intensity and the “Total Volume Method” which manages by total volume.

Table 2-1 World Trends in Energy Conservation Targets

	Indicator	Country/Region	Target Value	Base Year
Intensity Method	Energy per Real GDP (Energy GDP Intensity)	Japan	30 % reduction by 2030	2003
		China	20% reduction by 2010	-
	Energy GDP Elasticity Energy Intensity	Thailand	28 % improvement	-
		APEC (21 Countries / Areas)	At least 25 % improvement by 2030	2005
Total Volume Method	Primary Energy Consumption Gasoline Usage Greenhouse Gas Emission	EU	20 % reduction using renewable energy by 2020	2006
		USA	20% reduction by 2017	2007
		UK	20 % reduction by 2020	1990
		Germany	21 % reduction by 2012	1990

Intensity is generally obtained from a formula where the energy indicator is divided by the economic output. A special feature of the intensity method is to allow energy consumption growth by increasing economic output growth. Using the intensity method as an indicator seems to be more preferable for developing countries which wish to improve energy efficiency yet avoid an economic depression.

On the other hand, the total volume method has a stricter target than the intensity method because the method does not allow any energy consumption growth or any CO₂ emission growth. The total volume method is likely to be adopted by economically mature countries who positively take action on environment issues.

(3) Indicator Options for the KSA

Regarding long-term target indicators towards 2030 and middle term target indicators towards 2014, the following 4 options are studied. The long-term target is the basis of the long-term strategy towards 2030 and the middle term target is will be a priority issue attended to from time to time by 2015. Therefore, the middle term target should be reviewed by every 5 years to reflect timely issues.

Table 8-2 Long and Middle Term Indicators

Option	Term	Definition
Energy GDP Intensity	Long	Value which Total Primary Energy Supply (TEPS) is divided by real GDP (constant price)
Electricity GDP Intensity	Long	Value which total electricity consumption (total electricity sales) is divided by real GDP (constant price)
Electricity Consumption per Capita	Middle	Value which total electricity consumption (total electricity sales) is divided by population
Growth Rate of Peak Demand	Middle	Growth rate of peak power demand

(4) Past KSA Trends

Past trends in regard to the 4 options explained above will be reviewed hereafter.

(a) Energy GDP Intensity

The graph on the right shows the relationship between energy GDP intensity and GDP per capita in 2004 amongst 140 countries.

It indicates that KSA's position is above the average. In other words, the KSA has a greater potential to reduce its energy GDP intensity.

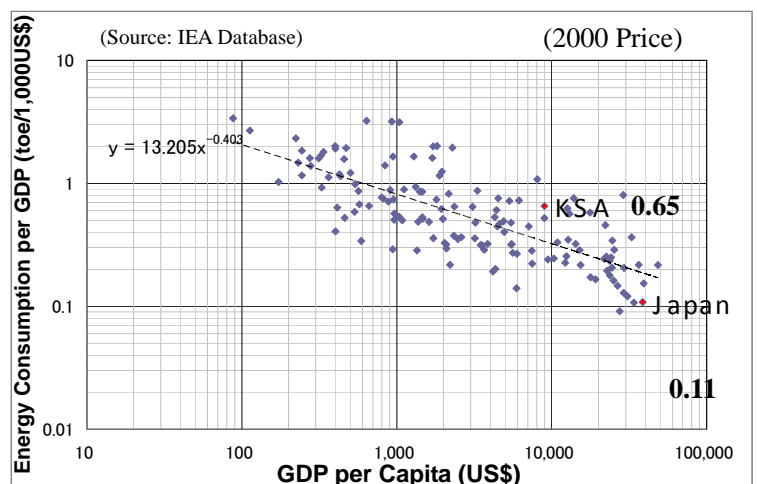


Figure 2-2 Relationship between Other Countries' GDP per Capita and Energy GDP Intensity (2004)

The following graph contains the historical data of energy GDP intensity from 1971 to 2004. The historical data of Japan or OECD countries has shifted to the right and down. However, Middle Eastern countries, including the KSA, have gone the opposite direction, left and up. In the past, roughly 30 years ago, the historical data of the KSA also moved to the right and down. Currently the KSA's energy GDP intensity has grown without GDP growth.

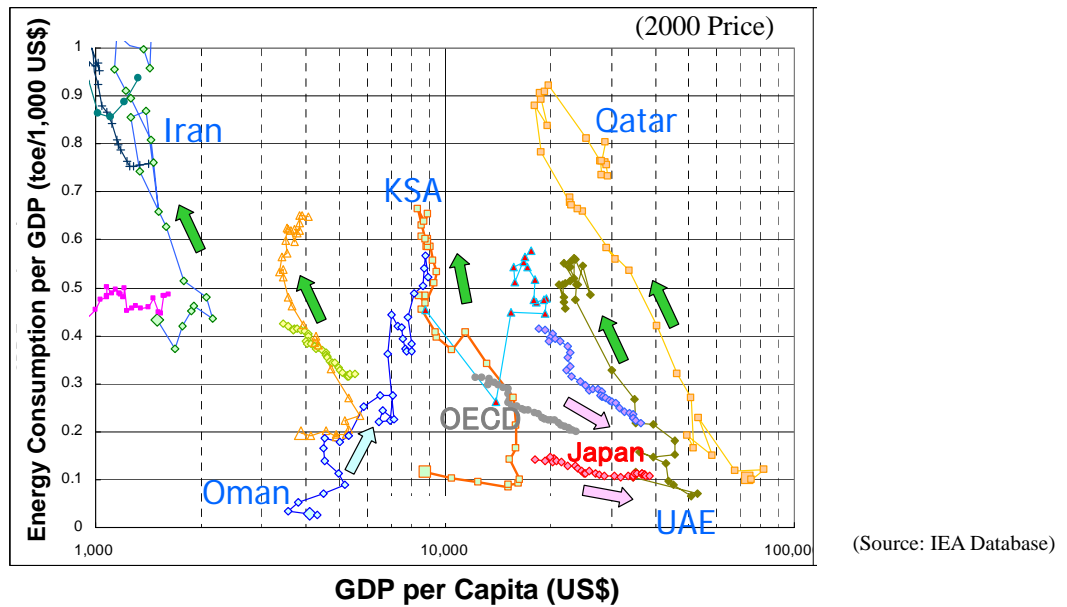


Figure 2-3 Historical Data of Energy GDP Intensity of Each Country (1971-2004)

(b) Electricity GDP Intensity

The graph on the right shows the relationship between electricity GDP intensity and GDP per capita in 2004 amongst 140 countries.

Similar to energy GDP intensity, KSA's position is above the average level. Thus, the KSA has greater potential to reduce its electricity GDP Intensity.

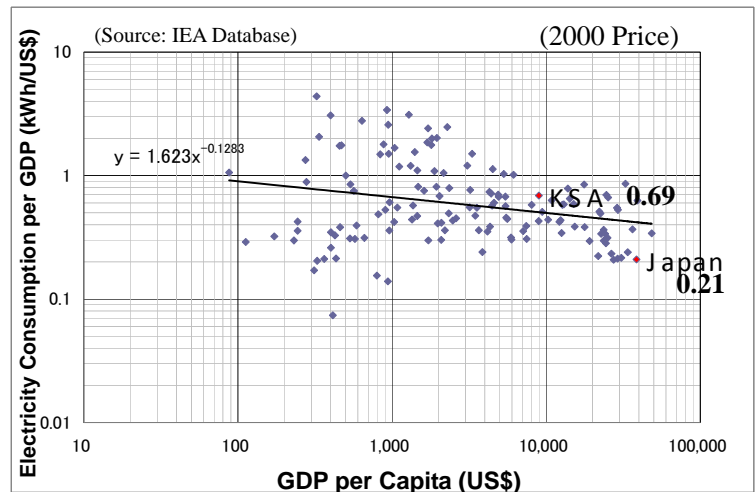


Figure 2-4 Relationship between Other Countries' GDP per Capita and Electricity GDP Intensity (2004)

The following graph contains the historical data of electricity GDP intensity from 1971 to 2004. Like energy GDP intensity, Middle Eastern countries, including the KSA, have generally shifted to the left and up. Japan and OECD countries levels remained flat.

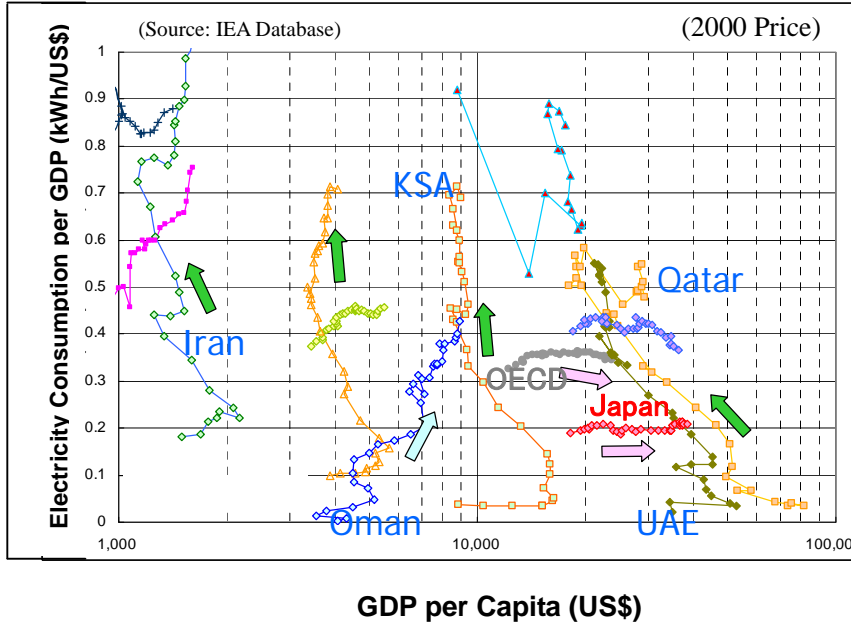


Figure 2-5 Historical Data of Electricity GDP Intensity of Each Country (1971-2004)

(c) Electricity Consumption per Capita

The following graph is also the historical data of electricity consumption per capita from 1971 to 2004. Japan and OECD countries have a tendency to gradually grow. Middle Eastern countries, including the KSA, have increased at a faster rate.

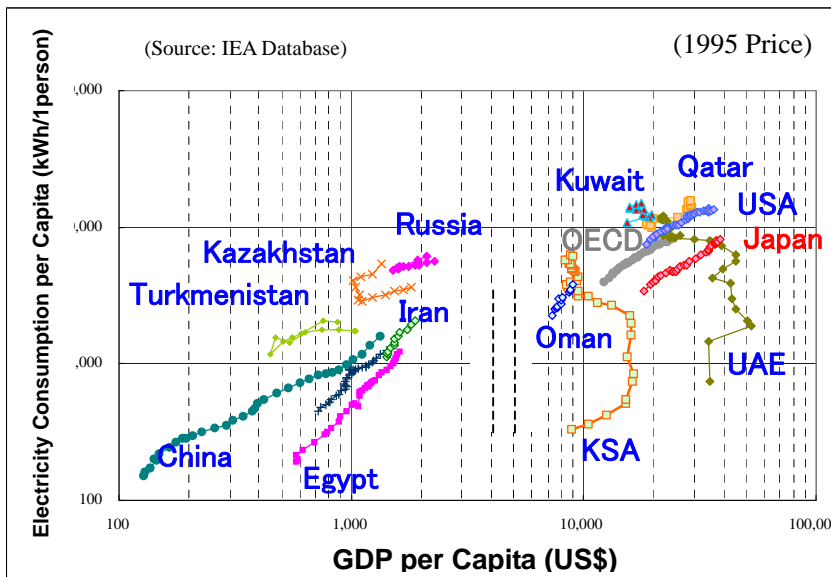


Figure 2-6 Historical Data of Electricity Consumption per Capita of Each Country (1971-2004)

(d) Growth Rate of Peak Demand

The following graph shows the historical data of peak demand in each year from 1995 to 2004. It indicates that peak demand of economically mature countries tends to grow at a slower rate.

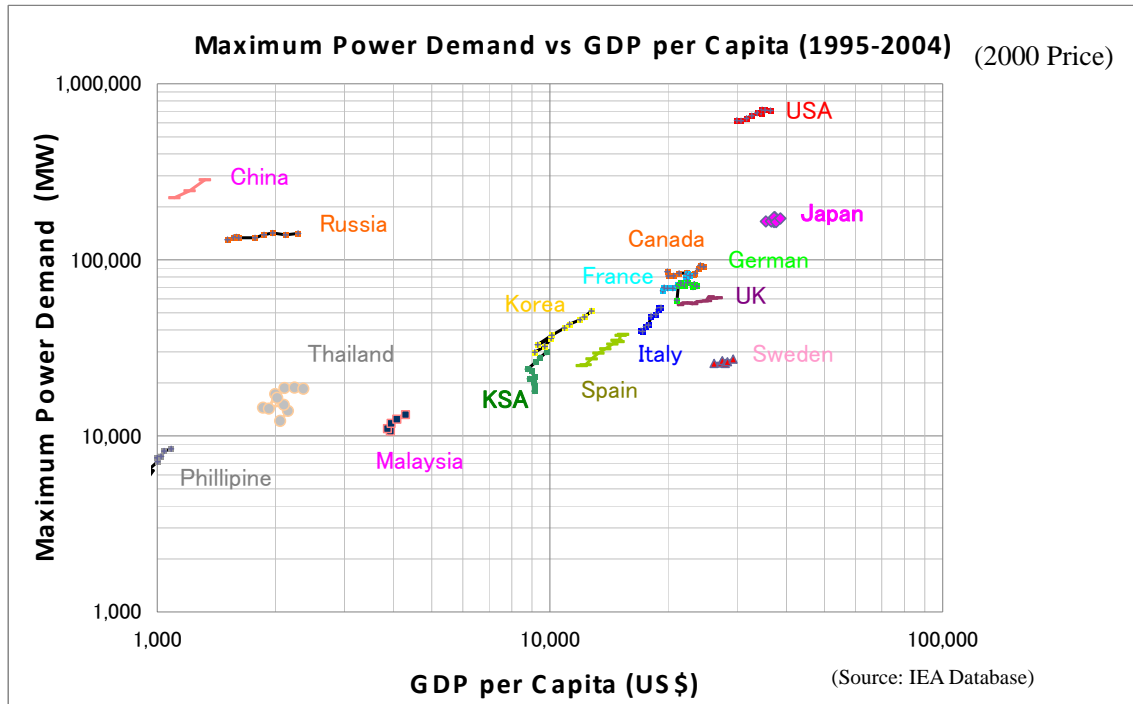


Figure 2-7 Historical Data of Peak Demand Growth (1995-2004)

2.2.2 Proposal of Objective

The objective represents a long-term vision towards 2030. The following 3 slogans are proposed considering the existing policies in the LTS 2025 and EDP, etc.

Objective of the Basic EC Principle (Slogan)

- Improving energy efficiency on the demand side.
- Ensure a reliable power supply by managing peak demand while integrating efforts on the supply and demand side.
- Build an energy conscious society.

2.2.3 Proposal of National Target

(1) Options for National Target

National targets are proposed as described in the 4 options outlined above. Advantages and disadvantages for each option are summarized as follows.

Table 2-3 Advantage and Disadvantage of Proposed Options

Option	Duration	Advantages	Disadvantages	Evaluation by the JICA Study Team
Energy GDP Intensity	Long Term	Can cover both heat and electricity. This indicator is adopted in many countries. Thus, comparison to other countries is also easy.	The scope of the Study is the electricity sector. Therefore, measures might not be enough for heat sector. However, some measures can cover both the electricity and heat sectors.	B
Electricity GDP Intensity	Long Term	This covers only the electricity sector, matching the scope of the study and the tasks of the executing agency, MOWE.	Energy conservation target generally cover both heat and electricity. Although this option covers only electricity, some measures can substantially contain both heat and electricity field. This means heat can be covered partially.	A
Electricity Consumption per Capita	Middle Term	It is easy to collect data.	It is easy to grasp individual consumption per person. However, it is difficult to synchronize with sector-wise management.	C
Growth Rate of Peak Demand	Middle Term	Apart from the 3 options mentioned above, peak demand can be controlled. Peak demand management is one of the important issues in the KSA.	-	A

The JICA Study Team recommends the following indicators for the long and middle term targets. As referred to in the table above, the “Electricity GDP Intensity” indicator does not cover the heat sector. However, for the industrial sector, it is difficult to separate heat and electricity in regard to energy conservation. In the Study, several of the proposed measures include heat in order to substantially promote heat energy conservation as well, if those measures can contain heat and electricity in common.

Proposed Indicators for the National Target

Long Term Target (by 2030): Electricity GDP Intensity

Middle Term Target (by 2015): Growth Rate of Peak Demand

“Energy GDP Intensity” is the indicator that is frequently used as a long term target in many countries. Data from other countries can easily be compared with this indicator. Theoretically, this indicator can be adopted for the KSA. However, the scope of the Study is electricity and the executing agencies handle only electricity. Since the scope of the Energy GDP Intensity is beyond the control by such agencies, the JICA Study Team does not consider this indicator.

(2) Proposal of Target Value

(a) Electricity GDP Intensity

For the target Electricity GDP Intensity value, the JICA Study Team recommends a 20 % to 30 % improvement by 2030, considering world trends and the current positioning of the KSA. The following graphs show past Electricity GDP Intensity trends of the KSA and KSA’s position in the world. Assuming GDP grows to some extent based on the policy of the LTS 2025, the target value is set at the center point between the current position and the developed countries’ position.

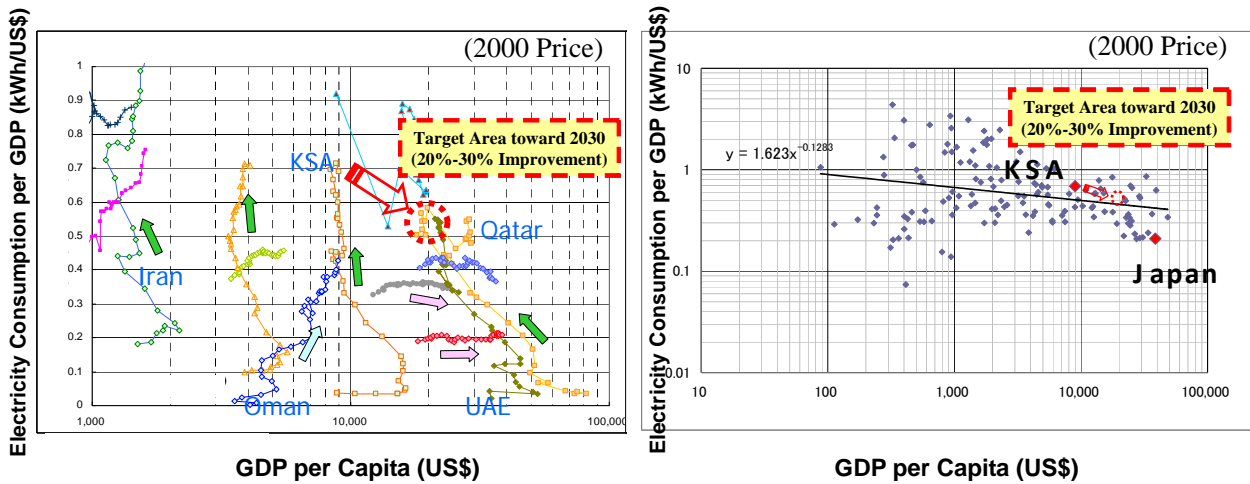


Figure 2-8 Target based on the Past Trends

Figure 2-9 Target based on the Position in the World (2004)

(b) Growth Rate of Peak Demand

Peak demand of the KSA recorded a 6.7 % growth rate from 2000 to 2005. On the other hand, the actual power capacity experienced a 5.7 % growth in the same period.

The graph on the right shows peak demand growth by 2015 at the same growth rate (6.7 % p.a.) and actual power capacity by 2015 at the same growth rate (5.7 % p.a.). Peak demand is expected to exceed actual power capacity in 2015.

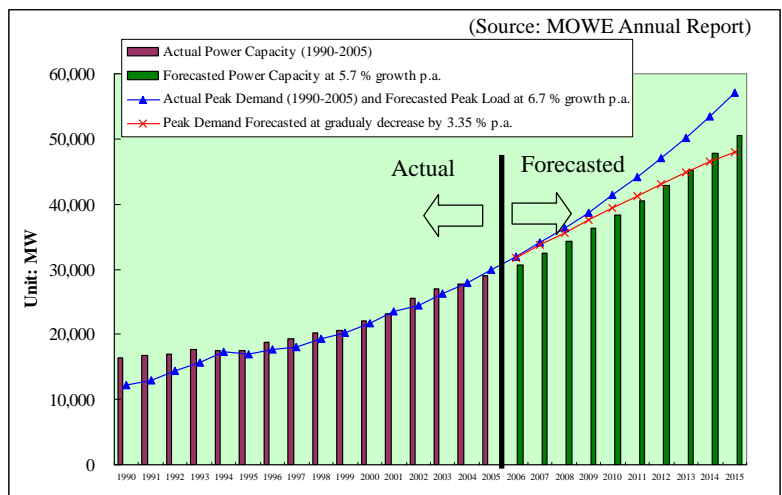


Figure 2-10 Estimate of Balance of Peak Demand and Actual Power Capacity

However, if the growth rate of peak demand gradually decreases by 2015 and if the rate becomes 50 % of the current growth rate (this means 3.35 % p.a. in 2015), the actual power capacity can cover the peak load in 2015 at current pace of development. Thus, the JICA Study Team recommends a 50% reduction in the growth rate of peak demand compared with the current growth rate (6.7 % p.a. 2000-2005).

(c) Energy GDP Intensity

As a reference, Energy GDP Intensity can improve 20% to 30 % by 2030 as shown below.

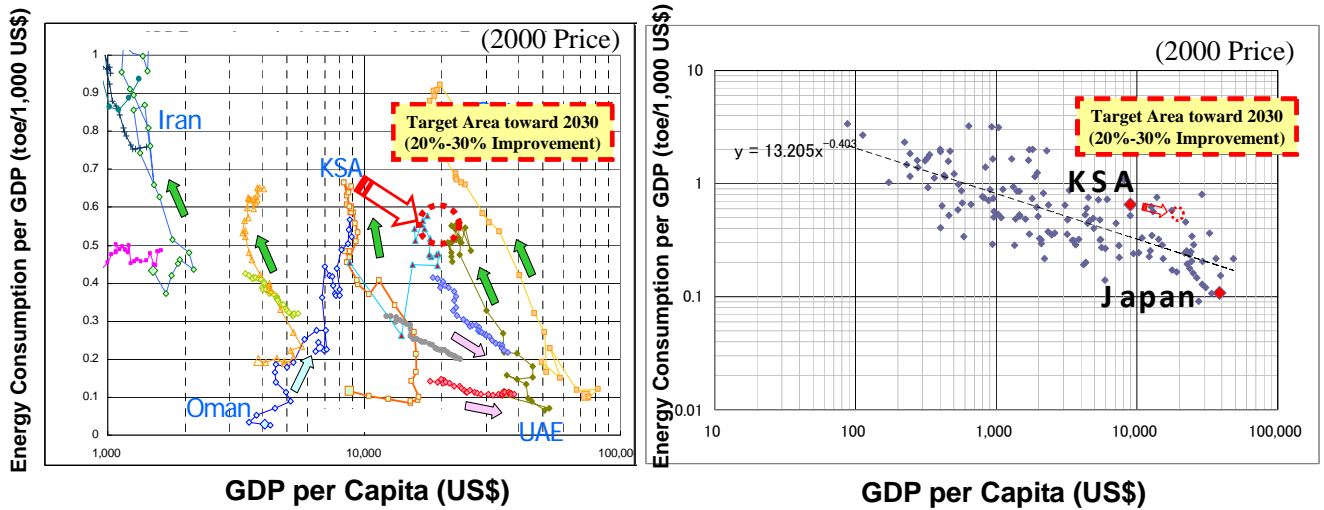


Figure 2-11 Target based on the Past Trends Figure 2-12 Target based on the Position in the World (2004)

(d) Base Year

Electricity GDP Intensity (or Energy GDP Intensity) data was fixed by 2005. Therefore, 2005 is defined as the base year. Regarding the growth rate of peak demand, the average growth rate from 2000 to 2005 was 6.7 % and is defined as the baseline.

(3) Summary

National targets and target values are summarized as follows. The JICA Study Team recommends 30 % improvement in Electricity GDP Intensity and 50% reduction in the growth rate of peak demand.

Table 2-4 Summary of National Targets and Target Values

Option	Target Year	Base Year	Low Target	Middle Target	High Target
Electricity GDP Intensity	2030	2005	20 % Improvement	25 % Improvement	30 % Improvement
Growth Rate of Peak Demand	2015	2000-2005	-	50 % Reduction	-
(Reference) Energy GDP Intensity	2030	2005	20 % Improvement	25 % Improvement	30 % Improvement

2.3 Government Action Policy and Sector-wise Action Strategy

2.3.1 Consideration Points

(1) Existing Policy

Several programs exist, such as NEEP or programs conducted by MOWE, SEC and so on. The JICA team proposes these policies for the purpose of continuous implementation by taking the existing programs and their integration into consideration. Points that should be considered are outlined below.

Table 2-5 Consideration Points from Existing Programs in the KSA

Program	Executing Agency	Consideration Points
Energy Efficiency Labels and Standards (EELS)	SASO	The program has already set a technical framework. In order to implement a pilot project, an effective implementation plan should be established.
National EC Campaign	MOWE	A conventional media campaign was implemented for the whole country years ago.
EC Instruction Booklet	MOWE, SEC	There are 2 kinds of instruction booklets for one the public and one for engineers.
Energy Education for Secondary and High Schools	MOWE, SEC, KACST	Executing agency staff visits schools and gives lectures to students as well as teachers.
Load Management of Demand Side	SEC	For peak shift and peak cut, SEC adopts a TOU option in the tariff and requests large customers to adjust the load.
NEEP Program (Completed by 2007)	NEEP	NEEP implemented and completed 8 programs. Permanent programs should be considered.

(2) Issues Identified through Discussion with Relevant Agencies and Site Survey Results

Issues identified through discussion with relevant agencies are summarized as follows. To tackle those issues, a government action policy and sector-wise action strategy are established.

(a) Issues Identified in the WB Report

The WB report “Report on National Energy Conservation Strategy” pointed out the following issues.

- ✓ Lack of awareness of the benefits of energy efficiency
- ✓ Tariffed energy prices below SEC’s average costs for most consumers
- ✓ Lack of a skilled cadre of energy efficiency managers, engineers and technicians
- ✓ Lack of energy efficiency technologies suited to Saudi needs and operating conditions
- ✓ Lack of delivery, distribution, and after-sales service networks for appliances and equipment
- ✓ Environmental costs and carbon benefits are not reflected in energy tariffs
- ✓ Lack of a central institution to develop, adopt and implement a national energy efficiency strategy

(b) Issues Identified through Discussion with the Relevant Agencies

Issues identified through discussion with the relevant agencies are as follows.

- ✓ Lack of technological information and an available database.
- ✓ Lack of a mandatory framework for energy management of large consumers and providing equipment to the market.
- ✓ Lack of incentives which can be a trigger for the replacement of inefficient equipment with energy efficient equipment or promote energy conservation services (ESCO, energy audit, maintenance improvement, etc.).
- ✓ Difficulty of market survey, especially in the residential sector.

(c) Issues Identified through Site Survey Results

The following issues were identified through site surveys.

- ✓ Lack of energy consumption data and daily energy management in industrial, commercial, and governmental sectors.
- ✓ Engineers lack skills and consciousness in the industrial, commercial, and governmental sectors.
- ✓ Lack of energy conscious operation in the commercial and governmental sectors.
- ✓ Lack of consciousness in the residential sector.
- ✓ Lack of incentives to change to high efficiency equipment in the residential sector.

(3) Lessons from Japan's Experience

From Japan's energy long term strategy, "New National Energy Strategy (2006)" the following points are adopted.

- ✓ Sector-wise policy and strategy are adopted to clarify sector responsibility.
- ✓ Cross-sector strategy is established to implement energy conservation to crossover to several sectors.
- ✓ Load leveling is also considered as a kind of energy conservation.

2.3.2 Proposal of Government Action Policy

(1) Definition of Government Action Policy

The government action policy is an actions policy implemented by the main organization for the promotion of energy conservation, the MOWE, targeting each including the governmental sector.

(2) Proposal of Government Action Policy

The government action policy is proposed as follows.

Table 2-6 Government Action Policy

Target Sector	Government Action Policy (for Each Sector)
Governmental Sector Action Policy (The MOWE's action policy for to governmental sector)	<ul style="list-style-type: none"> ● Promotion of periodic reporting using the intensity method ● Promotion of an energy audit scheme ● Promotion of EC business ● Promotion of high efficiency equipment and an IT-based management system ● Promotion of peak load management
Public Lighting Sector Action Policy	<ul style="list-style-type: none"> ● Promotion of periodic reporting using the intensity method
Industrial Sector Action Policy	<ul style="list-style-type: none"> ● Promotion of periodic reporting using the intensity method ● Promotion of an energy audit scheme ● Promotion of EC business ● Promotion of high efficiency equipment and an IT-based management system ● Promotion of peak load management
Commercial Sector Action Policy	<ul style="list-style-type: none"> ● Promotion of periodic reporting using the intensity method ● Promotion of an energy audit scheme ● Promotion of EC business ● Promotion of high efficiency equipment and an IT-based management system ● Promotion of peak load management
Residential Sector Action Policy	<ul style="list-style-type: none"> ● Promotion to raise awareness through education, information release, and campaigns
Mosque Sector Action Policy	<ul style="list-style-type: none"> ● Promotion to raise awareness through education and campaigns
School Sector Action Policy	<ul style="list-style-type: none"> ● Support of EC education
Cross Sector Action Policy	<ul style="list-style-type: none"> ● Promotion of supply of high efficiency equipment and load leveling equipment introduction to the market ● Establishment of an incentive system for energy conservation and peak shift ● Proper enforcement of EC building codes ● Maintenance assistance for middle and large-sized AC systems ● Releasing information, providing education and training, and creation of an energy efficiency database through a central institution (SEEC) ● Establishment of R&D strategy for EC technology ● Create an energy conscious society

2.3.3 Proposal of Sector-wise Action Strategy

(1) Definition of Sector-wise Action Strategy

Sector-wise strategy is an action strategy which is implemented by each sector in correspondence with the government action policy as mentioned above.

(2) Proposal of Sector-wise Action Strategy

The sector-wise action strategy is proposed as follows.

Table 2-7 Sector-wise Action Strategy

Target Sector	Action Strategy by Each Sector
Government Sector Action Strategy (including MOWE)	<ul style="list-style-type: none"> ● Establishment of the SEEC (Saudi Energy Efficiency Center) ● Encouraging energy conscious operation and practices ● Submission of a periodical monitoring report by the energy manager ● Introduction of EC business (ESCO project, high efficiency equipment and load leveling equipment, architectural technology, etc.) and information release ● Improvement of energy management skills (Capacity Building) ● Introduction of EC oriented building design
Public Lighting Sector Action Strategy	<ul style="list-style-type: none"> ● Formation of database for electricity consumption and monitoring by area
Industrial Sector Action Strategy	<ul style="list-style-type: none"> ● Submission of a periodical monitoring report by the energy manager ● Introduction of high efficiency equipment and load leveling equipment through an incentive scheme and ESCO, etc. ● Utilization of an energy audit service scheme ● Improvement of energy management skills (Capacity Building) ● Voluntary implementation of EC activities by companies associations/unions (or the Chamber of Commerce and Industry)
Commercial Sector Action Strategy	<ul style="list-style-type: none"> ● Practice of energy conscious operation ● Submission of a periodical monitoring report by energy manager ● Introduction of high efficiency equipment and load leveling equipment through an incentive scheme and ESCO, etc ● Utilization of an energy audit service scheme ● Improvement of energy management skills (Capacity Building) ● Introduction of EC oriented building design
Residential Sector Action Strategy	<ul style="list-style-type: none"> ● Practice of energy conscious operation ● Smart selection of EC appliances ● Utilization of an electricity consumption check system
Mosque Sector Action Strategy	<ul style="list-style-type: none"> ● Lecture of EC practice to prayers by Imam ● Practice of EC practices by mosque itself
School Sector Action Strategy	<ul style="list-style-type: none"> ● EC education for kids, EC practices at schools and visitation of P/S as a school field trip.
Cross-sector Action Strategy	<ul style="list-style-type: none"> ● Utilization of high efficiency equipment and load leveling equipment through a labeling and standard system, information release, etc. ● Cooperation regarding peak shift operation ● Proper implementation of EC building codes ● Participation in maintenance training for middle and large AC systems ● Participation in education, training, and campaigns ● Establishment of R&D strategy for EC technology and implementation

2.4 Sector-wise Guideline

2.4.1 Consideration Points

In Japan, an energy management system has been adopted for large consumers in the industrial and commercial sectors. In this system, an annual improvement rate of 1 % in energy intensity (including heat and electricity) is required as a guideline.

Regarding energy intensity, because it is difficult to calculate Energy GDP Intensity at the customer level, some alternative indicators are used. For example, productivity (= product output divided by energy consumption) in an industrial sector and energy consumption per area (= energy consumption divided by total floor area) in a commercial sector are used.

However, these alternative indicators do not consider the ameliorating effect of GDP growth. That is to say, for a 1 % annual improvement in such indicators, the annual improvement for Energy GDP Intensity, which includes GDP growth, is expected to be greater than 1 %.

2.4.2 Proposal of Sector-wise Guideline

(1) Sector-wise Concept Guideline in the KSA

Intensity basis method by sector is considered as a guideline in the KSA. Guideline value is proposed as annual basis indicator to easily check and conforms to the national target, 30 % improvement of Electricity GDP Intensity.

(2) Proposal of Sector-wise Guideline

Indicators and annual guideline values are proposed by sector in the following table. Guideline values are comprised of voluntary improvement and technological improvement in equipment by a labeling and standards system. In the following table, the “Government” includes public lighting, hospital, charity and agriculture sector, and the “Residential” includes mosque and school sector.

Table 2-8 Sector-wise Guideline

Sector	Alternative Indicators	Guideline Value (Annual Rate)		
		Voluntary Improvements	Technological Improvements in Equipment (For all sectors)	Total
Government	Electricity Consumption per Area (kWh/m ²) (= Electricity Consumption / Total Floor Area)	0.5 %	1.0 %	<u>1.5 %</u>
Industrial	Productivity (=Electricity Consumption / Product Output or Sales)	0.5 %	1.0 %	<u>1.5 %</u>
Commercial	Electricity Consumption per Area (kWh/m ²) (= Electricity Consumption / Total Floor Area)	0.5 %	1.0 %	<u>1.5 %</u>
Residential	Electricity Consumption per Household (kWh/household)	0 % (Same Level)	1.0 %	<u>1.0 %</u>

(3) Verifying Achievement of the National Targets according to the Guidelines

Assuming the proposed sector-wise guidelines are introduced, achievement of the national target (30 % improvement of Electricity GDP Intensity) is reviewed as follows.

Table 2-9 Accumulated Effect of Sector-wise Guideline

Sector	Share	Annual Improvement	Accumulated Effect by 2030	Total Effect by 2030
Government	20 %	1.5 %	30 %	20 % x 30 %
Industrial	20 %	1.5 %	30 %	20 % x 30 %
Commercial	10 %	1.5 %	30 %	10 % x 30 %
Residential	50 %	1.0 %	20 %	+) 50 % x 20 %
				25 %

As shown in the above table, a 25 % improvement in the accumulated improvement effect by sector-wise guidelines is expected by 2030. However, this value does not include the effect of GDP growth. If GDP growth is also considered, an improvement of 34 % in Electricity GDP Intensity (from 2005) can be achieved (detailed description in Chapter 9, 9.3). In other words, by means of the sector-wise guideline, the national target of 30 % improvement in Electricity GDP can be achieved.

2.5 Energy Conservation Measures (EC Measures)

2.5.1 Consideration Points

(1) Existing EC Measures of the KSA

As mentioned above, the following measures have already been implemented in the KSA. The Study must consider the consistency of the existing measures in its proposed measures.

- ✓ Energy Efficiency Labels and Standards (EELS)
- ✓ National EC Campaign
- ✓ EC Instruction Booklet
- ✓ Energy Education for Secondary and High Schools
- ✓ Load Management of Demand Side
- ✓ NEEP Program

(2) Examples of Japan’s EC Measures

For this Study, in order to review the existing measures in the KSA and select new measures, Japan’s EC measures are studied to see whether they can be applied to the KSA or not. To begin, examples of Japan’s EC measures are introduced as follows.

(a) Japan’s EC Measure Categories

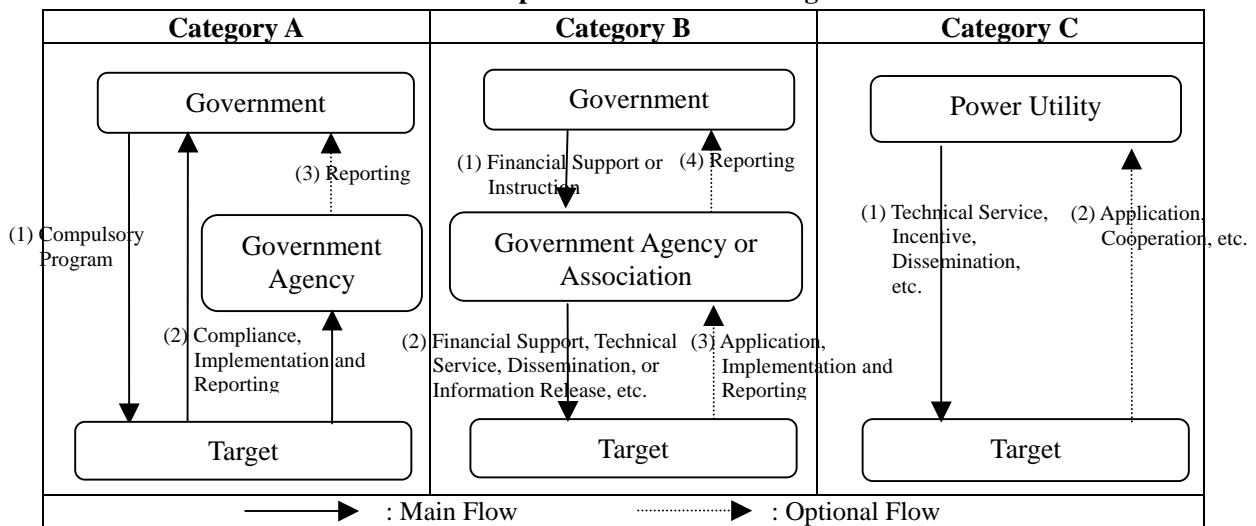
Japan’s EC measures are grouped into the following 3 categories.

Category A: A mandatory program based on law and regulation

Category B: A voluntary program supported by the government and implemented on an application basis through a government agency or association

Category C: A voluntary program promoted by power utilities

Table 2-10 Japan’s EC Measure Categories



(b) Japanese EC Measures

Examples of Japanese EC measures and their target sectors are summarized as follows.

Table 2-11 Japanese EC Measures and Target Sectors

	Industrial Sector	Commercial Sector	Residential Sector
Institutional Promotion System (Category A)	Energy Management System		
	Labeling System and Standard		
R&D Support (Category B)	Financial Support for Development of EC Technology		
Financial Support (Category B)	Preferred Interest Rate Loan for EC Project		
	Tax Incentive to Install EC Equipment		
	Subsidy for EC Project and Demonstration Project		
			Subsidy for Installation of High Efficiency System
Subsidy for Specific EC Equipment			
Technical Service (Category B)	Training Program for Energy Manager		
	Training Program for Engineers and Technicians		
	Energy Audit Service (free charge)		
Dissemination And Information Release (Category B)	Information Release of EC Equipment		
	Publication of Good EC Project		
	Award for Excellent EC Business Unit		
	EC Campaign		
	Instruction Booklet		
	Various Studies		
Dissemination And Information Release (Category C)	Announcement of Daily Demand and Supply Capacity through Media		
	Energy Analysis Support System		Check System of Customer Records
			Instruction Booklet and Lifestyle Laboratory Report
			Education for Schools
EC Museum			
Tariff System (Category C)	Incentive (Disincentive) Tariff Option		
	Load Adjustment Contract		
Technical Service (Category C)	Consulting Service for Energy Conservation		
	ESCO Business		EC Consulting Service for Residential Sector
R&D by Power Utility (Category C)	Joint Development of EC Equipment and Household Appliances		
	Development of EC Architectural Technology		
			Various Studies
	Laboratory Testing for Performance Check		

2.5.2 Selection of High Priority Measures

Priority measures are selected by the Steering Committee members consisting of the MOWE, and relevant agencies and companies.

Table 2-12 Definition of 5 Level Evaluations

Priority	Category	Definition
High	Category 1	A high priority measure (new measure) to be further developed in the Study.
	Category 2	A high priority measure (existing measure), to be further developed in the Study.
Middle	Category 3	A middle priority measure, recommendations will be made in the Study.
Low	Category 4	A low priority measure, a concept paper will be prepared for the future.
	Category 5	Difficult to apply in the KSA.

Table 2-13 Final Evaluation of EC Measures

Measure	Final Evaluation	
	Category	Expected Executing Agency
1. Energy Management System	1	SEEC
2. Energy Efficiency Labels and Standards (EELS)	2	SASO
3. Financial Support for Development of EC Technology	4*	KACST, MOWE
4. Preferable Interest Rate Loan for EC Project	4	Third Party
5. Tax Incentive to Install EC Equipment	4	-
6. (i) Subsidy for EC Project and Demonstration Project, and (ii) Subsidy for Installation of High Efficiency System (Large scale subsidy)	3	KACST, SEEC
7. Subsidy for Specific Equipment (Small scale subsidy)	3	MOWE, SEEC, MOF
8. Training Program for Energy Manager	1	KACST, SEEC
9. Energy Assessment Service	1	KACST, SEEC
10. Information Release of EC Equipment	4	SEEC
11. Publication and Award System	1	MOWE
12. EC Campaign	2	MOWE
13. Instruction Booklet (by Government or Association)	3	MOWE, SEC, SASO
14. Announcement of Daily Demand and Supply Forecast	3	SEC, MOCM
15. Check System of Customer Records	1	SEC, SEEC
16. Instruction Booklet and Lifestyle Laboratory Report (by Utility)	3	SEC, MOWE, SASO
17. EC Education for Schools	1	MOWE, SEC, KACST
18. EC Museum	1	SEEC, MOWE
19. Incentive (Disincentive) Tariff Option	3*	ECRA, SEC
20. Load Adjustment Contract	3*	SEC
21. (i) Consulting Service for Energy Conservation, and (ii) ESCO Business	3	SEEC, Third Party
22. EC Consulting Service for Residential Sector	3	SEEC
23. Joint Development of EC Equipment and Household Appliances	3	SEEC, KACST
24. Promotion of Architecture Technology	1	SASO, MOMRA
25. Monitoring and Awareness Survey	2	MOWE, KACST, Univ.
26. Laboratory Testing for Performance Check	3	SASO

* These measures are changed to high priority measures at the final decision by the Steering Committee.

(4) Additional High Priority Measures

11 high priority measures were selected as mentioned above. In addition, through discussion with the Steering Committee members, an additional 2 measures are selected as follows (total 13 measures). Measures, “19. Incentive (Disincentive) Option Tariff” and “20. Load Adjustment Contract”, that were initially evaluated as middle priority, were re-evaluated as high priority and packaged into the new measure, “Load Management”. “Promotion of R&D Scheme” is also additionally selected as one of high priority measures converting from the measure, “3 Financial Support for Development of EC Technology”.

- Load Management
- Promotion of R&D Scheme

(5) Tasks in the Study by Priority

As described above, EC measures were grouped into 3 priority categories, namely high priority, middle priority, and low priority. According to the priority category, the following tasks will be further conducted in the Study.

High Priority Measure:	Make an implementation plan paper assuming adoption of the measure in the KSA.
Middle Priority Measure:	Summarize Japanese methods, lessons, and recommendations for future implementation in the KSA.
Low Priority Measure:	Preparing a concept paper.

2.5.3 Outline of High Priority Measures

(1) Outline

Outline (tentative) of the selected high priority measures is described below. The contents are under consultation (not fixed yet).

Table 2-14 Outline of High Priority Measures (1/3)

Measure	Contents
1. Energy Management System (EMS)	<ul style="list-style-type: none"> ■ Large consumers, designated by criteria, submit annual reports (management report and middle term plan report) to SEEC. ■ Write a report and manage energy conservation activities, an energy manager will be appointed amongst the applicable customers. ■ Energy manager has a responsibility for energy management within the business unit and instruction for workers and reporting to SEEC. ■ SEEC checks the result and gives instruction in the case of poor management.
2. Energy Efficiency Labels and Standards (EELS)	<ul style="list-style-type: none"> ■ Manufactures and Importers (M&I) have to test the performance of the designated products (AC, Washing Machine, Refrigerator, and Freezer). ■ Create a label sheet, database, and printing system that should be established in collaboration with M&I, Retail Shops and SASO. ■ Random inspection of M&I and Retail Shops seems to be necessary. ■ The tasks outlined above should be a mandatory at the final stage. (voluntary in the pilot stage)

Table 2-15 Outline of High Priority Measures (2/3)

Measure	Contents
3. Training Program for Energy Manager	<ul style="list-style-type: none"> ■ There are 4 programs, namely energy manager training in line with the Energy Management System, electricity EC technology training, heat EC technology training, and A/C maintenance training. ■ SEEC makes all the necessary arrangements for training implementation. ■ Target trainees are managers and/or engineers except for the A/C maintenance course that is for field engineers from A/C maintenance service companies. ■ Training programs are to be operated on a chargeable basis. ■ Training centers in SEEC are equipped with facilities for hands-on practices.
4. Energy Assessment Service	<p>(Application)</p> <ul style="list-style-type: none"> ■ Dissemination of the Scheme to the target sectors. ■ Collection of applicants and selection by criteria. <p>(Hiring Consultant)</p> <ul style="list-style-type: none"> ■ Registration of consultant. ■ Dispatch of the appropriate persons to the selected applicants. <p>(Energy Assessment)</p> <ul style="list-style-type: none"> ■ Documentary evaluation before site audit. ■ One-day site audit. ■ Written report with recommended EC measures (within 3 months).
5. Publication and Award System	<ul style="list-style-type: none"> ■ Collection of EC Projects, practices, appliances, etc. on an application basis. ■ Creation and dissemination of a database and dissemination. ■ Selection of best performance by an independent committee. ■ Hold an award ceremony once a year (at a 3-day long Big Fair during EC Month).
6. EC Campaign	<ul style="list-style-type: none"> ■ Establishment of “Saudi Energy Conservation Month (Saudi EC Month)”. ■ Coordination of conventional “National EC Campaign” with the EC Month. ■ During the EC Month, the National EC Campaign starts and is strengthened. ■ Special events held during EC Month. ■ “3-day long Big Fair” and “Strengthening National EC Campaign” are components of EC Month. ■ Hold sub-events at the “3-day long Big Fair”, such as the announcement of campaigns, an award ceremony, a workshop, and manufacturer sales promotions, etc.
7. Check System of Customer Records	<ul style="list-style-type: none"> ■ Create an accumulative database for customer records (SEC has already had raw data). ■ Create a website access system. ■ Design a website screen to disseminate energy conservation information, CO₂ emission reduction, etc. ■ Dissemination of the system. ■ Create a list of customers who can access to the website (for internet survey).

Table 2-16 Outline of High Priority Measures (3/3)

Measure	Contents
8. EC Education for Schools	<p>(In Case of Direct Teaching Scheme)</p> <ul style="list-style-type: none"> ■ MOWE/SEC/KACST directly holds a seminar for students and teachers at school. <p>(In case of Training of Trainer (TOT) Scheme)</p> <ul style="list-style-type: none"> ■ MOWE/SEC/KACST hold a seminar for teachers at the workshop. ■ Cooperative teachers teach EC education in their classroom, supported by MOWE, SEC and KACST.
9. EC Museum	<ul style="list-style-type: none"> ■ Establishment of a 2-storey museum for (i) Education on electricity and energy conservation, (ii) Dissemination of EC appliances (How to select and use), (iii) Communication with customers. ■ Free of charge. (6 days open in a week, Open 8:00, Close 20:00). ■ Main components are (i) Display of power facility, (ii) Home appliances area, (iii) Kids area. Several events, workshops, shops, and a pray room will also be considered.
10. Promotion of Architecture Technology (Building Material Energy Performance Indication System (BEPIS))	<ul style="list-style-type: none"> ■ Setting target material/performance for standardization in accordance with SBC and existing Saudi construction and building material standards ■ Collection of data and making database ■ Random inspection of M&I and construction companies seems to be necessary. ■ The tasks outlined above should be a mandatory at the final stage. (voluntary in the pilot stage)
11. Monitoring and Awareness Survey	<ul style="list-style-type: none"> ■ Electricity consumption (SEC meter and/or measurement). ■ EC practice and EC technology (Industry). ■ EC awareness and practice level (Commercial and Residential, Specific Sector). ■ Study for effective dissemination (Labels and Standards). ■ Review and recommendation for future steps. ■ Establishment of a scheme to conduct the survey above.
12. Load Management	<ul style="list-style-type: none"> ■ Development of a load adjustment option tariff to give an incentive for peak shift/cut ■ Development of peak shift/cut potential calculation method
13. Promotion of R&D Scheme	<ul style="list-style-type: none"> ■ Development of R&D scheme

(2) Target Sectors of Each EC Measure

Target fields and sectors of each high priority measure are shown in the following table. Measures, which cannot separate heat and electricity or be implemented simultaneously, are formulated considering heat energy conservation.

Table 2-17 Target Sectors of Each High Priority EC Measure

Measure	Field	Government Sector	Industrial Sector	Commercial Sector	Residential Sector
1. Energy Management System (EMS)	Heat and Electricity	X	X	X	
2. Energy Efficiency Labels and Standards (EELS)	Electricity	X	X	X	X
3. Training Program for Energy Manager	Heat and Electricity	X	X	X	
4. Energy Assessment Service	Heat and Electricity	X	X	X	
5. Publication and Award System	Heat and Electricity	X	X	X	
6. EC Campaign					
Establishment of the EC Month	Electricity	X	X	X	X
Mosque EC Campaign	Electricity				X
7. Check System of Customer Records	Electricity	X	X	X	X
8. EC Education for Schools	Electricity				X
9. EC Museum	Electricity				X
10. Promotion of Architecture Technology	Electricity	X	X	X	X
11. Monitoring and Awareness Survey	Electricity	X	X	X	X
12. Load Management	Electricity		X	X	
13. Promotion of R&D Scheme	Electricity		X	X	

2.5.4 Methodology for Formulation of High Priority Measures

High priority measures will be formulated in the Study. Items to be formulated for each measure are as follows.

- Executing agency (agencies)
- Component of the scheme
- Flowchart of the scheme
- Implementing organization
- Annual budget
- Legal basis to implement the scheme
- Action plan

2.6 Summary of Basic Energy Conservation Principle

Table 2-18 Summary of EC Basic Principle (1/2)

Objective	National Target	Government Action Policy (for Each Sector)	Sector-wise Action Strategy (corresponding to the Government Action Policy)
<p>Slogan</p> <ul style="list-style-type: none"> Improving energy efficiency on the demand side. Managing peak demand with integrated efforts on the demand and supply sides, ensuring a reliable power supply. Create an energy conscious society. 	<p>Long Term Target <u>Option 1: Energy GDP Intensity</u> Improve the Energy GDP Intensity (energy consumption per GDP) by 2030 from the level in 2005. Target Option: 20 %, 25 %, 30 %</p> <p><u>Option 2: Electricity GDP Intensity</u> Improve the Electricity GDP Intensity (electricity consumption per GDP) by 2030 from the level in 2005. Target Option: 20 %, 25 %, 30 %</p> <p>Middle Term Target <u>Option 3: Electricity Consumption per Capita</u> Improve the electricity consumption per capita by 2015. Target Option: -</p> <p><u>Option 4: Growth Rate of Peak Demand</u> Reduction in the growth rate of peak demand by 2015. Target Option: 50 % reduction compared with the current (2000-2005) growth rate.</p> <p>Recommendation of the JICA Study Team Long Term Target: 30 % improvement of Electricity GDP Intensity (Option2) by 2030 from the base year 2005.</p> <p>Middle Term Target: 50 % reduction in the Growth Rate of Peak Demand (Option 4) by 2015 compared with the current (2000-2005) growth rate.</p>	<ul style="list-style-type: none"> Government Sector Action Policy <ul style="list-style-type: none"> Promotion of periodic reporting using the intensity method Promotion of an energy assessment service Promotion of EC business Promotion of high efficiency equipment and an IT-based management system Promotion of peak load management Public Lighting Sector Action Policy <ul style="list-style-type: none"> Promotion of periodical reporting using the intensity method Industrial Sector Action Policy <ul style="list-style-type: none"> Promotion of periodic reporting using the intensity method Promotion of an energy assessment service Promotion of EC business Promotion of high efficiency equipment and an IT-based management system Promotion of peak load management Commercial Sector Action Policy <ul style="list-style-type: none"> Promotion of periodic reporting using the intensity method Promotion of an energy assessment service Promotion of EC business Promotion of high efficiency equipment and an IT-based management system Promotion of peak load management Residential Sector Action Policy <ul style="list-style-type: none"> Promotion to raise awareness through education, information release, and campaigns Mosque Sector Action Policy <ul style="list-style-type: none"> Promotion to raise awareness through education and campaigns School Sector Action Policy <ul style="list-style-type: none"> Support of EC education Cross Sector Action Policy <ul style="list-style-type: none"> Promotion of supply of high efficiency equipment and load leveling equipment introduction to the market Establishment of an incentive system for energy conservation and peak shift Proper enforcement of EC building codes Maintenance assistance for middle and large AC systems Releasing information, provide education and training, and create an energy efficiency database through a central institution (SEEC) Establishment of R&D strategy for EC technology Create an energy conscious society 	<ul style="list-style-type: none"> Government Sector Action Strategy <ul style="list-style-type: none"> Establishment of SEEC (Saudi Energy Efficiency Center) Encouraging energy conscious operation and practices Submission of a periodical monitoring report by the energy manager Introduction of EC business (ESCO project, high efficiency equipment and load leveling equipment, architectural technology, etc.) and information releases Improvement of energy management skills (Capacity Building) Introduction of EC oriented building design Public Lighting Sector Action Strategy <ul style="list-style-type: none"> Formation of database for electricity consumption and monitoring by area Industrial Sector Action Strategy <ul style="list-style-type: none"> Submission of a periodical monitoring report by the energy manager Introduction of high efficiency equipment and load leveling equipment through an incentive scheme and ESCO, etc. Utilization of an energy audit service scheme Improvement of energy management skills (Capacity Building) Voluntary implementation of EC activities by company associations (or Chamber of Commerce and Industry) Commercial Sector Action Strategy <ul style="list-style-type: none"> Practice of energy conscious operation Submission of a periodical monitoring report by the energy manager Introduction of high efficiency equipment and load leveling equipment through an incentive scheme and ESCO, etc Utilization of an energy audit service scheme Improvement of energy management skills (Capacity Building) Introduction of EC oriented building design Residential Sector Action Strategy <ul style="list-style-type: none"> Practice of energy conscious operation Smart selection of EC appliances Utilization of an electricity consumption check system Mosque Sector Action Strategy <ul style="list-style-type: none"> Lecture of EC practice to prayers by Imam Practice of EC activities by mosque itself School Sector Action Strategy <ul style="list-style-type: none"> EC education for kids, EC practice in school, and visitation of P/S as a school field trip Cross Sector Action Strategy <ul style="list-style-type: none"> Utilization of high efficiency equipment and load leveling equipment through a labeling and standard system, information release, etc. Cooperation regarding peak shift operation Proper implementation of EC building codes Participation in maintenance training for middle and large AC systems Participation in education, training, and campaigns Establishment of R&D strategy for EC technology and implementation

Table 2-19 Summary of EC Basic Principle (2/2)

Sector-wise Action Strategy (corresponding to the Government Action Policy)	High Priority EC Measures	Middle Priority EC Measures	Sector-wise Guideline
<ul style="list-style-type: none"> ● Government Sector Action Strategy <ul style="list-style-type: none"> ✓ Establishment of SEEC (Saudi Energy Efficiency Center) ✓ Encourage energy conscious operation and practices ✓ Submission of a periodical monitoring report by the energy manager ✓ Introduction of EC business (ESCO project, high efficiency equipment and load leveling equipment, architectural technology, etc.) and information releases ✓ Improve energy management skills (Capacity Building) ✓ Introduction of EC oriented building design ● Public Lighting Sector Action Strategy <ul style="list-style-type: none"> ✓ Formation of database for electricity consumption and monitoring by area 	<ul style="list-style-type: none"> ● EC Measures targeting at Government Sector <ol style="list-style-type: none"> (1) Energy Management System (EMS) (2) Energy Assessment Service (EAS) (3) Publication of Good EC Project utilizing ESCO project, high efficiency equipment and load leveling equipment, architectural technology, etc. (4) EC Campaign (EC practice with data monitoring for Government buildings, Monitoring of electricity consumption of public lighting by area) 	(1) Instruction Booklet for Engineers	<p>Annual 1.5 % improvement by 2030</p> <p>Electricity Share: 20 % (including public lighting, hospital, charity, agriculture)</p> <p>Annual Impact = 1.5 % x 0.2 = <u>0.3 %</u></p>
<ul style="list-style-type: none"> ● Industrial Sector Action Strategy <ul style="list-style-type: none"> ✓ Submission of a periodical monitoring report by the energy manager ✓ Introduction of high efficiency equipment and load leveling equipment through an incentive scheme and ESCO, etc. ✓ Utilization of an energy audit service scheme ✓ Improve energy management skills (Capacity Building) ✓ Voluntary implementation of EC activities by company associations (or Chamber of Commerce and Industry) 	<ul style="list-style-type: none"> ● EC Measures targeting at Industrial Sector <ol style="list-style-type: none"> (1) Energy Management System (EMS) (2) Energy Assessment Service (EAS) (3) Publication and Award System (4) Check System of Customer's Record (5) Load Management (Incentive options, load adjustment, etc.) 	<ol style="list-style-type: none"> (1) Subsidy for EC Project, Demonstration Project, and Subsidy for Installation of High Efficiency System (Large scale subsidy) (2) EC Business Promotion (consulting service, ESCO, etc.) (3) Instruction Booklet for Engineers 	<p>Annual 1.5 % improvement by 2030</p> <p>Electricity Share: 20 %</p> <p>Annual Impact = 1.5 % x 0.2 = <u>0.3 %</u></p>
<ul style="list-style-type: none"> ● Commercial Sector Action Strategy <ul style="list-style-type: none"> ✓ Practice energy conscious operation ✓ Submission of a periodical monitoring report by the energy manager ✓ Introduction of high efficiency equipment and load leveling equipment through an incentive scheme and ESCO, etc. ✓ Utilization of an energy audit service scheme ✓ Improve energy management skills (Capacity Building) ✓ Introduction of EC oriented building design 	<ul style="list-style-type: none"> ● EC Measures targeting at Commercial Sector <ol style="list-style-type: none"> (1) Energy Management System (EMS) (2) Energy Audit Scheme (EAS) (3) Publication and Award System (4) Check System of Customer Records (5) Load Management (Incentive options, load adjustment, etc.) 	<ol style="list-style-type: none"> (1) Subsidy for EC Project, Demonstration Project, and Subsidy for Installation of High Efficiency System (Large scale subsidy) (2) EC Business Promotion (consulting service, ESCO, etc.) (3) Instruction Booklet for Engineers 	<p>Annual 1.5 % improvement by 2030</p> <p>Electricity Share: 10 %</p> <p>Annual Impact = 1.5 % x 0.1 = <u>0.15 %</u></p>
<ul style="list-style-type: none"> ● Residential Sector Action Strategy <ul style="list-style-type: none"> ✓ Practice energy conscious operation ✓ Smart selection of EC appliances ✓ Utilization of an electricity consumption check system ● Mosque Sector Action Strategy <ul style="list-style-type: none"> ✓ Lecture of EC practice to prayers by Imam ✓ Practice of EC activities by mosque itself ● School Sector Action Strategy <ul style="list-style-type: none"> ✓ EC education for kids, EC practice in school, and visitation of P/S as a school field trip 	<ul style="list-style-type: none"> ● EC Measures targeting at Residential Sector <ol style="list-style-type: none"> (1) Check System of Customer's Record (2) EC Education for Schools (3) EC Museum (4) EC Campaign (Instruction by Imam to prayers and EC activities initiated by mosque itself) (5) Publication and Award System 	<ol style="list-style-type: none"> (1) EC Consulting Service for Residential Sector (2) Instruction Booklet for General People 	<p>Annual 1.0 % improvement by 2030</p> <p>Electricity Share: 50 %</p> <p>Annual Impact = 1.0 % x 0.5 = <u>0.5 %</u></p>
<ul style="list-style-type: none"> ● Cross Sector Action Strategy <ul style="list-style-type: none"> ✓ Utilization of high efficiency equipment and load leveling equipment through a labeling and standard system, information release, etc. ✓ Cooperation regarding peak shift operation ✓ Proper implementation of EC building codes ✓ Participation in maintenance training for middle and large AC systems ✓ Participation in education, training, and campaigns ✓ Establishment of R&D strategy for EC technology and implementation 	<ul style="list-style-type: none"> ● EC Measures targeting at Cross Sector <ol style="list-style-type: none"> (1) Energy Efficiency Labels and Standards (EELS) (2) Training Program for Energy Manager (including engineers) (3) Promotion of Architecture Technology (4) Monitoring and Awareness Survey (5) Promotion of R&D Scheme 	<ol style="list-style-type: none"> (1) Subsidy for Specific Equipment (Small scale subsidy) (2) Announcement of Daily Demand and Supply (3) Joint Development of EC Equipment and Household Appliances (4) Laboratory Testing for Performance Check 	<p>Total Annual Impact = 0.3 % + 0.3 % + 0.15 % + 0.5 % = <u>1.25 %</u></p> <p>Accumulated Impact by 2030 = <u>25 %</u> (=1-0.9875²³) (that is equivalent to 34 % improvement of Electricity GDP Intensity by 2030 from 2005)</p>

Chapter 3 Review of Proposed National Target

3.1 Power Demand Forecasts

3.1.1 Purpose of Power Demand Forecasts

The purpose of the power demand forecasts is to evaluate the basic energy conservation principle proposed by the JICA Study Team. For that purpose, the JICA Study Team draws up an appropriate power demand forecasting model and compares the simulation results with and without the principle. Specifically, the past power demand trends are collected, and a power demand is forecast up to 2030 in line with the concepts of the existing “Long Term Strategy 2025 (LTS 2025)” and “Eighth Development Plan (EDP)”. Then, the long term and middle term targets in the Basic EC Principle are reviewed from the viewpoint of those forecasts.

3.1.2 Case Study Setting and Preconditions

(1) Setting Case and Scenario

There are 2 base study cases, one with the energy conservation principle and one without. The case without the energy conservation principle is set as the “BAU (Business as Usual) Case” and the case implementing the energy conservation principle is set as the “EEC (Energy Efficiency and Conservation) Base Case”. In addition, sensitivity analysis of EEC factor change is conducted. As for EEC factor change, 2 scenarios, namely an EEC High Promotion Scenario and EEC Low Promotion Scenario are set as options for the EEC Base Case.

Table 3-1 Simulation Case and Optional Scenario

Cases	EEC Factor Change Options
BAU Case (Without energy conservation principle)	
EEC Base Case (25% reduction in total power consumption from the BAU Case, that is equivalent to a 34% improvement in Electricity GDP Intensity from the 2005 base year)	EEC High Promotion Scenario (More EEC achieved than the EEC Base Case)
	EEC Low Promotion Scenario (Less EEC achieved than the EEC Base Case)

(2) Preconditions of the BAU Case

- Sectoral electricity intensities in the past five years (2000-2005) have increased or remained flat, except for the Refinery & Chemical sector. Generally, so long as technical innovations do not occur in the sectors, electricity intensities of sectoral GDP do not change, and remain constant at the same level. Therefore, rate changes in electricity GDP intensities for the previous year converge to zero, even though current electricity GDP intensities in some sectors are going up while others are going down. In other words, it can be said that future electricity intensities for sectoral GDP remain at a constant level.
- Currently, crude oil prices are rising, however in the long-term it is estimated that crude oil

prices will fall due to the entrance of substitution energy sources into the market. Therefore, Real oil prices are set to fall to \$60/bbl. Under this assumption, it is believed that current prices for inexpensive oil products in the KSA will be maintained in the future. It is also assumed that a large rise in oil prices will not cause a decrease in domestic energy demand.

- This Study uses 6.5 % for 2005-2010, 5.0 % for 2010-2020, and 4.0 % for 2020-2030 for the BAU Case. In other words, the high economic growth rate set for period from 2005-2015. After that, the growth rate of the GDP will gradually decrease. GDP growth rates for each five-year increment in the BAU case are listed in the following table.

Table 3-2 GDP Growth Rate in the BAU Case

	Unit	05-10	10-15	15-20	20-25	25-30
BAU Case	%	6.5	5.0	5.0	4.0	4.0

(3) Preconditions of the EEC Base Case

- The scenario for the EEC Base Case sets achievement of a 25 % energy conservation rate by 2030 (25 % electricity consumption reduction from the BAU Case in 2030). This is equivalent to a 34 % improvement in Electricity GDP Intensity in 2030 from the level in 2005. The average economic growth rate of the EEC Base Case is 5.0 %, similar to the BAU Case.
- To realize an energy conservation rate of 25 %, EEC factors are set according to the following table.

Table 3-3 EEC Factors for the BAU Case and the EEC Base Case

Sector	Case	05-09	10-15	16/20	21-25	26-30
Agriculture	BAU (%)	0	0	0	0	0
	EEC (%)	0	-1	-1	-1	-1
Oil Refinery	BAU (%)	0	0	0	0	0
	EEC (%)	0	-1.5	-1.5	-1.5	-1.5
Manufacturing	BAU (%)	0	0	0	0	0
	EEC (%)	0	-1.5	-1.5	-1.5	-1.5
Commercial	BAU (%)	0	0	0	0	0
	EEC (%)	0	-1.5	-1.5	-1.5	-1.5
Government	BAU (%)	0	0	0	0	0
	EEC (%)	0	-1.5	-1.5	-1.5	-1.5
Residential	BAU (%)	0	0	0	0	0
	EEC (%)	0	-1	-1	-1	-1

(4) Preconditions of EEC Factor Change Options

- Regarding the EEC factor change, there are 2 options, namely the EEC High Promotion Scenario (high energy conservation achievement compared to the EEC Base Case) and the EEC Low Promotion Scenario (low energy conservation achievement compared to the EEC Base Case). These scenarios have the same level economy growth as the EEC Base Case. EEC factors of these scenarios are as follows.

Table 3-4 EEC Factors for EEC Factor Change Options

Sectors	Case	05-09	10-15	16/20	21-25	26-30
Agriculture	Base (%)	0	-1	-1	-1	-1
Oil Refinery	High (%)	0	-2	-2	-2	-2
	Base (%)	0	-1.5	-1.5	-1.5	-1.5
	Low (%)	0	-1	-1	-1	-1
Manufacturing	High (%)	0	-2	-2	-2	-2
	Base (%)	0	-1.5	-1.5	-1.5	-1.5
	Low (%)	0	-1	-1	-1	-1
Commercial	High (%)	0	-2	-2	-2	-2
	Base (%)	0	-1.5	-1.5	-1.5	-1.5
	Low (%)	0	-1	-1	-1	-1
Government	High (%)	0	-2	-2	-2	-2
	Base (%)	0	-1.5	-1.5	-1.5	-1.5
	Low (%)	0	-1	-1	-1	-1
Residential	High (%)	0	-1	-1	-1	-1
	Base (%)	0	-1	-1	-1	-1
	Low (%)	0	0	0	0	0

3.2 Power Demand Forecast Results

3.2.1 Countrywide Power Demand Forecasts

In the BAU Case, the average growth rate of power demand during 2005-2030 is forecast at 4.3 %. In particular, the manufacturing and commercial & service sectors have higher growth rates than the others. The average growth rate of the EEC Base Case (25 % electricity consumption reduction compared with the BAU Case) indicates 3.2 % in the same term, and it is lower than the BAU Case by a difference of 1.1 %.

The power demand of the EEC Base Case is 13 % lower than the BAU Case in 2020 and 25 % in 2030. This shows that the results of the EEC factors gradually become effective.

Table 3-5 Power Demand in the BAU Case

BAU Case		2005	2010	2015	2020	2025	2030	05-30
Agriculture.Fishery	GWh	3,164	4,348	5,232	6,133	7,132	8,260	3.9
Refinery & Petrochemicals	GWh	15,698	21,229	26,441	33,878	41,410	50,664	4.8
Manufacturing	GWh	18,103	28,744	39,228	52,717	67,239	85,583	6.4
Commercials & Services.	GWh	15,580	25,006	34,454	45,844	57,757	72,536	6.3
Government	GWh	22,434	29,205	36,369	45,139	53,181	62,557	4.2
Residentials	GWh	78,304	99,105	114,288	129,470	145,158	162,569	3.0
Total	GWh	153,283	207,638	256,012	313,179	371,876	442,169	4.3

Table 3-6 Power Demand in the EEC Base Case

		2005	2010	2015	2020	2025	2030	05-30
Agriculture.Fishery	GWh	3,164	4,305	4,925	5,491	6,072	6,688	3.0
Refinery & Petrochemicals	GWh	15,698	20,911	24,149	28,689	32,515	36,886	3.5
Manufacturing	GWh	18,103	28,313	35,827	44,642	52,796	62,309	5.1
Commercials & Services.	GWh	15,580	24,631	31,467	38,822	45,351	52,810	5.0
Government	GWh	22,434	28,766	33,216	38,225	41,758	45,544	2.9
Residentials	GWh	78,304	98,114	107,600	115,919	123,596	131,637	2.1
Total	GWh	153,283	205,040	237,185	271,788	302,087	335,874	3.2

3.2.2 Regional Power Demand

The supply network in the KSA is divided into four groups, namely COA, EOA, WOA, and SOA. Recently, COA was connected to EOA, and another interconnection between COA and WOA is also planned. In this context, it is difficult to forecast future dispatched power independently. However, as a reference for the Study, the JICA Study Team tried to forecast the future dispatched power after referring to the past growth rate of each supply network, the results are shown in the following table.

Table 3-7 Regional Dispatched Power in the BAU Case

		2005	2010	2015	2020	2025	2030
COA	GWh	38,995	51,698	63,743	77,976	92,591	110,093
EOA	GWh	76,918	98,411	117,126	138,128	157,898	180,469
WOA	GWh	45,962	63,123	80,637	102,079	125,289	153,822
SOA	GWh	10,160	14,588	19,391	25,439	32,246	40,766
Total	GWh	172,035	227,745	280,804	343,508	407,889	484,989
COA	S%	22.7	22.7	22.7	22.7	22.7	22.7
EOA	S%	44.7	43.2	41.7	40.2	38.7	37.2
WOA	S%	26.7	27.7	28.7	29.7	30.7	31.7
SOA	S%	5.9	6.4	6.9	7.4	7.9	8.4
Total	S%	100.0	100.0	100.0	100.0	100.0	100.0

Table 3-8 Regional Dispatched Power in the EEC Base Case

		2005	2010	2015	2020	2025	2030
COA	GWh	38,995	51,052	59,055	67,671	75,215	83,627
EOA	GWh	76,918	97,180	108,513	119,872	128,266	137,085
WOA	GWh	45,962	62,334	74,707	88,588	101,777	116,844
SOA	GWh	10,160	14,406	17,965	22,077	26,194	30,966
Total	GWh	172,035	224,897	260,154	298,109	331,342	368,400
COA	S% of GWh	22.7	22.7	22.7	22.7	22.7	22.7
EOA	S% of KTOE	44.7	43.2	41.7	40.2	38.7	37.2
WOA	S% of KTOE	26.7	27.7	28.7	29.7	30.7	31.7
SOA	S% of KTOE	5.9	6.4	6.9	7.4	7.9	8.4
Total	S% of KTOE	100.0	100.0	100.0	100.0	100.0	100.0

3.2.3 EEC Factor Change Option Sensitivity Study

(1) EEC High Promotion Scenario

The “EEC High Promotion Scenario” is the scenario in which more energy conservation will be achieved than in the EEC Base Case. The EEC factors of the EEC High Promotion Scenario are defined in the following table. Regarding the oil sector, the manufacturing sector, the commercial sector, and the governmental sector, the EEC factors rose to 2.0 % from 1.5 % of the EEC Base Case. The Scenario has the same economic growth as the EEC Base Case.

Table 3-9 EEC Factors in the EEC High Promotion Scenario and the EEC Base Case

Sectors	Case	05-09	10-15	16/20	21-25	26-30
Agriculture	High (%)	0	-1	-1	-1	-1
	Base (%)	0	-1	-1	-1	-1
Oil Refinery	High (%)	0	-2	-2	2	-2
	Base (%)	0	-1.5	-1.5	-1.5	-1.5
Manufacturing	High (%)	0	-2	-2	-2	-2
	Base (%)	0	-1.5	-1.5	-1.5	-1.5
Commercial	High (%)	0	-2	-2	2	-2
	Base (%)	0	-1.5	-1.5	-1.5	-1.5
Government	High (%)	0	-2	-2	-2	-2
	Base (%)	0	-1.5	-1.5	-1.5	-1.5
Residential	High (%)	0	-1	-1	-1	-1
	Base (%)	0	-1	-1	-1	-1

The average growth rate of power demand in the EEC High Promotion Scenario is forecast at 2.9 % from 2005 to 2030. It is 0.3 % lower than the EEC base case (3.2 %). The residential sector has the same power demand (2.1 %) in both cases because of the same EEC factors.

Table 3-10 Power Demand in the EEC High Promotion Scenario compared with the EEC Base Case

Case	Sector	Unit	2005	2010	2015	2020	2025	2030	30/05
EEC	Industry	TWh	53	78	96	118	137	159	4.5
	Government	TWh	22	29	33	38	42	46	2.9
	Residentials	TWh	78	98	108	116	124	132	2.1
	Total	TWh	153	205	237	272	302	336	3.2
High EEC	Industry	TWh	53	78	94	112	127	143	4.1
	Government	TWh	22	29	32	36	38	41	2.4
	Residentials	TWh	78	98	108	116	124	132	2.1
	Total	TWh	153	205	233	264	289	316	2.9
Differ	Industry	TWh	0	0	-3	-6	-10	-15	
	Government	TWh	0	0	-1	-2	-3	-5	
	Residentials	TWh	0	0	0	0	0	0	
	Total	TWh	0	-1	-4	-8	-13	-20	

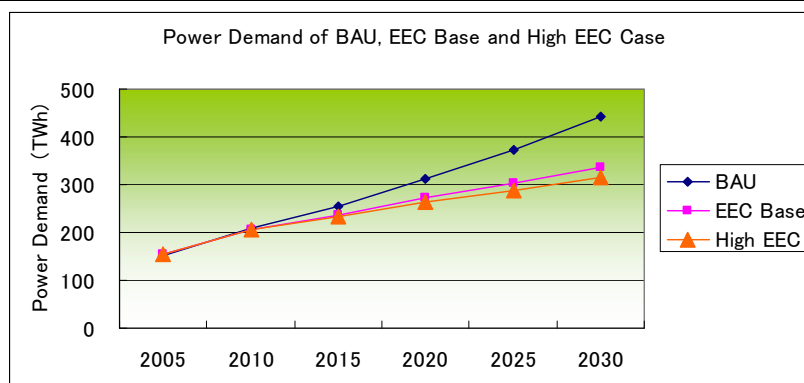


Figure 3-1 Power Demand of the EEC High Promotion Scenario, the BAU Case and the EEC Base Case

(2) Low Promotion Scenario

The EEC Low Promotion Scenario is the scenario in which less energy conservation will be achieved than in the EEC Base Case. The EEC factors of the EEC Low Promotion Scenario are defined in the following table. Regarding the oil sector, the manufacturing sector, the commercial sector, and the government sector, the EEC factors are dropped by 1.0 % from 1.5 % of the EEC Base Case. The residential sector is also dropped to 0 % from 1.0 % of the EEC Base Case. The Scenario has the same economy growth as the EEC Base Case.

Table 3-11 EEC Factors in the EEC Low Promotion Scenario and the EEC Base Case

Sectors	Case	05-09	10-15	16-20	21-25	26-30
Agriculture	Low (%)	0	-1	-1	-1	-1
	Base (%)	0	-1	-1	-1	-1
Oil Refinery	Low (%)	0	-1	-1	-1	-1
	Base (%)	0	-1.5	-1.5	-1.5	-1.5
Manufacturing	Low (%)	0	-1	-1	-1	-1
	Base (%)	0	-1.5	-1.5	-1.5	-1.5
Commercial	Low (%)	0	-1	-1	-1	-1
	Base (%)	0	-1.5	-1.5	-1.5	-1.5
Government	Low (%)	0	-1	-1	-1	-1
	Base (%)	0	-1.5	-1.5	-1.5	-1.5
Residential	Low (%)	0	0	0	0	0
	Base (%)	0	-1	-1	-1	-1

The average growth rate of power demand in the EEC Low Promotion Scenario is forecast at 3.8 % from 2005 to 2030. It is 0.6 % higher than the EEC Base Case (3.2 %). Meanwhile, in the residential sector, the average growth rate is forecast at 3.0 % in the EEC Low Promotion Scenario compared with 2.1 % in the EEC Base Case because of the difference in EEC factors.

Table 3-12 Power Demand in the EEC Low Promotion Scenario compared with the EEC Base Case

Case	Sector	Unit	2005	2010	2015	2020	2025	2030	30/05
EEC	Industry	TWh	53	78	96	118	137	159	4.5
	Government	TWh	22	29	33	38	42	46	2.9
	Residentials	TWh	78	98	108	116	124	132	2.1
	Total	TWh	153	205	237	272	302	336	3.2
Low EEC	Industry	TWh	53	79	99	124	148	176	4.9
	Government	TWh	22	29	34	40	45	51	3.3
	Residentials	TWh	78	99	114	129	145	163	3.0
	Total	TWh	153	207	248	294	338	389	3.8
Differ	Industry	TWh	0	0	3	6	11	17	
	Government	TWh	0	0	1	2	4	5	
	Residentials	TWh	0	1	7	14	22	31	
	Total	TWh	0	2	11	22	36	53	

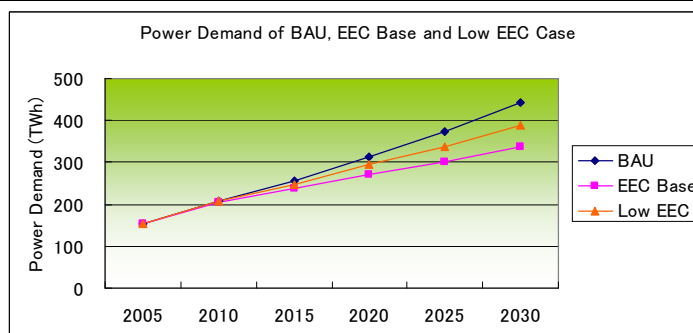


Figure 3-2 Power Demand of the EEC Low Promotion Scenario, the BAU Case and the EEC Base Case

3.3 Review of Achievement of National Target from Power Demand Forecasts

In this section, the possibility of achieving the middle and long-term national targets proposed is reviewed. The proposed targets are as follows.

Table 3-13 Proposed National Targets

Term	National Target
1) Long Term	30 % improvement of Electricity GDP Intensity (electricity consumption per GDP) by 2030 from 2005
2) Middle Term	50 % reduction in the growth rate of peak demand by 2015 compared with the current growth rate (2000-2005)

3.3.1 Electricity GDP Intensity

(1) Target Value of Electricity GDP Intensity

The proposed long-term target is 30 % improvement of Electricity GDP Intensity by 2030 from the level in 2005. The Electricity GDP Intensity in 2005 was 202 kWh/1,000SR. Thus, the Indicator aims to be at 140 kWh/1,000SR in 2030 (30 % reduction).

(2) Review of Achievement for Each Case and Option Scenario

The following figure shows the results of the review of the achievement in the BAU Case, the EEC Base Case, the EEC High Promotion Scenario, and the EEC Low Promotion Scenario, respectively.

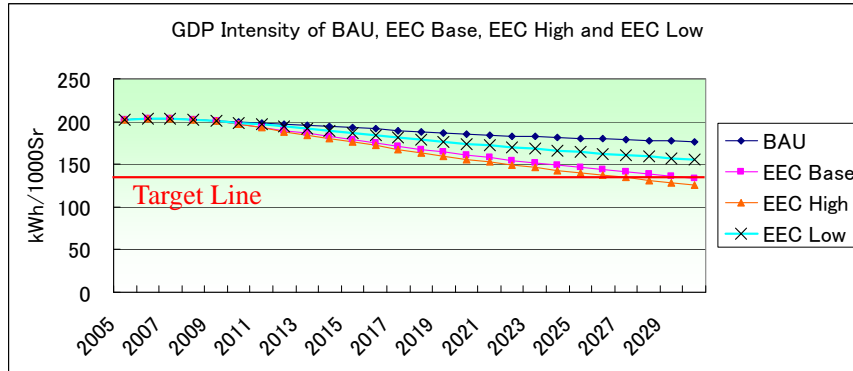


Figure 3-3 Electricity GDP Intensity in Each Case and Option Scenario

Table 3-14 Achievement of Each Case and Option Scenario

	Reduction Level of Total Electricity Consumption from the BAU Case at 2030	Reduction Level of Electricity GDP Intensity at 2030 (Base Year: 2005)
		National Target Value (30 %)
BAU Case	-	13 %
EEC Base Case	25 %	34 %
EEC High Promotion Scenario	28 %	38 %
EEC Low Promotion Scenario	12 %	23 %

Clear!

3.3.2 Peak Demand

The middle term target is 50 % reduction in the growth rate of peak demand by 2015 compared to the current growth rate (2000-2005). The average growth rate of peak demand during 2000-2005 was 6.7 %. This means a 3.35 % growth rate is required by 2015. As shown in the following figure, the growth rate of the BAU Case during 2010-2015 is forecast at 3.7 %, and the EEC Base Case is 2.1 %. Thus, if the EEC Base Case can be achieved, the middle term target will be also achieved.

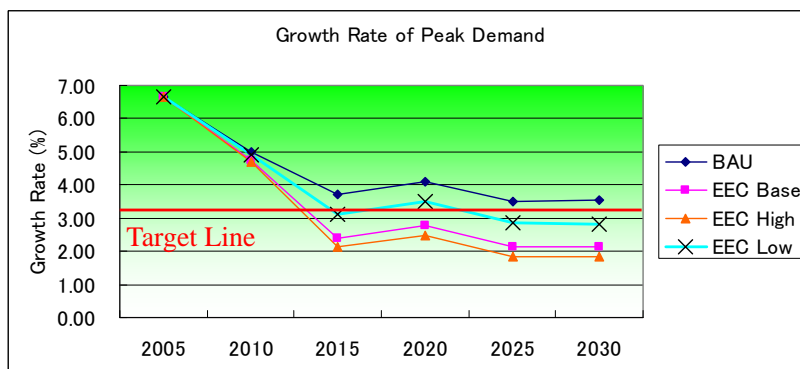


Figure 3-4 Growth Rate of Peak Demand

Chapter 4 High Priority Measures

4.1 Implementation Structure

4.1.1 Executing Agency

The 13 high priority measures will be executed by the following agencies at the final stage. Some of the measures are jointly conducted. Out of the 13 measures, Saudi Energy Efficiency Center (SEEC), that is the new central institute for implementation of measures, is expected to conduct 9 measures as a main agency or supporting agency.

Table 4-1 List of Executing Agency

	High Priority Measures	Main Agency	Supporting Agency
1	Energy Management System	<u>SEEC</u>	SEC, etc.
2	Energy Efficiency Labels and Standards	<u>SASO/SEEC</u>	MOWE, SEC
3	Training Program for Energy Manager	<u>SEEC</u>	ARAMCO, SABIC, etc.
4	Energy Assessment Service	<u>SEEC</u>	COC
5	Publication and Award System	<u>SEEC</u>	COC, etc.
6	EC Campaign	MOWE	<u>SEEC</u> , SEC, etc.
7	Check System for Customer's Record	SEC	
8	EC Education for Schools	MOWE	MOE, SEC, KACST
9	EC Museum	<u>SEEC</u>	MOWE, SEC, etc.
10	Promotion of Architectural Technology	<u>SASO/SEEC</u>	MOCI, SBCC, MOMRA, KACST
11	Monitoring and Awareness Survey	<u>SEEC</u>	MOWE, SEC, etc.
12	Load Management	SEC	ECRA, COC
13	Promotion of R&D Scheme	KACST	Univ., etc.

4.1.2 Schedule of Human Resources

Incremental human resources to implement each high priority measure in main agencies are summarized in the following human resources schedule. In case the current staff in the existing agency can cover tasks within his capability, it is neglected from the schedule.

Table 4-2 Human Resources Schedule (Incremental Staff)

	Executing Agency	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
1 Energy Management System	SEEC HQ			3	3	3	3	3	3	3	3	3
	SEEC Local Offices											
2 Energy Efficiency Labels and Standards	SASO	5	5	5	5	5	5	5	5	5	5	5
	SEEC HQ											
3 Training Program for Energy Manager	SEEC HQ			3	3	3	3	3	3	3	3	3
	SEEC Local Offices											
4 Energy Assessment Service	SEEC HQ			4	4	4	4	4	4	4	4	4
5 Publication and Award System	SEEC HQ			3	3	3	3	3	3	3	3	3
	SEEC Local Offices											
6 EC Campaign	SEEC HQ											
7 Check System of Customer Records	SEC		1	1	1	1	1	1	1	1	1	1
8 EC Education for Schools	MOWE	(No incremental staff)										
9 EC Museum	SEEC HQ			2	2	2	2	2	2	2	2	2
	SEEC Museum Office						9	9	9	25	25	25
10 Promotion of Architectural Technology	SASO	2	2	2	2	2	2	2	2	2	2	2
	SEEC HQ											
11 Monitoring and Awareness Survey	SEEC HQ			1	1	1	3	3	3	3	3	3
12 Load Management	SEC	(No incremental staff)										
13 Promotion of R&D Scheme	KACST	(No incremental staff)										

4.1.3 Budget Required

Each measure needs direct costs to execute. The following table shows the required direct costs excluding human resources costs and general administration costs. The direct costs consist of a spot expenditure for one event like construction/installation costs and annual basis expenditure like operation/maintenance costs.

Table 4-3 Budget Required

(Unit: million SR)

	Executing Agency	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
1 Energy Management System (Database, internet access system, temporary training program)	MOWE&MOPMR		0.6									
2 Energy Efficiency Labels and Standards (Database, internet access system) (Test cost for random inspection)	SASO		0.4									
	SEEC				0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
3 Training Program for Energy Manager (Training of Teachers) (Training equipment and facilities) (Operation of training program in the pilot stage) (Operation of training program in the final stage)	MOWE		1.26									
	SEEC				5.35							
	SEEC					0.344	0.344					
	SEEC							0.68	0.68	0.68	0.68	0.68
4 Energy Assessment Service (Training for consultants) (Assessment service operation)	MOWE		0.04									
	SEEC				0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43
5 Publication and Award System (Database, internet access system)	SEEC				1.5							
6 EC Campaign	MOWE/SEEC	(No cost)										
7 Check System of Customer Records (Database, internet access system)	SEC		1.5									
8 EC Education for Schools (Making education materials) (DT scheme) (TOT scheme)	MOWE		0.1									
	MOWE			0.06	0.06							
	MOWE					0.126	0.126	0.126	0.126	0.126	0.126	0.126
9 EC Museum (Feasibility Study) (Detailed Design and Construction) (Museum and building operation)	MOWE		3									
	SEEC				177							
	SEEC						3.86	7.72	7.72	7.72	7.72	7.72
10 Promotion of Architectural Technology (Database, internet access system) (Inspection cost)	SASO			1.5								
	SEEC				0.225	0.45	0.45	0.45	0.45	0.45	0.45	0.45
11 Monitoring and Awareness Survey (Database, internet access system) (Survey cost in the pilot stage) (Survey cost in the final stage)	MOWE			1.5								
	MOWE		1.1	1.1								
	SEEC				1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
12 Load Management (Tariff discount in the pilot stage) (Tariff discount in the final stage)	SEC		0.06									
	SEC			20	20	20	20	20	20	20	20	20
13 Promotion of R&D Scheme (Needs and seeds survey) (Demonstration project) (Basic Research)	KACST		1									
	KACST					9		9		9		9
	KACST							24		24		24

From the above measures, the following 3 measures need a large amount of budget.

Table 4-4 Measures which Need a Large Amount of Budget

Name of Measure	Executing Agency	Main Expenditure Expected	Budget Required
EC Museum	SEEC	Design and construction of SEEC HQ building including a museum space	177 million SR
Load Management (Emergency Load Adjustment Contract)	SEC	Discounted tariff (actually it is reduction of revenue. Reduction of revenue is regarded as an expenditure)	20 million SR/year (depends on number of applied customers)
Promotion of R&D Scheme	KACST	Financial support of demonstration project and basic research conducted by applicants	34 million SR/year

4.1.4 Legislation Required

(1) Required Legal Basis for Implementation of High Priority Measures

Some measures of the high priority measures require a legal basis to implement. In this Study, required legal basis for some measures is proposed from the following categories.

- ✓ Category A: Mandatory programs
- ✓ Category B: Voluntary programs which are executed by SEEC as a government agency

Based on the above criteria, 9 measures are identified as measures which need legal basis.

Table 4-5 Measures which Need Legal Basis

	Category	High Priority Measures	Main Agency	Supporting Agency
1	A	Energy Management System	<u>SEEC</u>	SEC, etc.
2	A	Energy Efficiency Labels and Standards	SASO/ <u>SEEC</u>	MOWE, SEC
3	A	Training Program for Energy Manager	<u>SEEC</u>	ARAMCO, SABIC, etc.
4	B	Energy Assessment Scheme	<u>SEEC</u>	COC
5	B	Publication and Award System	<u>SEEC</u>	COC, etc.
6	B	EC Campaign	MOWE	<u>SEEC</u> , SEC, etc.
9	B	EC Museum	<u>SEEC</u>	MOWE, SEC, etc.
10	A	Promotion of Architectural Technology	SASO/ <u>SEEC</u>	MOCI, SBCC, MOMRA, KACST
11	B	Monitoring and Awareness Survey	<u>SEEC</u>	MOWE, SEC, etc.

(2) Structure of Legislation

Legislation for each measure identified above is proposed as an Act and related regulations (specifications and guideline) which are linked to the Act.

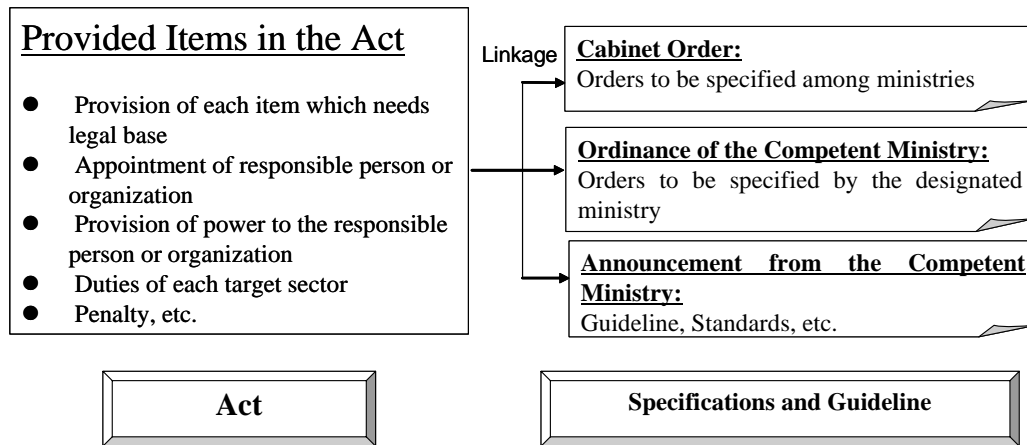


Figure 4-1 Structure of Legal Basis

The Act provides fundamental conditions such as the responsible person or organization, target sector and their duties and penalty. Related regulations are specified technical matters such as technical specifications, guidelines, and standards. Those related documents are stipulated in the Act and linked.

The related regulations include the following 3 types. These documents are issued in the name of cabinet or competent ministry in accordance with stipulation in the Act.

- Cabinet Order: Orders to be specified among ministries
- Ordinance of the Competent Ministry: Orders to be specified by the designated ministry
- Announcement from the Competent Ministry: Guideline, Standards, etc.

(3) Required Item to be Stipulated in the Act

(a) Mandatory Programs (Category A)

(i) Energy Management System

The measure, Energy Management System, contains an obligation and penalty. To enforce this measure, in the very least the following items should be stipulated in the Energy Management System part of the Act.

Table 4-6 Provision of the Act for Energy Management System

Item to be Stipulated in Act	Expected Contents
Evaluation of Criteria for Business Operators	<ul style="list-style-type: none"> ● Target fields and the guidance for rational use ● Evaluation criteria to judge proper implementation of EC activities by designated Factories and Buildings
Guidance and Advice	<ul style="list-style-type: none"> ● Provision of power to correct improper implementation (to the Minister)
Designation of Designated Energy Management Factories and Buildings	<ul style="list-style-type: none"> ● Definition of the designated Factories and Buildings ● Provision of obligation of reporting
Energy Managers	<ul style="list-style-type: none"> ● How to appoint Energy Manager(s) in each designated Factory and Building ● How to notify assigned Energy Manager to the Minister
Duty of Energy Manager	<ul style="list-style-type: none"> ● How to manage energy-consuming facilities, improve and supervise methods by the Energy Manager
Preparation of Medium Term Plan	<ul style="list-style-type: none"> ● Obligation of preparation of Middle Term Plan ● How to prepare Middle Term Plan (Guideline)
Periodical Reports	<ul style="list-style-type: none"> ● Obligation of preparation of Periodical Report ● How to prepare Periodical Report (Guideline)
Instructions and Orders on Rationalization Plans	<ul style="list-style-type: none"> ● Instruction and Order to improper Factory and Building
Penalty	<ul style="list-style-type: none"> ● Provision of penalty to a business operator who does not improve even after recommendation and order of the Minister

(ii) Energy Efficiency Labels and Standards (EELS)

This measure also contains an obligation with penalty. The items to be stipulated in the EELS part of the Act, are as follows.

Table 4-7 Provision of the Act for Energy Efficiency Labels and Standards

Item to be Stipulated in Act	Expected Contents
Role of Manufacturers and Importers	<ul style="list-style-type: none"> ● Provision of philosophy to improve the performance of machinery and equipment by all business operators engaged in manufacturing or importing energy-consuming machinery and equipment
Standards of Judgment for Manufacturers /Importers and Registration of the Performance	<ul style="list-style-type: none"> ● Designation of designated machinery and equipment ● Standards of judgment with regard to the improvement of the performance of each designated machinery and equipment ● Minimum standard level ● Obligation of sending data to a designated agency
Recommendation and Orders concerning Improvement of Performance	<ul style="list-style-type: none"> ● Provision of power to recommend manufacturer/importer to improve the performance when necessary ● Publication and order when manufacturer/importer fails to follow such recommendation
Labeling and Obligation to Manufacturers /Importers	<ul style="list-style-type: none"> ● Labeling method and its obligation
Recommendation and Orders concerning Labeling	<ul style="list-style-type: none"> ● Provision of power to recommend manufacturer/importer to improve the labeling when necessary ● Publication and order when manufacturer/importer fails to follow such recommendation
Provision of Information to General Consumers	<ul style="list-style-type: none"> ● Provision of retail shops' endeavor to provide information with regard to designated machinery and equipment (label display)
Penalty	<ul style="list-style-type: none"> ● Provision of penalty to manufacturer/importer who does not improve even after recommendation and order of the Minister

(iii) Training Program for Energy Manager

This measure includes a qualification system of “Energy Manager” as a part of the Energy Management System. So this measure also needs a legal basis for the qualification of Energy Manager.

Table 4-8 Provision of the Act for Training Program for Energy Manager

Item to be Stipulated in Act	Expected Contents
Qualified Energy Manager’s License	<ul style="list-style-type: none"> ● How to qualify for Energy Manager ● Provision of Qualification Methods (Examination, or Qualification Training Course, etc.) ● Designation of a responsible body for such Examination or Qualification Training Course ● Expected subjects of Examination or Qualification Training Course

(iv) Promotion of Architectural Technology

This measure (Promotion of Architectural Technology: Building Material Energy Performance Indication System) is a similar scheme to the Energy Efficiency Labels and Standards (EELS). The contents will also be similar to that of EELS.

(b) Voluntary Programs Executed by SEEC (Category B)

The following 5 measures that are voluntary programs are expected to be executed by SEEC.

- Energy Assessment Service
- Publication and Award System
- EC Campaign
- EC Museum
- Monitoring and Awareness Survey

Assuming SEEC is established as a government agency, a legal basis of SEEC is proposed including the above 5 measures (red column) as follows.

Table 4-9 Legal Basis for Establishment of SEEC (as a Government Agency)

Item to be Stipulated in Act	Expected Contents
Establishment of SEEC (Saudi Energy Efficiency Center)	<ul style="list-style-type: none"> ● Incorporation, status, and office location ● Vision and mission
Governance	<ul style="list-style-type: none"> ● Governing board members and chairman (ex. government, private sector selected from membership, academia, citizen, etc.) ● Participation of private sector by membership ● Board member meeting
Organization and Staff	<ul style="list-style-type: none"> ● Department and its role ● Maximum number of each department ● Status of staff
SEEC’s Activities and SEEC’s Role in Each Activity*1	<ul style="list-style-type: none"> ● Energy Assessment Service ● Publication and Award System ● EC Campaign ● EC Museum ● Monitoring and Awareness Survey
Finance	<ul style="list-style-type: none"> ● Financial source of each activity (MOF budget, sponsor’s support, revenue from membership fee, revenue from training fee, self budget, etc) ● Allocation of budget to each activity

*1 Mandatory programs executed by SEEC are stipulated by the other act.

4.2 Recommendation for Formulation of Each High Priority Measure

4.2.1 Formation of Preparation Team

As mentioned above, out of the 13 high priority measures, 9 measures will be handled by SEEC as a main agency or supporting agency. However, SEEC has not been established yet (it is expected in 2010 after official procedure). Even after establishment of SEEC, legislation and implementation regulation for each measure will also be required before starting the 9 measures. This means that 9 high priority measures will officially start after 2011.

To efficiently use a time before the establishment of SEEC, the official approval procedures of legislation and implementation regulation of measures executed by SEEC, preparatory work is proposed as optional work conducted by a "Preparation Team". This Team will consist of MOWE and/or other concerning agencies. The preparatory work should be undertaken for making draft legislation and implementation regulation of SEEC's measures.

4.2.2 Recommended Actions Undertaken by Preparation Team

(1) Energy Management System

To make draft legislation and implementation regulation for Energy Management System, a practical trial is recommended. Lessons learned from the trial will be reflected on draft legislation and implementation regulation.

Scope 1

Preparatory Work: Trial of Energy Management System in 10 voluntary consumers
 Objective: Preparation of draft legislation and implementation regulation
 Duration: 2008/10-2010/12
 Preparation Team: MOWE and MOPMR
 Target: 10 voluntary consumers
 Tasks of Target: Assignment of temporary Energy Manager, Energy management, Making reports, etc.
 Expected Output: Energy management method, Reporting method, Database, etc.

Scope 2

Preparatory Work: Trial of energy conservation activities in 2 model sites in accordance with the expected Energy Management System
 Objective: Preparation of draft legislation and implementation regulation
 Duration: 2009/1-2010/3
 Preparation Team: MOWE and MOPMR
 Target: 2 model sites (factory and building)
 Tasks of Target: Total Quality Management (TQM) activities, Energy management, etc.
 Expected Output: Energy management method, etc.

(2) Energy Efficiency and Labels and Standards

This measure has already been implemented as a pilot stage (voluntary program) by SASO. After the establishment of SEEC, SASO and SEEC will jointly implement this as a final stage (mandatory program). To make draft legislation and implementation regulation for the mandatory program, a preparatory work is recommended as follows.

Scope 1

Preparatory Work: Making draft legislation and implementation regulation
 Objective: Preparation of draft legislation and implementation regulation
 Duration: 2009/4-2010/3
 Preparation Team: SASO and MOWE
 Expected Output: Comparison of legislation in other countries, Comparison of database in other countries, Comparison of inspection methods in other countries, etc.

Scope 2

Preparatory Work: Monitoring and awareness survey
 Objective: Improvement of dissemination system
 Duration: 2009/4-2010/3
 Preparation Team: SASO and MOWE
 Target: Customers, retail shops and manufactures
 Expected Output: Standardization of questionnaire/interview survey, Penetration ratio, Effective dissemination system, etc.

(3) Training Program for Energy Manager

This program must be established before official implementation of Energy Management System. Therefore, during the preparatory time before establishment of SEEC, training program preparations including recruitment of teachers is recommended.

Scope 1

Preparatory Work: Making a draft training program for Energy Manager
 Objective: Preparation of draft legislation and implementation regulation
 Duration: 2009/4-2010/3
 Preparation Team: MOWE
 Expected Output: A draft training program for Energy Manager, Candidates of teachers, Certification system of Energy Manager, Operation way of training program and certification system, etc.

(4) Energy Assessment Service

Before starting an official implementation, it should standardize the quality of the service. The following preparatory work is recommended.

Scope 1

Preparatory Work: Standardization of Energy Assessment Service
 Objective: Preparation of draft legislation and implementation regulation
 Duration: 2009/4-2010/3
 Preparation Team: MOWE
 Target: Factory and building
 Expected Output: Quick survey in target sites, Standardization of reporting, Database, etc.

(5) Publication and Award System

The most important thing is to establish a collection system of good projects and practices from each target sector. Before starting an official implementation, it should to some extent secure a collection system.

Scope 1

Preparatory Work: Trial of award system in “Electricity” in Riyadh
 Objective: Preparation of draft legislation and implementation regulation and establishment of collection system
 Duration: 2009/1-2010/3
 Preparation Team: MOWE
 Target: Industrial and commercial sector in Riyadh (Electricity)
 Expected Output: Collection system, Application system, Evaluation method, etc.

(6) EC Campaign

This measure has already been implemented by MOWE as a main executing agency. SEEC will also join the campaign program after its establishment. To make draft legislation and implementation regulation of SEEC’s activity, a preparatory work is recommended.

Scope 1

Preparatory Work: Development of campaign contents
 Objective: Preparation of draft legislation and implementation regulation
 Duration: 2009/4-2010/3
 Preparation Team: MOWE
 Expected Output: Website design for dissemination, Campaign contents, etc.

(7) EC Museum

It is necessary to conduct a feasibility study for the EC museum including a SEEC office building. This feasibility study is expected to be completed by SEEC establishment and then it will be authorized by SEEC.

Scope 1

Preparatory Work: Feasibility study for EC museum including SEEC office building

Objective: Making a consensus of feasibility design of SEEC office building and EC museum

Duration: 2008/10-2010/3

Preparation Team: MOWE

Expected Output: Basic design of EC museum and SEEC office building including training facilities, Cost estimation, and Museum operation method

(8) Promotion of Architectural Technology

This program is similar to the Energy Efficiency Labels and Standards (EELS). However, the concerned agencies and targets are different. So it is important to design this scheme and have consensus of the stakeholders.

Scope 1

Preparatory Work: Design of the scheme and have consensus of the stakeholders

Objective: Preparation of draft legislation and implementation regulation

Duration: 2009/4-2010/3

Preparation Team: SASO and MOMRA

Expected Output: Design of the scheme, Consensus of stakeholders, Target materials, Database, etc.

(9) Monitoring and Awareness Survey

This measure is expected to be conducted by MOWE as a pilot project. After that, the measure will be transferred to the newly established SEEC.

Scope 1

Preparatory Work: Making draft legislation and implementation regulation

Objective: Preparation of draft legislation and implementation regulation

Duration: 2009/4-2010/3

Preparation Team: MOWE

Expected Output: Standardization of questionnaire and analysis method, Data collection method, Making database booklet

(10) Priority of Each Preparatory Work

Priority of the preparatory work for the 9 measures is proposed as follows.

Table 4-10 Priority of Preparatory Work A: Important, B: Optional

Preparatory Work		Priority	Remarks
Energy Management System	Scope 1	A	This is the first trial of the measure.
	Scope 2	B	This scope is a supplementary work for the scope 1.
Energy Efficiency and Labels and Standards	Scope 1	B	SASO has already started the voluntary program. So SEEC's implementation regulation can be made by transformation of SASO's regulation.
	Scope 2	A	It is important to establish monitoring and its reflection on the existing program.
Training Program for Energy Manager	Scope 1	A	This program must be established before official implementation of Energy Management System.
Energy Assessment Service	Scope 1	B	NEEP had implemented energy assessment quick service. The experience can be utilized for making implementation regulation.
Publication and Award System	Scope 1	A	This is the first trial of the measure.
EC Campaign	Scope 1	B	This measure has already been implemented by MOWE as a main executing agency.
EC Museum	Scope 1	A	To establish EC museum and SEEC building, it is necessary to conduct a feasibility study.
Promotion of Architectural Technology	Scope 1	A	From now, a scheme design will be conducted.
Monitoring and Awareness Survey	Scope 1	A	MOWE will conduct monitoring and awareness survey. This survey should be standardized to conduct from now on.

4.2.3 Recommended Actions Undertaken by Existing Agencies

Apart from SEEC's measures, some measures of existing agencies are recommended to conduct basic studies before implementation.

(1) EC Education for Schools

This measure will be conducted by MOWE together with Ministry of Education (MOE). Before starting this measure, the following tasks are required as a preparation work.

- Preparation of draft presentation materials and experiment goods
- Demonstration at Saudi schools using the draft materials
- Demonstration at Saudi schools in front of teachers who are expected as trainers.
- Finalization of presentation materials and experimental goods

(2) Load Management (Emergency Load Adjustment Contract)

This measure has been prepared by SEC. To formulate the measure, the following items should be studied.

- Designing specifications of the contract, such as:
 - Identification of eligible customers (demand size, sector)
 - Minimum requirement of adjustment [xxx kW, or xxx % of the contract capacity]
 - Identification of peak hours when the scheme is applied
 - Maximum number of requests per year
 - Lead time of notifying the adjustment [xx hours prior to the start of load adjustment]
 - Estimation of “avoidable cost” with peak shift, which leads to the unit price of tariff discount [incentives for actual adjustment and for stand-by]
 - Penalties for customers who didn't accept the request
- Drafting contract document

Chapter 5 Proposal of Saudi Energy Efficiency Center (SEEC)

5.1 SEEC Overview

5.1.1 Objective

In general, several concerned agencies are involved in energy conservation measures covering wide areas such as industrial, commercial, residential, governmental, school, mosque, etc. To effectively implement such measures, a central institute, that can enforce mandatory programs or implement voluntary programs under well good coordination with concerned agencies, is expected. In the KSA, this agency will be named “Saudi Energy Efficiency Center (SEEC)”.

As mentioned in the previous chapter, 9 measures have been selected for SEEC’s activities through discussion with the Steering Committee of the Study. SEEC is recommended to have the power of making legislation for enforcement and implementation, making strategy, implementation and evaluation for the measures.

The selected 9 measures are implemented by SEEC with the cooperation of each target sector. In order to receive the cooperation of each sector, representatives of each sector should also be involved in the operation of SEEC. Therefore a philosophy of the formation of SEEC is “All KSA” in order to gather the cooperation of private sectors and citizens.

5.1.2 Vision and Mission

SEEC’s vision and mission are proposed as follows. This vision and mission are created assuming SEEC is established as a national agency but an independent agency from existing ministries.

(Vision)

Saudi Energy Efficiency Center (SEEC) is to be a main center institute to sustain energy conservation activities in the KSA by managing energy consumption, enhancing energy management capabilities, supporting energy efficiency activities, and improving awareness and knowledge.

(Mission)

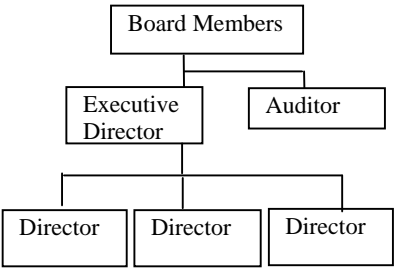
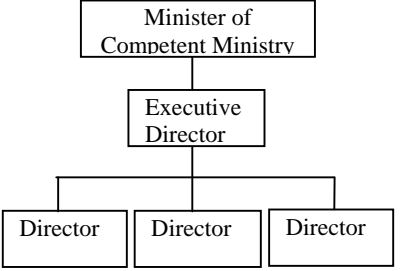
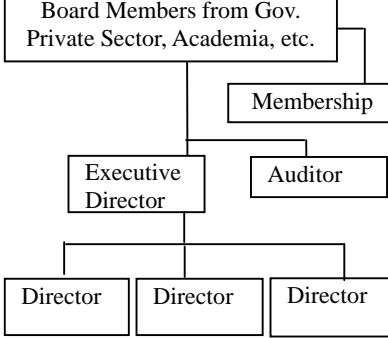
SEEC will be an independent national agency to provide integrated services in making policy, planning, managing, implementing, promoting, supporting, and coordinating energy conservation measures in electricity and heat for all public and private sectors.

5.1.3 Governance

(1) Options

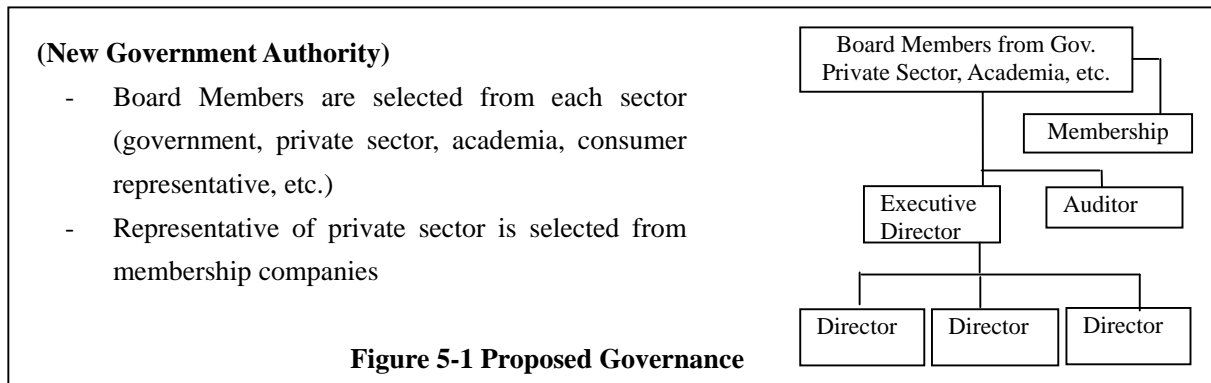
The JICA Study Team proposed 3 options for SEEC’s governance structure for its formation as shown below.

Table 5-1 Options of SEEC’s Governance

Option A (New Government Authority)	Option B (A Part of an Existing Ministry)	Option C (New Autonomous Authority)
		
<p>(Advantage) It is a conventional style in KSA. Board members can consist of Government sector, as well as private sector.</p>	<p>(Advantage) It seems to be easier to formulate a new organization because this option is an expansion of an existing ministry.</p>	<p>(Advantage) Involvement of private sector is stronger than Option A. Strong cooperation of private sector is expected.</p>
<p>(Disadvantage) It is an issue to get strong cooperation from private sector.</p>	<p>(Disadvantage) Security of enforcement power to cover wide areas (sometimes shared by more than 2 ministries) is an issue if a single ministry becomes SEEC.</p>	<p>(Disadvantage) Security of enforcement power is an issue if it is a Non-governmental organization.</p>

(2) Proposed Governance Structure

Through discussions with the Steering Committee during the Study, a combination of Option A and C was recognized as a preferable structure of SEEC’s governance. In this Study, it is assumed that a mixture of Option A and Option C is adopted. The proposed structure is as follows.



5.1.4 Organization

(1) Expected Tasks of SEEC

As shown below, SEEC implements the 9 measures as a main agency or supporting agency as shown in the following table.

Table 5-2 Expected SEEC's Measures

High Priority Measures	Main Agency	Supporting Agency
Energy Management System	<u>SEEC</u>	SEC, etc.
Energy Efficiency Labels and Standards	SASO/ <u>SEEC</u>	MOWE, SEC
Training Program for Energy Manager	<u>SEEC</u>	ARAMCO, SABIC, etc.
Energy Assessment Service	<u>SEEC</u>	COC
Publication and Award System	<u>SEEC</u>	COC, etc.
EC Campaign	MOWE	<u>SEEC</u> , SEC, etc.
EC Museum	<u>SEEC</u>	MOWE, SEC, etc.
Promotion of Architectural Technology	SASO/ <u>SEEC</u>	MOCI, SBCC, MOMRA, KACST
Monitoring and Awareness Survey	<u>SEEC</u>	MOWE, SEC, etc.

Regarding the above 9 measures, SEEC is expected to conduct:

- Making legislation and implementation regulation
- Making strategy
- Implementation and inspection
- Evaluation and revision

(2) Headquarters and Local Offices

To widely diffuse energy conservation activities covering the whole country, one headquarters (HQ) and 2 local offices are proposed to be located in Riyadh and main cities (Jeddah and Dammam). Riyadh headquarters has the functions of making legislation, regulation and strategy, and implementation of energy conservation activities in the central region including Riyadh.

On the other hand, local offices have the functions for implementation of “local measures” that should consider local affairs. In this context, 3 measures (Energy Management System, Training Program for Energy Manager and Publication and Award System) are nominated for tasks of local offices. The Jeddah local office covers the western and southern areas and the Dammam office covers the northern area, respectively.

The above 3 measures are planned to start a full scale implementation (final stage) from 2013 or 2014 according to each implementation plan paper. Commissioning of local offices is expected in 2013 (hopefully at the same time of commissioning of the headquarters building).

(3) Demarcation of Headquarters and Local Offices

Demarcation of SEEC's headquarters and local offices is proposed as follows.

Table 5-3 Demarcation of Headquarters and Local Offices

Tasks		Headquarters	Local Offices
Making Legislation and Implementation Regulation		x	
Making Strategy		x	
Implementation	Country-wide Activities (6 measures)	x	
	Local Area Activities (3 measures)	x	x
Inspection		x	
Evaluation and Revision		x	

(4) Measures Handled by Headquarters' Department and Local Offices

To implement the 9 measures, 3 implementing departments, 1 museum operation office and 1 administration department are proposed in the headquarters. Besides this, 2 local offices will have staff for implementation of local area activities of 3 measures.

(HQ Department)Energy Management System and Training Department

- Energy Management System
- Training Program for Energy Manager
- Energy Assessment Service

Labeling and Marking Department

- Energy Efficiency Labels and Standards
- Promotion of Architectural Technology (Building Material Energy Performance Indication System (BEPIS))

EC Promotion Department

- Publication and Award System
- EC Campaign
- Monitoring and Awareness Survey

Museum Operation Office

- EC Museum

(Local Offices)Jeddah Local Office (Western and Southern Areas) and Dammam Local Office (Northern Area)

- Local implementation of Energy Management System
- Local implementation of Training Program for Energy Manager
- Local implementation of Publication and Award System

(5) Proposed Organization Chart at the Final Stage

As a result of counting necessary staff in implementation plan papers for the 9 measures which are expected to be done by SEEC, the following organization and staff are proposed at the final stage of SEEC (2015).

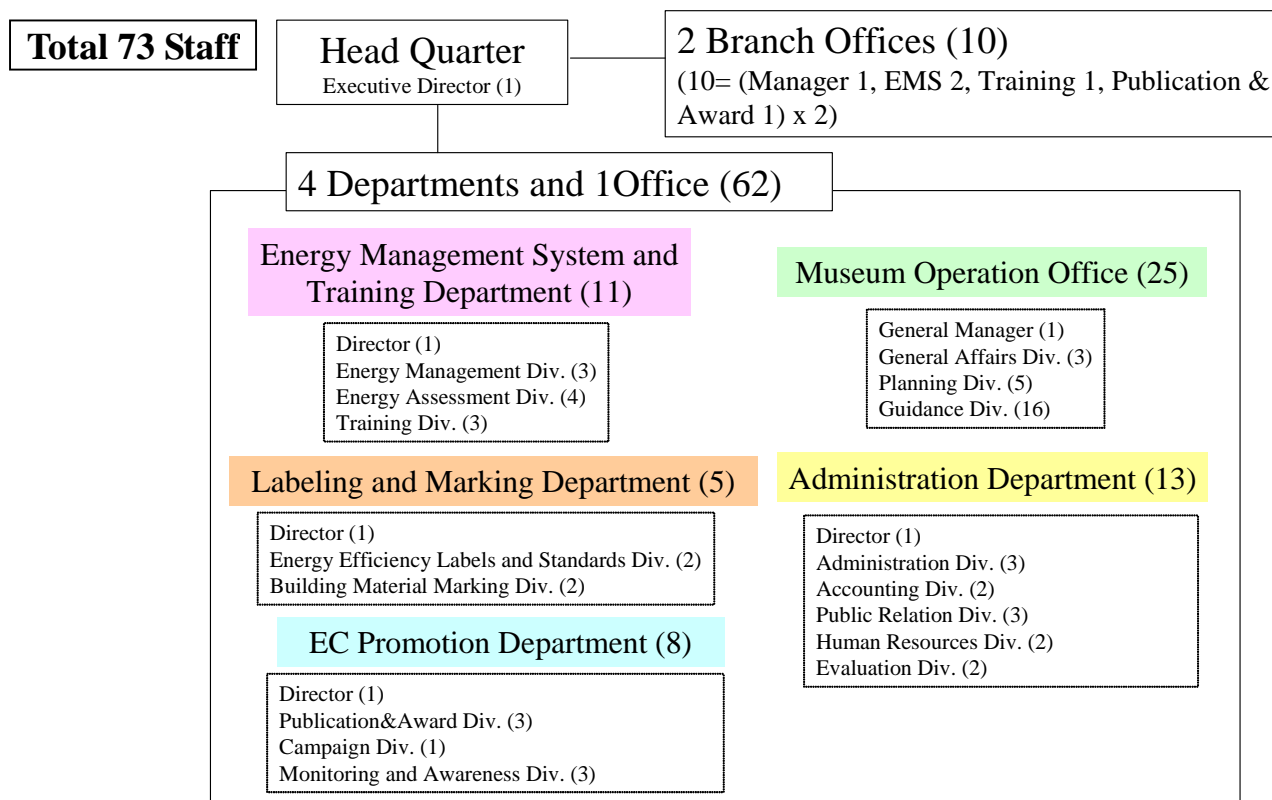


Figure 5-2 Proposed Organization Chart (at the Final Stage 2015)

5.2 Implementation Plan of SEEC

5.2.1 Overall Implementation Plan

Out of selected 13 measures, SEEC will be responsible for implementation of the 9 measures as a main agency or supporting agency. However, SEEC needs a time for official procedures to be established. Assuming SEEC is approved by the cabinet by April 2010, SEEC will officially begin from April 2010 in this implementation plan.

Although all of SEEC's official activities will start from its commissioning at 2010, some preparatory work including making draft legislation and implementation regulation are expected to be conducted beforehand by a "Preparation Team".

Reflecting the above conditions, an overall implementation plan of SEEC including human resources and required costs is proposed as shown below.

	2008	2009	2010	2011	2012	2013	2014	2015
SEEC Formation								
Preparation Team (MOWE/Steering Committee/JICA)		Preparation of SEEC and Regulations						
Cabinet Approval Procedure		Appraisal of SEEC						
SEEC (Temporary Office: HQ)				EC Measure Implementation (Pilot and Final)				
SEEC (Permanent Office: HQ)		F/S	D/D and Construction				Full Operation	
SEEC (Permanent Office: Local Offices)							Full Operation	
Preparation of Legislation								
SEEC and its Activities		Drafting Act and Relating Documents	Finalization of Legislation					
Energy Management System		Drafting Act and Relating Documents	Finalization of Legislation					
Energy Efficiency Labels and Standards		Drafting Act and Relating Documents	Finalization of Legislation					
Training Program for Energy Manager		Drafting Act and Relating Documents	Finalization of Legislation					
Promotion of Architectural Technology		Drafting Act and Relating Documents	Finalization of Legislation					
Preparation and Implementation of Each EC Measure								
SEEC Activity as an Executing Agency		Preparation Team	SEEC					
S1 Energy Management System		Preparation of Regulation	Finalization of Regulation	Pilot Stage				Final Stage I&2
S3 Training Program for Energy Manager		Preparation of Regulation	Finalization of Regulation	Pilot Stage			Final Stage	
S4 Energy Assessment Service		Preparation of Regulation	Finalization of Regulation	Final Stage				
S5 Publication and Award System		Preparation of Regulation	Finalization of Regulation	Pilot Stage			Final Stage	
S9 EC Museum				Preparation of Regulation	Finalization of Regulation	Full Operation		
S11 Monitoring and Awareness Survey		Preparation of Regulation	Finalization of Regulation	Final Stage				
SEEC Activity as a Supporter								
S2 Energy Efficiency Labels and Standards (mainly executed by SASO)		Preparation of Regulation	Finalization of Regulation	Final Stage				
S6 EC Campaign (mainly executed by MOWE)		Preparation of Regulation	Finalization of Regulation	Final Stage				
S10 Promotion of Architectural Technology (mainly executed by SASO)		Preparation of Regulation	Finalization of Regulation	Pilot Stage		Final Stage		
Human Resource Arrangement (Persons)								
HQ								
Executive Director			1	1	1	1	1	1
Department Directors			3	3	3	4	4	4
Department Staff			21	21	21	31	31	33
EC Museum Staff (incl. General Manager)							9	25
Local Offices								
Office Manager							2	2
Office Staff							4	4
Total			25	25	25	36	36	38
Budget Arrangement (million SR)								
Direct Costs for Measures								
Measures Implementation Costs (1)			42.1		59.7		58.6	34.2
(out of which, HQ Building and EC Museum Costs)								
Human Resource Costs								
Personnel Expense (25,000SR/month/person) (2)			5.6		11.1		13.4	18.9
General Administration Costs								
General Adm. Cost (= ((1)+(2)) x 15%)			7.2		10.6		10.8	8.0
Total			54.9		81.4		82.8	61.1

Figure 5-3 Overall Implementation Plan of SEEC

5.2.2 Human Resources and Organization Plan

According to each implementation plan paper for SEEC’s measures, a human resources plan is summarized below.

Table 5-4 Human Resources Plan

	2010	2011	2012	2013	2014	2015	2016	2017	2018
Total Staff	25 25 25	36 36 38 38	38 47 47 47	49 65 69 69	69 69 69 69	73 73	73 73	73 73	73 73
Formation	Formation A (Initial)	Formation A-->Formation B (Transition Period)			Formation B (Semi-final)	Formation C (Final)			
SEEC Office	Temporary Office HQ			Permanet Office HQ with EC Museum					
				Permanet Local Offices (Dammam, Jeddah)					

At the initial stage of SEEC in 2010, 25 staff including an Executive Director is required. At that time, SEEC office will start from a temporary office (Formation A). After that, the organization will gradually expand according to the progress of each measure.

The SEEC permanent office including EC Museum and local offices are expected to be commissioned in July 2013. SEEC will enter into the semi-final formation (Formation B) in July 2013.

When the last measure (Energy Management System) will go into the final stage in 2015, SEEC will be the final formation (Formation C, as shown in Figure 5-2).

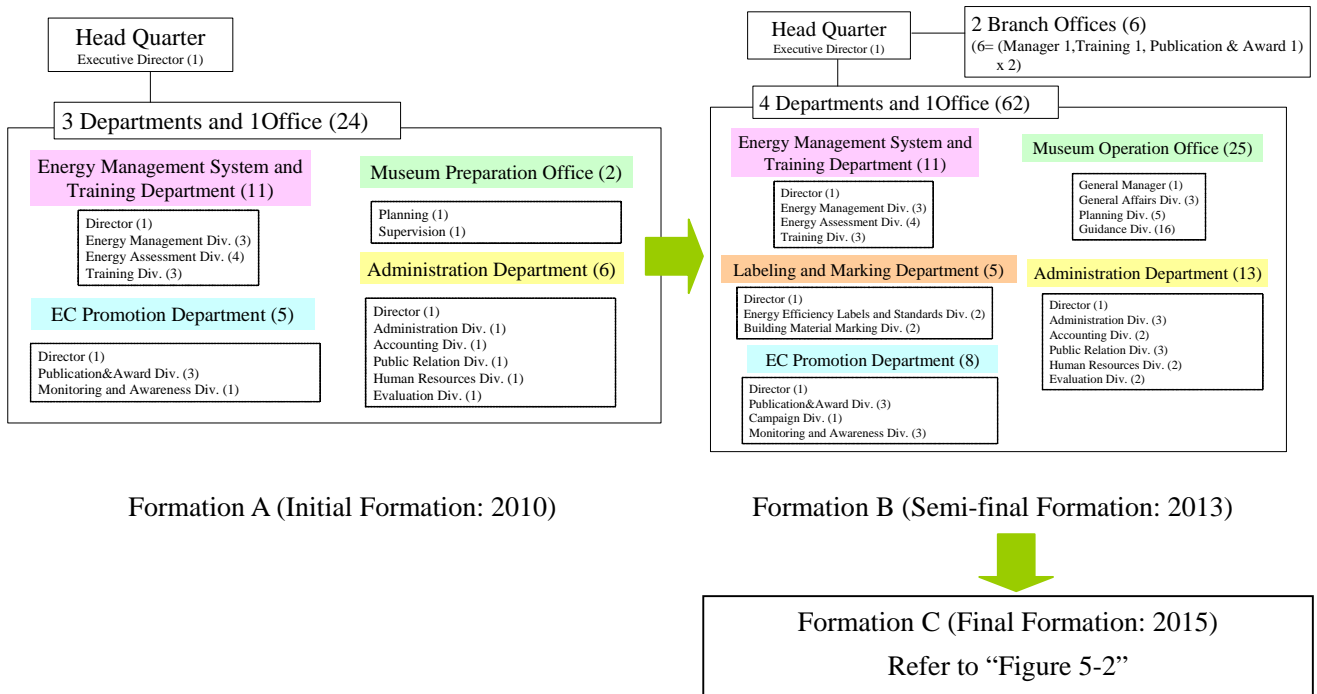


Figure 5-4 Transition of SEEC Organization

5.2.3 Budget Plan

(1) Summary of Budget Plan

In SEEC's budget plan, direct costs, human resource costs and general administration costs are considered. SEEC will start as a temporary office in an existing ministry from April 2010 to July 2013 (the timing of the commissioning of SEEC's new building). During the temporary office period, some measures will start. However, the largest expenditure is the costs for a detailed design and construction of both the SEEC building and EC Museum. It will cost 177 million SR over 2 and 3/4 years.

After going into the final formation in 2015, 37.3 million SR/year is estimated to be required for the budget. This includes operation and maintenance of the SEEC building and museum.

(2) Breakdown of the Budget Plan

The breakdown of the budget plan is shown below.

		(Unit: million SR)									
		2010	2011	2012	2013	2014	2015	2016	2017	2018	
Direct Costs	Energy Management System										
	Energy Efficiency Labels and Standards (Test cost for random inspection)		0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	
	Training Program for Energy Manager (Training equipment and facilities)	5.35									
	(Operation of training program in the pilot stage)		0.344	0.344							
	(Operation of training program in the final stage)					0.68	0.68	0.68	0.68	0.68	
	Energy Assessment Service (Assessment service operation)		0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	
	Publication and Award System (Database, internet access system)		1.5								
	EC Campaign										
	EC Museum (incl. SEEC building) (Detailed Design and Construction)	177									
	(Museum and Building Operation)				3.86	7.72	7.72	7.72	7.72	7.72	
	Promotion of Architectural Technology (Inspection cost)		0.225	0.45	0.45	0.45	0.45	0.45	0.45	0.45	
	Monitoring and Awareness Survey (Survey cost in the final stage)			1.1	1.1	1.1	1.1	1.1	1.1	1.1	
Sub-total (1)		42.1	59.7	58.6	34.2	10.6	10.6	10.6	10.6	10.6	
Human Resources Costs	Human Resource (persons)	25 25 25	36 36 38 38	38 47 47 47	49 65 69 69	69 69 69 69	73 73	73 73	73 73	73 73	
	Human Resource Costs (million SR) (1 man-month=25,000SR)	5.6	11.1	13.4	18.9	20.7	21.9	21.9	21.9	21.9	
	Sub-total (2)	5.6	11.1	13.4	18.9	20.7	21.9	21.9	21.9	21.9	
General Adm. Costs	General Administration Costs = ((1)+(2)) x 15%	7.2	10.6	10.8	8.0	4.7	4.9	4.9	4.9	4.9	
	Sub-total (3)	7.2	10.6	10.8	8.0	4.7	4.9	4.9	4.9	4.9	
	Grand-total (1)+(2)+(3)	54.9	81.4	82.8	61.1	35.9	37.3	37.3	37.3	37.3	

Figure 5-5 Budget Plan Breakdown

Chapter 6 Economic Analysis

6.1 Purpose of Economic Analysis

A project economic analysis is implemented to compare between the cases of project implemented case (called “With Project”) and project not-implemented case (called “Without Project”). When analyzing national economies effected by implementing energy conservation projects, the comprehensive effectiveness of energy conservation projects have to be evaluated, not individual projects. In this study, the cost and benefit in the nation-wide are analyzed between the BAU Case where the projects are not implemented (Without Project) and the EEC Base Case where the projects are implemented (With Project).

National cost in this economic analysis includes the cost of the government to implement projects and the additional expenses and investments that the electricity users (government, Industry, commercial, residential sectors) run into with energy conservation. In practice, implementation costs of the government are negligibly small when compared to the additional expenses and investments for implementing energy conservation. (less than 1 %). Therefore, in the economic analysis, only the above additional expenses and investments are counted as a national economic cost for implementing energy conservation. The national benefit of energy conservation is fossil fuels being saved (to increase oil export) and suppressing the effects that new power station construction may have.

6.2 Expenses and Benefits

6.2.1 Expenses in Economic Analysis

When implementing energy conservation of 1.0-1.5 % per year in sectors by the above calculation from 2010 to 2030, incremental investments for electric facilities and buildings are indicated in the following table. As pointing out the special trend in the Residential sector, incremental investments from 2010 to 2015 have decreased a little. A reason for this is because the population growth rate has declined. The total expenses have increased at the average rate of 4.0 % per year in line with expansion of the GDP.

The total investments of all the sectors increased 4.0 %. However, the investments in oil refinery, petrochemical, manufacturing and commercial & services sectors increased to more than 4.0 % of the average growth rate. Meanwhile, the growth rates of agriculture and residential sectors are rather small at 2.0 % and 0.6 %.

Table 6-1 Incremental Investment for Electric Facilities and Buildings (Unit: million SR)

Items	Sectors	2005	2010	2015	2020	2025	2030	2010-30
Investment of Appliances, Electric Equipment and Building	Agriculture and Fishery	0	465	555	603	650	687	2.0%
	Refinery & Petrochemicals	0	462	622	761	883	1,004	4.0%
	Manufacturing	0	1,747	2,421	3,050	3,640	4,261	4.6%
	Commercials & Services	0	3,581	4,879	6,272	7,634	9,209	4.8%
	Government	0	3,995	5,189	6,358	7,374	8,476	3.8%
	Residential	0	1,063	1,036	1,088	1,137	1,207	0.6%
	Total	0	11,312	14,701	18,132	21,318	24,844	4.0%

Note: The values in the table are summation of investments for appliances (Table14-3) and buildings (Table14-5).

6.2.2 Benefits in Economic Analysis

Reduction of crude oil and oil product consumption in the domestic market brings an increase in crude oil exports to the KSA. In this economic analysis, it is assumed that fossil energies saved by energy conservation can be exported as crude oil to other countries. In calculating the benefits from the reduction in power plant construction and energy saved, the figure of US\$ 330,000/MW will be used. Future crude oil price is assumed to be US\$ 60/bbl (2005 real price), slightly above costs of oil substitute energies which can be estimated to be US\$ 50/bbl. Benefits of CO₂ reduction is not accounted.

Table 6-2 Benefit Evaluation (Fossil Energy, New Power Generation Plant, CO₂ Emission)

Items 1	Items 2	Unit	2005	2010	2015	2020	2025	2030
Fuel Reduction	BAU Fuel in Power	kTOE	44,700	59,352	73,179	89,520	106,298	126,391
	EEC Fuel in Power	kTOE	44,700	58,609	67,798	77,689	86,350	96,007
	Balance (1)	kTOE	0	742	5,382	11,831	19,949	30,384
	Balance (2)	1000bbl	0	5,493	39,819	87,542	147,604	224,815
	Crude Oil Price (Arabian Light)	US\$/bbl	49	60	60	60	60	60
	Export Values	US\$ million	0	330	2,389	5,253	8,856	13,489
	(Export Values in SR)	Million SR	0	1,235	8,952	19,681	33,184	50,543
Reduction of New Power Plants	Installed Capacity in BAU Case	MW	32,337	41,996	50,373	61,621	73,170	87,001
	Installed Capacity in EEC Base Case	MW	32,337	41,471	46,668	53,477	59,438	66,086
	Balance (1)	MW	0	525	3,704	8,144	13,732	20,915
	Construction Cost	US\$/MW	330,000	330,000	330,000	330,000	330,000	330,000
	Reduction Cost (=BAU-EEC Base)	US\$ million	0	173	1,222	2,688	4,531	6,902
	(Reduction Cost in SR)	Million SR	0	650	4,581	10,070	16,979	25,861
Total Benefit		Million SR	0	1,885	13,533	29,752	50,164	76,404

6.3 Results of Economic Analysis

When calculating Economic Internal Rate of Return (EIRR) under the above assumptions, EIRR is 19.2 %. If Weighted Average Capital Cost (WACC) is assumed to be 7 % in the KSA, EIRR is expected to be more than 14 %. Therefore, the viewpoint of this economic analysis (and from a nation-wide perspective) it is economically feasible.

Table 6-3 Results of Economic Analysis

Item	Unit	2008	2010	2015	2020	2025	2030
COST	Million SR	0	11,312	14,701	18,132	21,318	24,844
BENEFIT	Million SR	0	1,885	13,533	29,752	50,164	76,404
RETURN	Million SR	0	-9,427	-1,168	11,619	28,846	51,560
IRR (2008-2030)	%	19.2					

When 23 % of the additional crude oil export is used for energy conservation in the whole country, EIRR becomes 14 %. However, 23 % of the additional crude oil export is the amount used by the whole country. This is not to say that the government can count the whole amount as revenue. The income from crude oil exports to the government is around 70 % when referring to the historical financial income of the KSA government, and the remains (30 %) go to companies as the sales amount. Therefore, 70 % of “23 % of the additional crude oil export” becomes funds for energy conservation measures used by the government. It means that the amount is 16 % (=23 %*0.7) of additional crude oil export saved by energy conservation. The annual government budgets for EEC measures are 0.20 billion SR (US\$ 0.05 billion) in 2010, 1.44 billion SR (US\$ 0.38 billion) in 2015, 3.16 billion SR (US\$ 0.84 billion) in 2020, 5.34 billion SR (US\$ 1.42 billion) in 2025 and 8.13 billion SR (US\$ 2.17 billion) in 2030.

Table 6-4 Potentiality of Subsidy at 14 % of EIRR

Item	Unit	2008	2009	2010	2015	2020	2025	2030
COST	Million SR	0	0	11,312	14,701	18,132	21,318	24,844
BENEFIT	Million SR	0	0	1,885	13,533	29,752	50,164	76,404
Incentive Resource	Million SR	0	0	-284	-2,059	-4,527	-7,632	-11,625
RETURN	Million SR	0	0	-9,711	-3,227	7,093	21,213	39,936
IRR (2008-2030)	%	14.0						
Gov.-Income Rate	%			70	70	70	70	70
Incentive from Gov.	Million SR			199	1,441	3,169	5,343	8,137

6.4 Consideration from the Economic Analysis

Profitability of energy conservation measures is affected by predictions of future crude oil prices. Under the recent conditions where the West Texas Intermediate (WTI) spot crude oil price in New York market reaches US\$ 100-120/bbl, it is expected to get more profitable to conserve fossil fuel energy such as oil, gas, and coal. In the KSA’s case, energy conservation programs by houses and companies brings the benefit of crude oil being saved by energy conservation measures. The saved oil can be exported directly at a higher price in the international market than the domestic market.

Regarding incentives for companies to invest capital funds for energy conservation by the government, it is difficult for the government to give direct incentives to the companies. This is because most of them are foreign financed companies. However, the government should offer some incentives to executing organizations such as energy management system, labeling and standard system, training program, energy assessment and so on.

The capital funds required for implementing agency of energy conservation (the total amount up to 2030 is around 1.67 billion SR for high priority energy conservation measures proposed by the JICA Study Team, and the average annual budget of the organization is 76 million SR per year) is negligibly small compared to the energy conservation effects. Thus it can be recommended that the energy conservation master plan proposed by the JICA Study Team are useful for the KSA.