Part 4 Proposal of Basic Energy Conservation Principle

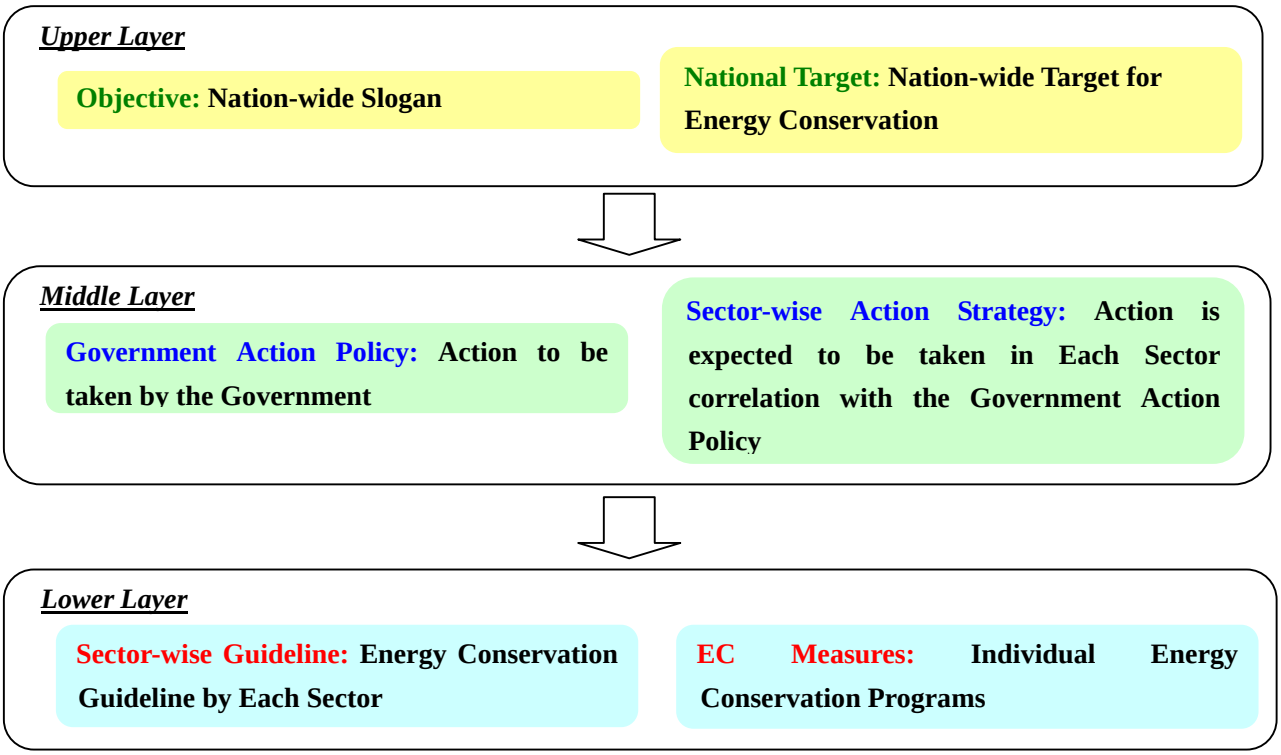
Chapter 8 Basic Energy Conservation Principle

8.1 Concept of Basic Energy Conservation Principle

8.1.1 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.

8.1.2 Workflow

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

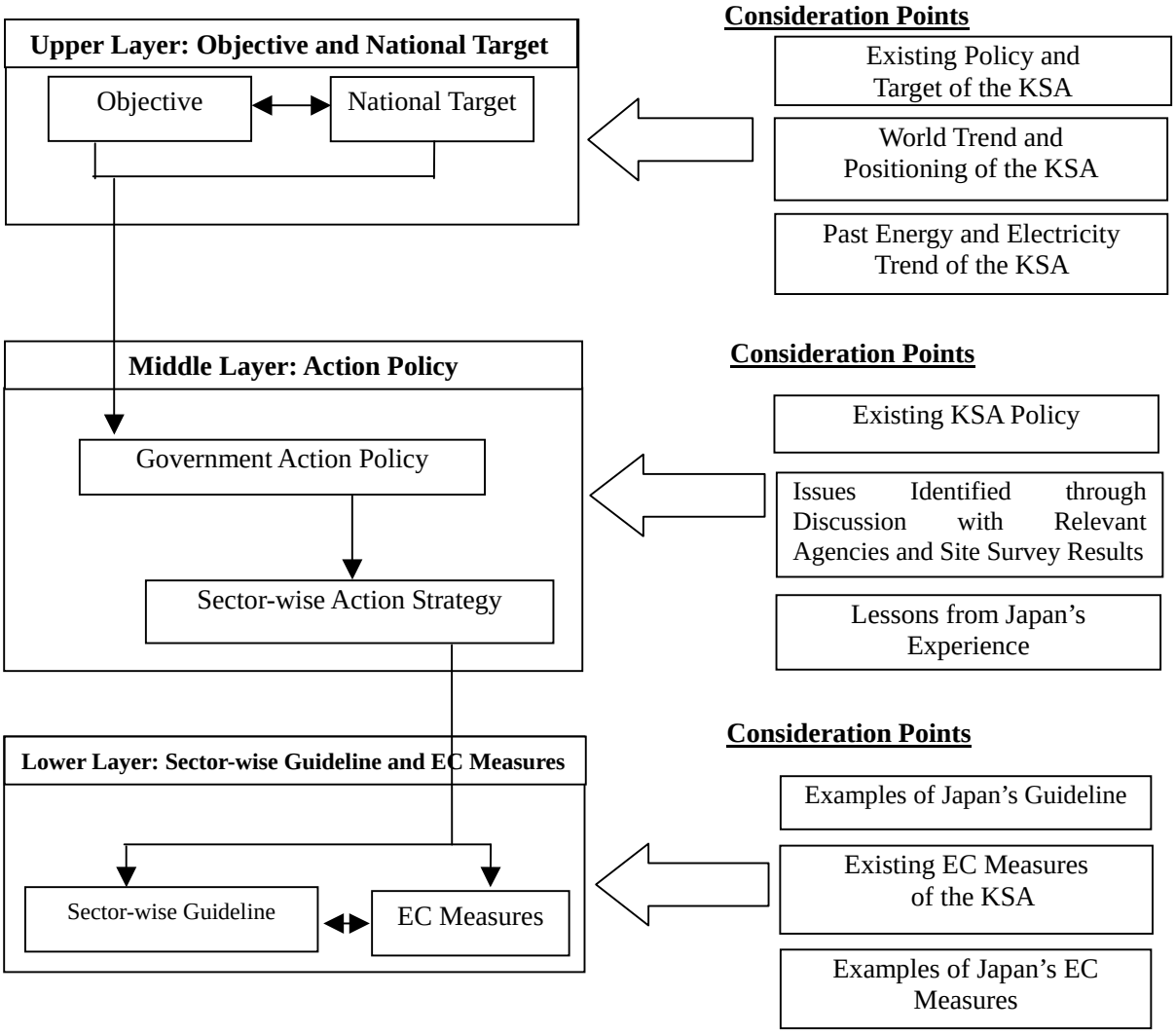


Figure 8-1 Flowchart of Formulation of EC Basic Principle

8.2 Objective and National Target

8.2.1 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 8-1 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	Thailand	28 % improvement	-
	Energy Intensity	APEC (21 Countries / Areas)	At least 25 % improvement by 2030	2005
Total Volume Method	Primary Energy Consumption	EU	20 % reduction using renewable energy by 2020	2006
	Gasoline Usage	USA	20% reduction by 2017	2007
	Greenhouse Gas Emission	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 the than 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.

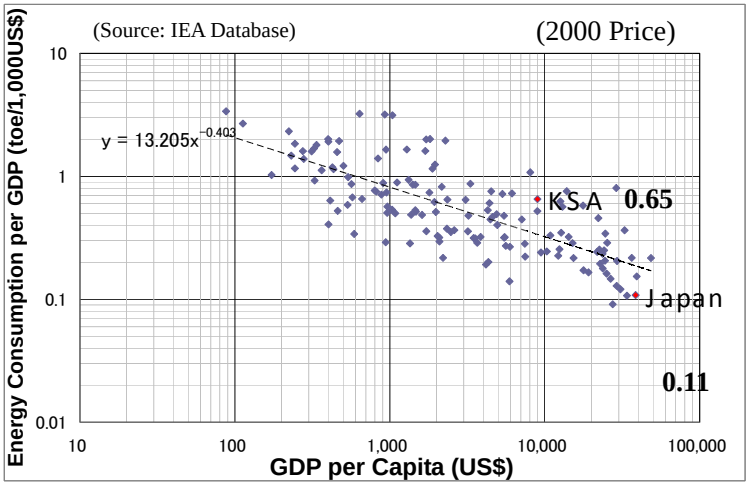
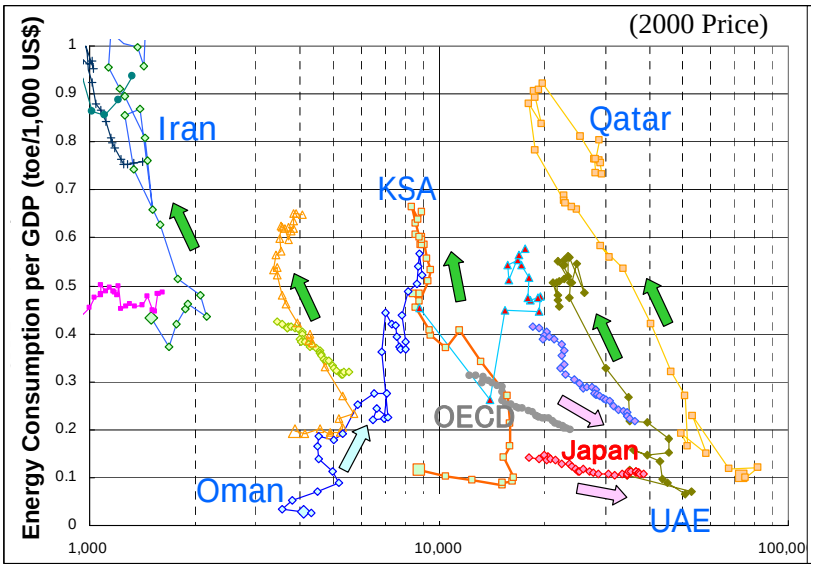


Figure 8-2 Relationship between Other Countries' GDP per Capita and Energy GDP Intensity (2004)

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.



(Source: IEA Database)

Figure 8-3 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.

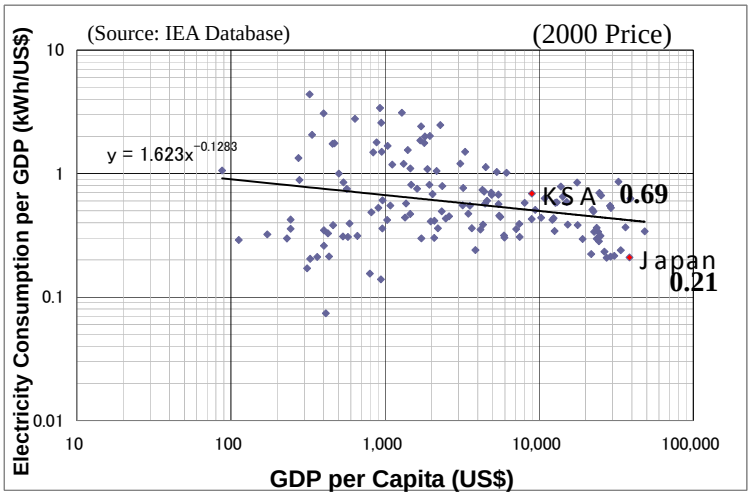


Figure 8-4 Relationship between Other Countries' GDP per Capita and Electricity GDP Intensity (2004)

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.

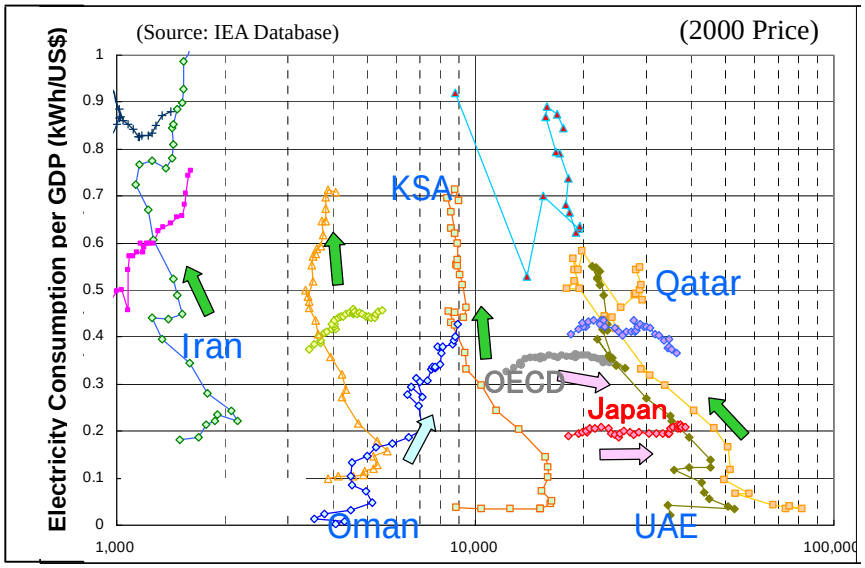


Figure 8-5 Historical Data of Electricity GDP Intensity of Each Country (1971-2004)

(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.

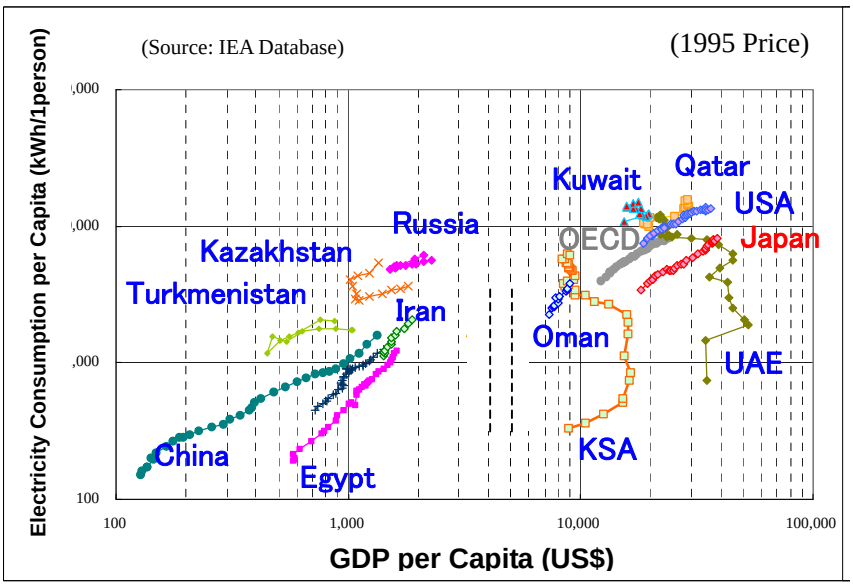


Figure 8-6 Historical Data of Electricity Consumption per Capita of Each County (1971-2004)

(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.

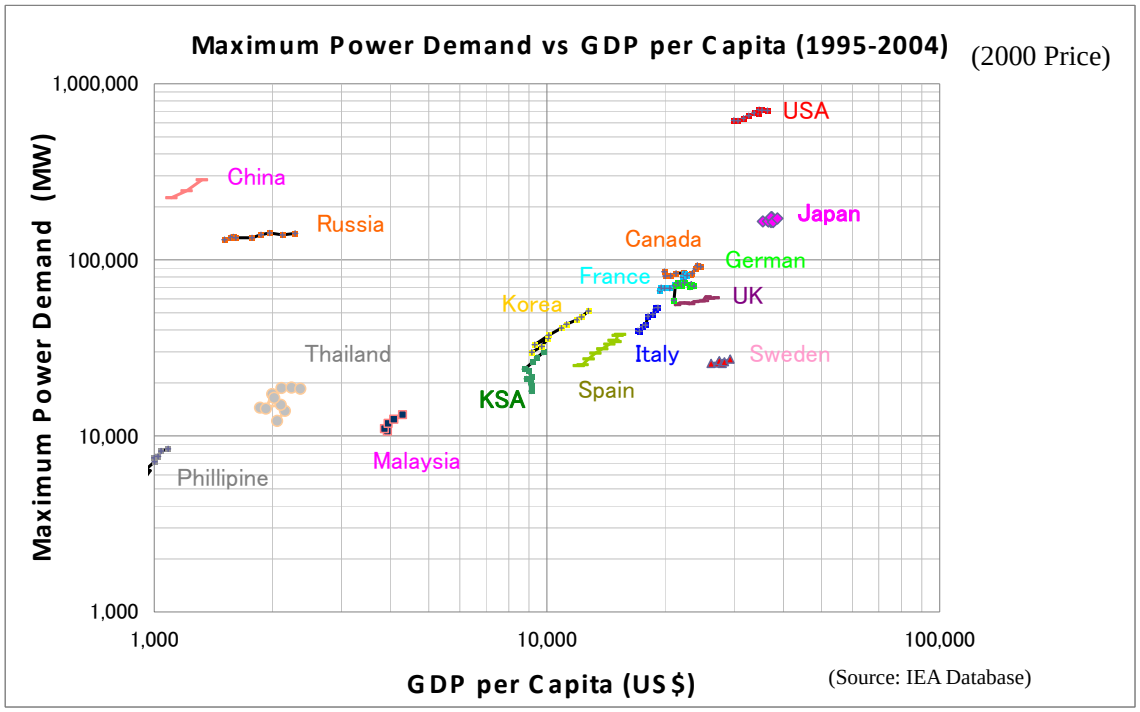


Figure 8-7 Historical Data of Peak Demand Growth (1995-2004)

8.2.2 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.**

8.2.3 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 8-3 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.

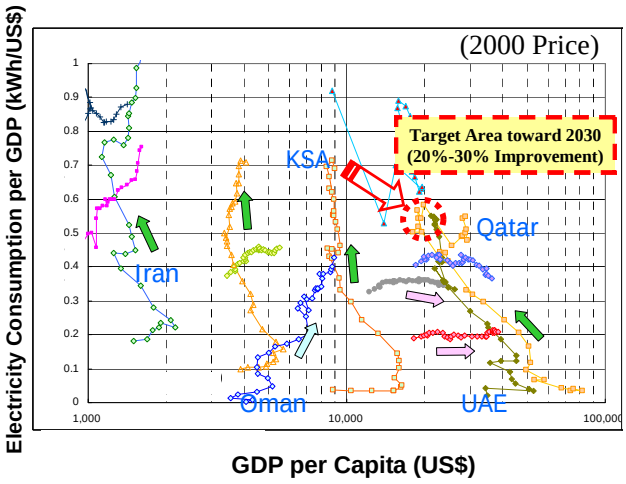


Figure 8-8 Target based on the Past Trends

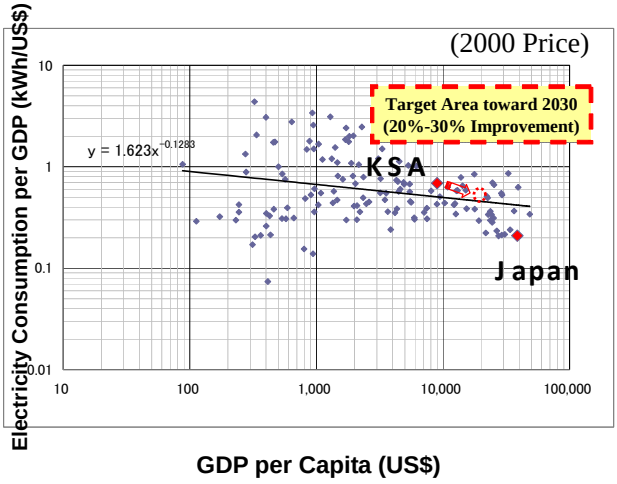


Figure 8-9 Target based on the Position in the World (2004)

(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.

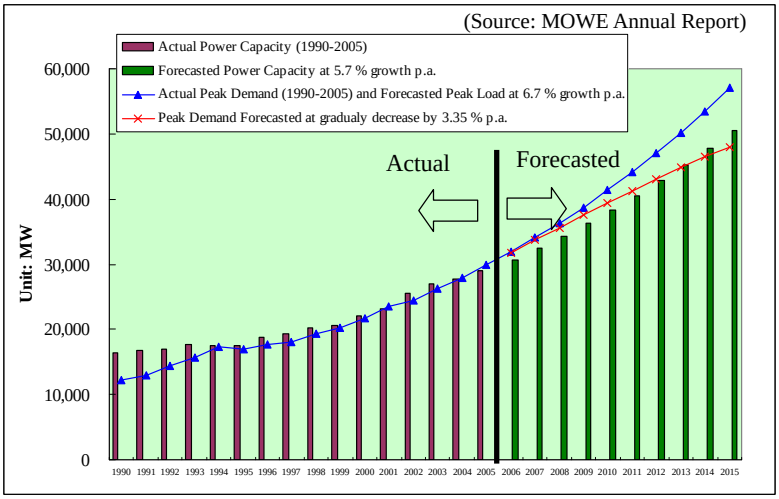
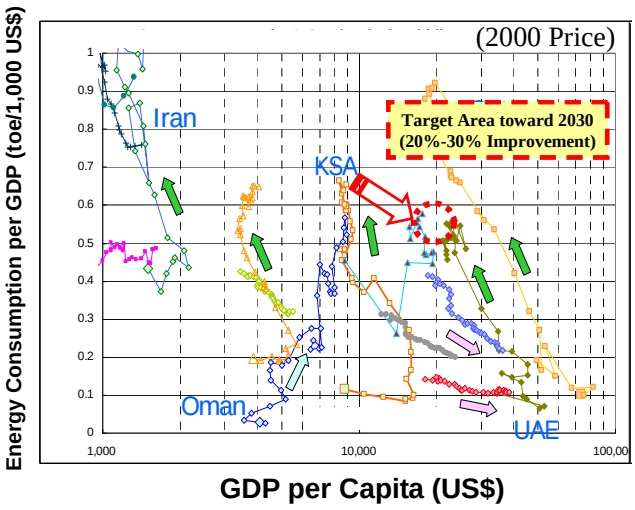


Figure 8-10 Estimate of Balance of Peak Demand and Actual Power Capacity

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.



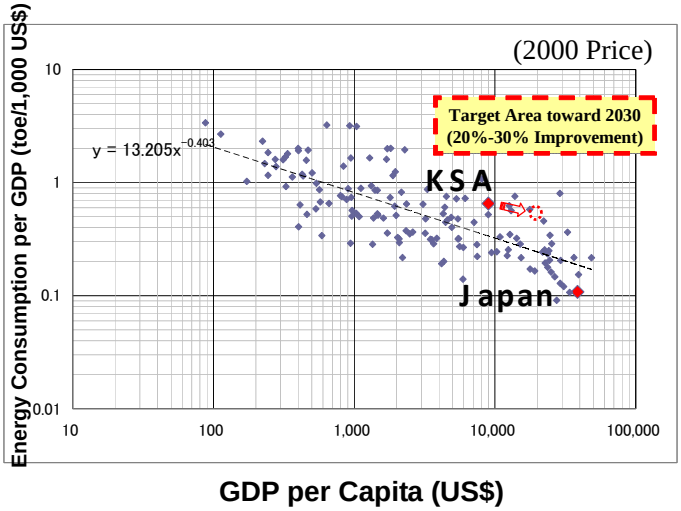


Figure 8-11 Target based on the Past Trends

Figure 8-12 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 8-4 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

8.3 Government Action Policy and Sector-wise Action Strategy

8.3.1 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 8-5 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.

8.3.2 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 8-6 Government Action Policy

Target Sector	Government Action Policy (for Each Sector)
Governmental Sector Action Policy (The MOWE's action policy for to governmental sector)	● 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	● Promotion of periodic reporting using the intensity method
Industrial Sector Action Policy	● 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	● 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	● Promotion to raise awareness through education, information release, and campaigns
Mosque Sector Action Policy	● Promotion to raise awareness through education and campaigns
School Sector Action Policy	● Support of EC education
Cross Sector Action Policy	● 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

8.3.3 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 8-7 Sector-wise Action Strategy

Target Sector	Action Strategy by Each Sector
Government Sector Action Strategy (including MOWE)	● 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	● Formation of database for electricity consumption and monitoring by area
Industrial Sector Action Strategy	● 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	● 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	● Practice of energy conscious operation ● Smart selection of EC appliances ● Utilization of an electricity consumption check system
Mosque Sector Action Strategy	● Lecture of EC practice to prayers by Imam ● Practice of EC practices by mosque itself
School Sector Action Strategy	● EC education for kids, EC practices at schools and visitation of P/S as a school field trip.
Cross-sector Action Strategy	● 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

8.4 Sector-wise Guideline

8.4.1 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 %.

8.4.2 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 8-8 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/m2) (= Electricity Consumption / Total Floor Area)	0.5 %	1.0 %	1.5 %
Industrial	Productivity (=Electricity Consumption / Product Output or Sales)	0.5 %	1.0 %	1.5 %
Commercial	Electricity Consumption per Area (kWh/m2) (= Electricity Consumption / Total Floor Area)	0.5 %	1.0 %	1.5 %
Residential	Electricity Consumption per Household (kWh/household)	0 % (Same Level)	1.0 %	1.0 %

(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 8-9 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.

8.5 Energy Conservation Measures (EC Measures)

8.5.1 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

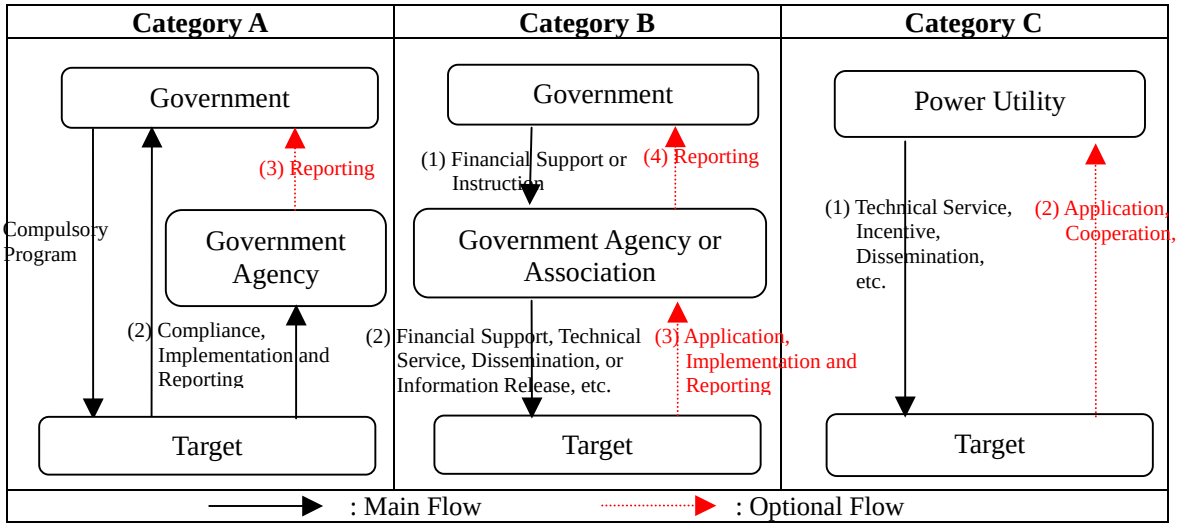
Japan's EC measures are grouped into the following 3 categories.

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 8-10 Japan's EC Measure Categories



(b) Japanese EC Measures

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

Table 8-11 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		

8.5.2 Selection of High Priority Measures

The Study selects and formulates detailed plans for priority measures to be implemented in the KSA. Priority measures are selected by the Steering Committee members consisting of the MOWE, and relevant agencies and companies. In this section, the evaluation process for priority measures is described. After selection of the high priority measures, details regarding the implementation of each measure are described in Chapter 10.

(1) Evaluation Process

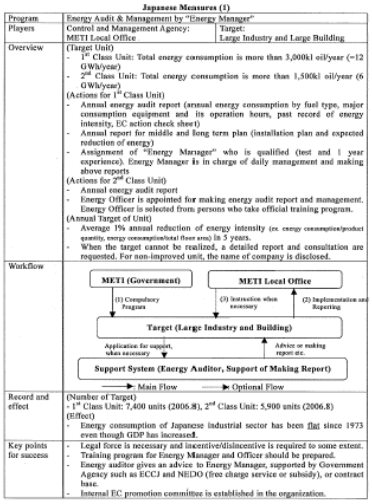
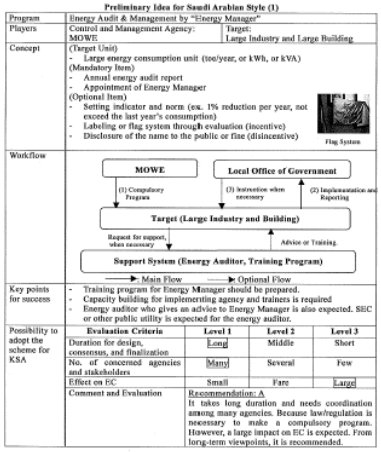
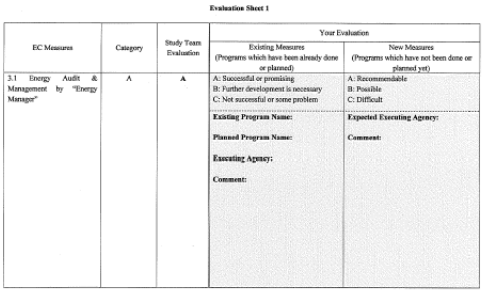
Evaluation of priority measures is carried out through the following process.

Table 8-12 Evaluation Process for Priority Measures

Flowchart	Consultation
1st Step (Workshop) (1) Introduction of 26 Japanese examples. ⇩ (2) Introduction of Saudi version based on modification of 26 Japanese examples. ⇩ (3) Collect opinions from the Workshop participants by questionnaire regarding the introduced measures in terms of which EC measures that should be considered of high priority at length in the Study and the assumed implementing agencies.	The Steering Committee members and members from related agencies
2nd Step (4) Report the initial evaluation, including the results of the questionnaire, of the JICA Study Team to the Steering Committee. ⇩ (5) Final evaluation by the Steering Committee. ⇩ (6) Hold consultation to decide the level of priority for each measure.	The Steering Committee members

(2) Materials Used in the Workshop (1st Step)

Table 8-13 Materials used in the Workshop

Samples of Materials	Outline of the Material
	Explanatory Material for the Japanese Examples (Contents) ➢ Title of the Program ➢ Executing Agencies ➢ Target Sector ➢ Outline of the Scheme ➢ Flowchart of the Scheme ➢ Actual Results and Effect ➢ Lessons
	Material for the Saudi Version based on the Japanese Examples (Contents) ➢ Title of the Program ➢ Expected Executing Agencies ➢ Expected Target Sectors ➢ Expected Outline of the Scheme ➢ Expected Flowchart of the Scheme ➢ Success Points ➢ Evaluation Factors for Application ➢ JICA Study Team's Evaluation (initial)
	Questionnaire for Opinion Collection (Questions) ➢ New Program or Existing Program? ➢ Evaluation of Application for the KSA ➢ Expected Executing Agencies ➢ Other Comments

(3) Evaluation Results

Measures are evaluated by the process describes above and grouped into 5 categories as follows.

Table 8-14 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 8-15 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 from the Japanese examples. 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.

8.5.3 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 8-16 Outline of High Priority Measures (1/3)

Measure	Contents
1. Energy Management System (EMS)	■ 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)	■ 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 8-17 Outline of High Priority Measures (2/3)

Measure	Contents
3. Training Program for Energy Manager	■ 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	(Application) ■ Dissemination of the Scheme to the target sectors. ■ Collection of applicants and selection by criteria. (Hiring Consultant) ■ Registration of consultant. ■ Dispatch of the appropriate persons to the selected applicants. (Energy Assessment) ■ Documentary evaluation before site audit. ■ One-day site audit. ■ Written report with recommended EC measures (within 3 months).
5. Publication and Award System	■ 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	■ 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	■ 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 8-18 Outline of High Priority Measures (3/3)

Measure	Contents
8. EC Education for Schools	(In Case of Direct Teaching Scheme) ■ MOWE/SEC/KACST directly holds a seminar for students and teachers at school. (In case of Training of Trainer (TOT) Scheme) ■ 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	■ 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))	■ 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	■ 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	■ 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	■ 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 8-19 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	

8.5.4 Methodology for Formulation of High Priority Measures

(1) Establishment of Sub-Committees

13 measures were selected as high priority measures in the Study. In order to effectively study so many measures, 5 sub-committees will be established from the members of the Steering Committee and handle the discussion of each measure as follows.

Table 8-20 Establishment of Sub-Committees

Sub-Committee	Member	Measures to be Discussed
Sub-Committee 1 (Energy Management System)	**1. ARAMCO (Leader)** 2. MOWE 3. NEEP/KACST 4. SEC 5. SABIC 6. COC (Chamber of Commerce)	Energy Management System
		Training Program for Energy Manager
		Energy Assessment Service
Sub-Committee 2 (Label)	**1. SASO (Leader)** 2. SBCC (Saudi Building Code Committee) 3. MOMRA (Ministry of Municipality and Rural Affairs) 4. MOIC (Ministry of Industry and Commerce) 5. MOWE	EE Labels and Standards
		Promotion of Architecture Technology
Sub-Committee 3 (Awareness)	**1. MOWE (Leader)** 2. MOEdu (Ministry of Education) 3. MOHEdu (Ministry of High Education) 4. MOCul&Media (Ministry of Culture and Media) 5. MOIA (Ministry of Islamic Affaires) 6. ARAMCO 7. SEC 8. MOF	EC Campaign
		Publication and Award System
		EC Education for Schools
		EC Museum
Sub-Committee 4 (Load Management)	**1. SEC (Leader)** 2. MOWE 3. ECRA 4. ARAMCO 5. SABIC 6. COC	Load Management
		Check System of Customer's Record
Sub-Committee 5 (R&D)	**1. KACST (Leader)** 2. MOHEdu 3. SASO 4. SWCC 5. MOWE	Promotion of R&D Scheme
		Monitoring and Awareness Survey

(2) Formulation of the Implementation Plan Paper

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

8.6 Summary of Basic Energy Conservation Principle

Table 8-21 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)
Slogan ● 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.	**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 % <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 % **Middle Term Target** <u>Option 3: Electricity Consumption per Capita</u> Improve the electricity consumption per capita by 2015. Target Option: - <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. **Recommendation of the JICA Study Team** Long Term Target: 30 % improvement of Electricity GDP Intensity (Option2) by 2030 from the base year 2005. Middle Term Target: 50 % reduction in the Growth Rate of Peak Demand (Option 4) by 2015 compared with the current (2000-2005) growth rate.	● <u>Government Sector Action Policy</u> ✓ 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 ● <u>Public Lighting Sector Action Policy</u> ✓ Promotion of periodical reporting using the intensity method ● <u>Industrial Sector Action Policy</u> ✓ 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 ● <u>Commercial Sector Action Policy</u> ✓ 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 ● <u>Residential Sector Action Policy</u> ✓ Promotion to raise awareness through education, information release, and campaigns ● <u>Mosque Sector Action Policy</u> ✓ Promotion to raise awareness through education and campaigns ● <u>School Sector Action Policy</u> ✓ Support of EC education ● <u>Cross Sector Action Policy</u> ✓ 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	● <u>Government Sector Action Strategy</u> ✓ 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 ● <u>Public Lighting Sector Action Strategy</u> ✓ Formation of database for electricity consumption and monitoring by area ● <u>Industrial Sector Action Strategy</u> ✓ 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) ● <u>Commercial Sector Action Strategy</u> ✓ 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 ● <u>Residential Sector Action Strategy</u> ✓ Practice of energy conscious operation ✓ Smart selection of EC appliances ✓ Utilization of an electricity consumption check system ● <u>Mosque Sector Action Strategy</u> ✓ Lecture of EC practice to prayers by Imam ✓ Practice of EC activities by mosque itself ● <u>School Sector Action Strategy</u> ✓ EC education for kids, EC practice in school, and visitation of P/S as a school field trip ● <u>Cross Sector Action Strategy</u> ✓ 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 8-22 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
● Government Sector Action Strategy ✓ 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 ✓ Formation of database for electricity consumption and monitoring by area	● EC Measures targeting at Government Sector (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	Annual 1.5 % improvement by 2030 Electricity Share: 20 % (including public lighting, hospital, charity, agriculture) Annual Impact = 1.5 % x 0.2 =0.3 %
● Industrial Sector Action Strategy ✓ 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)	● EC Measures targeting at Industrial Sector (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.)	(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	Annual 1.5 % improvement by 2030 Electricity Share: 20 % Annual Impact = 1.5 % x 0.2 =0.3 %
● Commercial Sector Action Strategy ✓ 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	● EC Measures targeting at Commercial Sector (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.)	(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	Annual 1.5 % improvement by 2030 Electricity Share: 10 % Annual Impact = 1.5 % x 0.1 =0.15 %
● Residential Sector Action Strategy ✓ Practice energy conscious operation ✓ Smart selection of EC appliances ✓ Utilization of an electricity consumption check system ● Mosque Sector Action Strategy ✓ Lecture of EC practice to prayers by Imam ✓ Practice of EC activities by mosque itself ● School Sector Action Strategy ✓ EC education for kids, EC practice in school, and visitation of P/S as a school field trip	● EC Measures targeting at Residential Sector (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	(1) EC Consulting Service for Residential Sector (2) Instruction Booklet for General People	Annual 1.0 % improvement by 2030 Electricity Share: 50 % Annual Impact = 1.0 % x 0.5 =0.5 %
● Cross Sector Action Strategy ✓ 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	● EC Measures targeting at Cross Sector (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	(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	Total Annual Impact = 0.3 %+0.3 %+0.15 %+0.5 % = 1.25 % Accumulated Impact by 2030 = 25 % (=1-0.9875^23) (that is equivalent to 34 % improvement of Electricity GDP Intensity by 2030 from 2005)

Chapter 9 Review of Proposed National Target

9.1 Power Demand Forecasts

9.1.1 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.

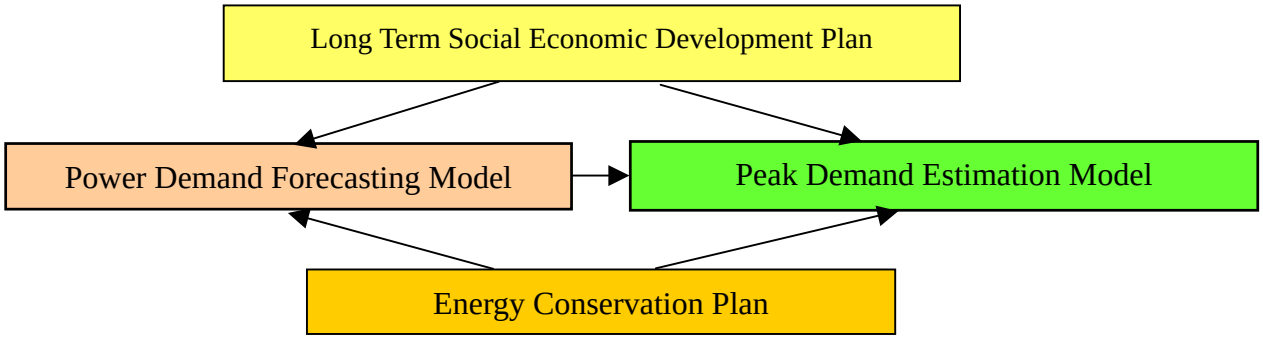


Figure 9-1 Flow of Power Demand Forecasts

9.1.2 Power Demand Forecast Concept

(1) Functions of the Power Demand Forecasting Model

KSA power demand has increased against the background of favorable economic growth since the 2003. In order to forecast of power demand, the past changes in power demand trends and actual data are analyzed, and constitutional factors for forecasting the future power demand of this country are studied as well. These changes in power demand can be considered to reflect the changes of social economic structure following economic development of the KSA, as power demand means results from economic and social activities. For that reason, the development stages of the KSA are considered and the actual situation of the power demand structure is analyzed in the Study as well. The power demand forecasting model used in the Study has the following features.

(a) Model Linked to the Social Economic Development Plan

The aforementioned LTS 2025 and EDP are considered preconditions for the model.

(b) Power Demand Forecasts Based on the Changes in Energy Intensities

Recently, it is said that energy intensity is important for energy and power forecasting and evaluation. Energy intensity in the industry sector follows a descending trend or remains flat if special measurements are not applied. For model building, past sectoral electricity GDP intensity is analyzed. In the Study, when the energy conservation principle is not implemented, power demand is forecast by constant intensity. When the energy conservation principle is positively implemented, it is forecast using energy conservation factors.

(c) Power Demand by Region

Although country-wide power demand forecasts are required for establishing an energy conservation principle, to forecast future peak demand, regional power demands are also required. For that reason, power demand by regional supply area, COA, EOA, WOA and SOA, are forecast.

(d) Peak Demand

The growth rate of peak demand is an important indicator for evaluating the energy conservation principle. Daily load curve and the growth rate of peak demand by regional supply area (COA, EOA, and WOA) are estimated as a reference.

(2) Power Demand Forecasts

In the model, the economic indicators that are expressed by the Government and the related organizations are used as external variables, and the other indicators that are not expressed are calculated as internal variables in the model. For power demand forecasting, energy and power demand are forecast by sector. Then, the amount of energy generated and fuel consumed by the power supply and the energy demand supply balance are estimated. Generally speaking, a large aggregation of regression and definition equations are used to construct an econometric model. Then, statistical and logical economic tests are examined. The following tests were conducted for building the model:

(a) Evaluation of Power Demand Forecasting Equations

- Determination of the coefficient (more than 0.85)
- T-value test of the regression coefficient (More than 2.0)
- Durbin Watson ratio (1＜DW<3)
- Sign test of the regression coefficient

(b) Evaluation of the Macro Economic Forecast

- Real GDP growth rate
- GDP per person（US$ base）

(c) Evaluation of the Energy Demand Forecast

- Energy demand growth rate
- Energy consumption per GDP（GDP elasticity）
- Energy consumption per person

For building the model above, an econometric method is generally applied according to the process outlined above. The following figure is an outline of the model. The model can be classified into two blocks, a macro economic block and a power demand block. The regional power demand refers to the peak demand estimation model.

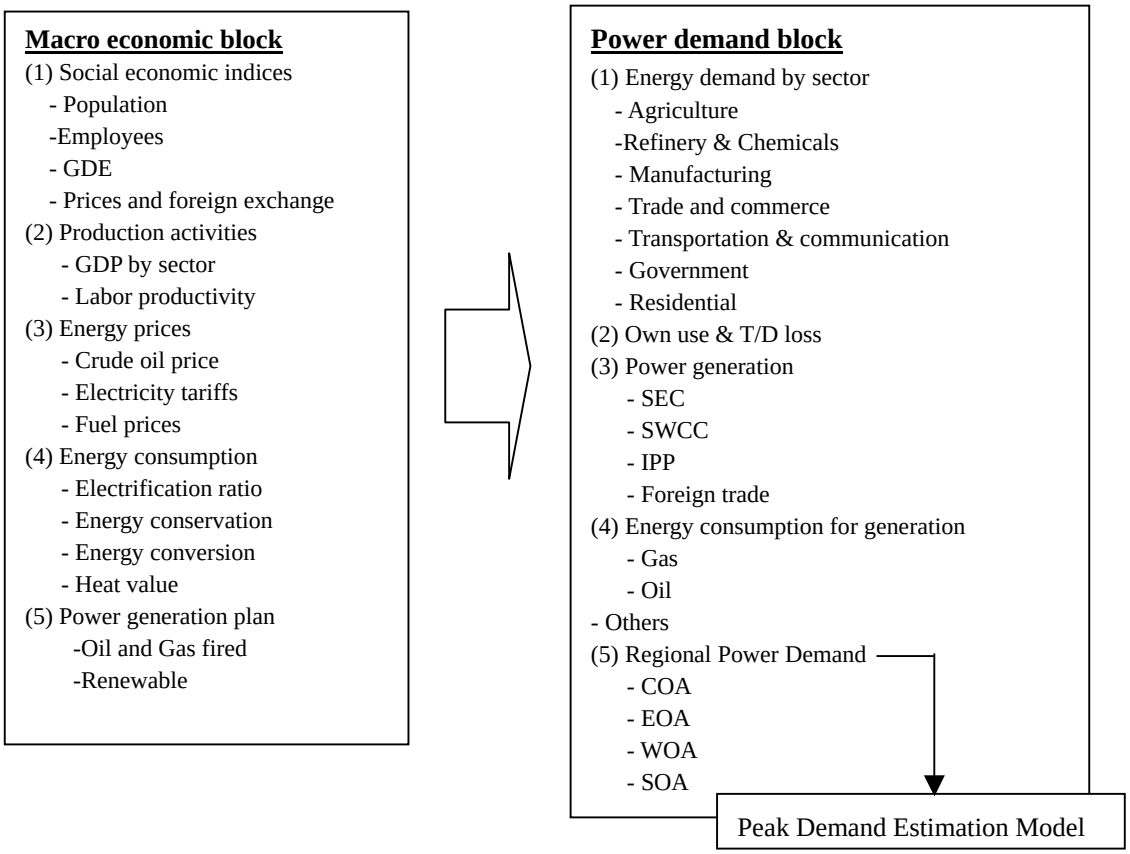


Figure 9-2 Outline of Power Demand Forecasting Model

(3) Peak Demand Estimation

The procedures for peak demand estimation are as follows.

(a) Daily Load Curve Data Collection

- 3 Regional Supply Areas: COA, EOA, & WOA
- Selection of daily load curve with peak demand in a month
- Targeted years: 2007-2010, 2015, 2020, 2025, 2030

(b) Building Equations by Auto Regression Analysis

Estimation of peak demand is measured by auto regression analysis of regional and monthly data. For the formula for calculating peak power demand, first the daily load curve data from the equations are built up with power demand in 2005, daily load curve in 2005, and power demand in the targeted years.

$DLC t = Demand t / Demand 2005 * DLC 2005

Demand t: Power demand in t-year (t: 2001-2030)

DLC 2005: Actual data of peak demand in 2005

$DLC t: First daily load curve based on 2005 (t: 2001-2030)

The Second daily load curve data are estimated with first daily load curve and the difference between first daily load curve and second daily load curve in previous year. The second daily load curve data are estimated by regression analysis.

DLC t = a* $DLC t + b*($DLC t-1 - DLC t-1)

DLC t: Second daily load curve based on the year of 2005 (t: 2001-2030)

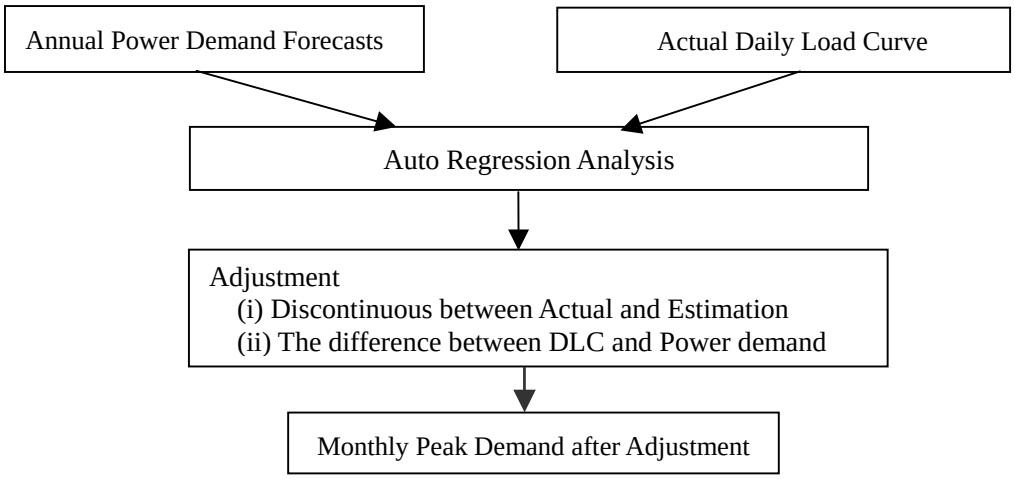


Figure 9-3 Model Flow of Peak Demand Estimation

9.1.3 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. The following table shows the base cases and option scenarios of the EEC Base Case by energy conservation achievement level.

Table 9-1 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)

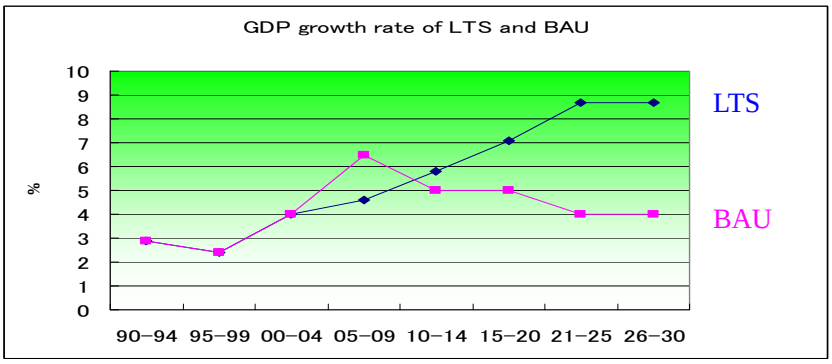
(a) Preconditions of the BAU Case

- 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 9-2 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

Comparison of the GDP growth rate between the BAU Case and the LTS 2025 case is shown in the following figure.



LTS：Growth Rate in the LTS 2025　　BAU：Growth Rate of the BAU Case

Figure 9-4 GDP Growth Rate in the LTS 2025 Case and the BAU Case in the Study

(b) 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 9- 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

(c) 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 9-4 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

(2) Other Preconditions

(a) Population Growth Rate

The future population structure of the KSA is forecast to change drastically due an increase in the workforce population between the ages of 15-64. Although many foreign workers currently have jobs in the KSA, they will be replaced by a Saudi labor force in future, and adversely the number of foreign workers in the labor force market will decrease. Although the growth rate of the population for the past ten years was 3 % per year on average, a future growth rate of 2.3 % has been estimated for the Saudi population, and at the same time, the number of foreign workers is estimated to decrease by 1.0 %. As a result, the total growth rate of the population in the KSA will increase from 1.2 % to 1.3 %. This assumption is set for the BAU Case and the EEC Base Case.

Table 9-5 Population Growth Rate of the KSA

	Unit	05-10	10-15	15-20	20-25	25-30
Growth Rate	%	1.5	1.4	1.3	1.2	1.2

(b) Crude Oil Price Outlook

Currently (as 2007), the West Texas Intermediate (WTI) crude oil price on the New York market is traded at US$ 100-120/bbl. As Arabian light crude oil price are US$ 10-20/bbl lower than WTI prices, crude oil was traded for US$ 80-100/bbl in the latter half of 2007. However, if current high crude oil prices continue in the future, it can be said that substitution energy sources will appear on the market, causing the price of crude oil to decrease. It is said that the cost of substitution energy sources such as oil sand, oil from coal gasification, gas from coal liquefaction, and so on is US$ 40-50/bbl, and it is thought that these energy sources can be traded at US$ 60/bbl. Therefore, in the future, it is estimated that Arabian light crude can be traded at US$ 60/bbl. However, US$ 60/bbl is the real price for 2007 and does not account for inflation. When calculating the nominal crude oil price including inflation, the price climbs to US$ 100/bbl in 2030 (Inflation rate of US$ is 2.5 % per year). In case of the high economy scenario, it is assumed that current high crude oil prices continue in the future, otherwise, in the case of the low economy scenario, the crude oil price decreases to US$ 40/bbl due the affect of substitution energy sources. Under the circumstances above, power demand in the KSA is not forecast to be affected by crude oil price because current domestic oil products are around a tenth the price of world oil product prices.

Table 9-6 Arabian Light Price Outlook

	Unit	05-10	11-15	16-20	21-25	26-30
Crude Oil Price	$/bbl	60-80-60	60	60	60	60

(c) Sectoral GDP

Sectoral GDP assumptions were set for the model after referring to the sectoral GDPs in the LTS 2025. Sectoral GDP growth rates in LTS 2025 are calculated on the assumption that total GDP growth rate is 6.6 %. As the growth rate of the total GDP in the BAU Case is 5.0 %, the sectoral GDP growth rates in the BAU Case are set in proportion between the two GDP growth rates. However, the growth rate of the agriculture sector is set with a lower growth rate instead of the proportional low growth rate mentioned above.

In the future, the growth rates of non-oil sectors are strong; the role of the manufacturing sector will become especially large. In addition, within the service sector, communication, tourism, and information are expected to have the fastest growth rates. The government also expects a good foreign balance due to increasing foreign income from the development of tourism rather than oil exportation.

Table 9-7 Outlook for Growth Rate of Sectoral GDP

Sectors	05-10	10-15	15-20	20-25	25-30
Agriculture & Fishery	3.0	2.5	2.5	2.5	2.5
Mining (Oil, Gas & Others)	5.2	4.2	4.2	3.2	3.2
Manufacturing (Refinery & Chemical)	7.8	5.0	5.0	4.0	4.0
Manufacturing (Elec, Const & Others)	7.8	5.6	5.6	4.6	4.6
Transportation & Communication	8.1	5.8	5.8	4.8	4.8
Service (Government)	4.3	4.0	4.0	3.0	3.0
Service (Trade, Hotels & Others)	6.0	5.0	5.0	4.0	4.0
GDP(Real 1999 price)	6.5	5.0	5.0	4.0	4.0

(3) Setting Electricity GDP Intensity

First, sectoral electricity intensities for GDP are analyzed in order to forecast power demand for the BAU Case. As mentioned above, the power demand in the EEC Base Case is forecast by the change in the EEC factor after setting the electricity GDP intensity of the BAU Case. Generally, electricity GDP intensity continues to be flat if special technical innovation and improvement are not carried out within the manufacturing process, on electric appliances, and so on. However, the past electricity intensity for several years in the KSA was not flat, some sectors increased and others decreased. The changes in electricity intensities were mainly caused by sectoral changes in processes and methodologies. Electricity GDP intensities in the BAU Case are set under the assumption that the changes above will not occur in the future. Concretely, it is assumed that changes in the rate of EEC factors (up or down) converge to zero in the near future.

(a) Agriculture Sector

Electricity GDP intensity in the agriculture sector is defined by “Electricity consumption in the agriculture sector/GDP in the agriculture sector”. The intensity was 30 GWh/Billion SR in 1991, and became 80 GWh/Billion SR in 2005. It is believed that electricity intensity increased due to an increase in working houses on farms. Yearly rate changes in the past (1991-1993) were around 15%, but the rate has remained about 5% in recent years (2001-2003). The range of the rate change gradually narrows. Although the rate change in 2005 was +5%, it is assumed that the future rate change will converge to zero by 2015, and after 2015, the rate change remains at zero. This means that electricity GDP intensity in the agriculture sector will not change after 2015. As a result, the electricity GDP intensity in the agriculture sector will change from 80 GWh/Billion SR in 2005 to 100 GWh/Billion SR in 2030, as follows.

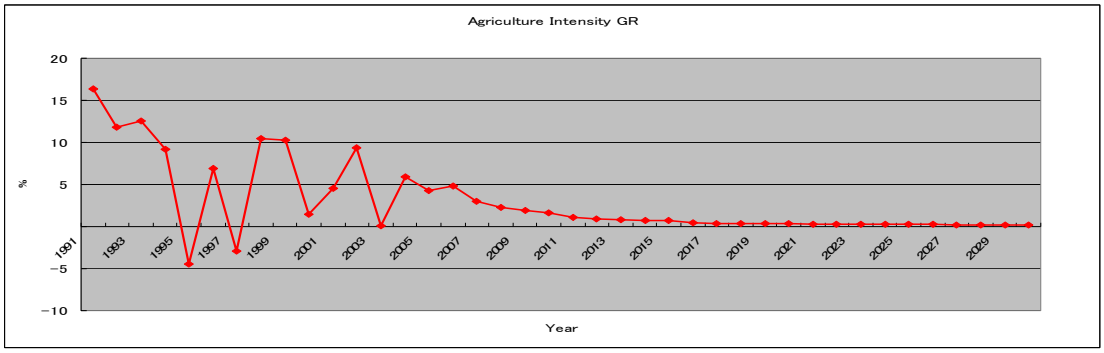


Figure 9-5 Annual Rate Change of Electricity GDP Intensity in the Agriculture Sector

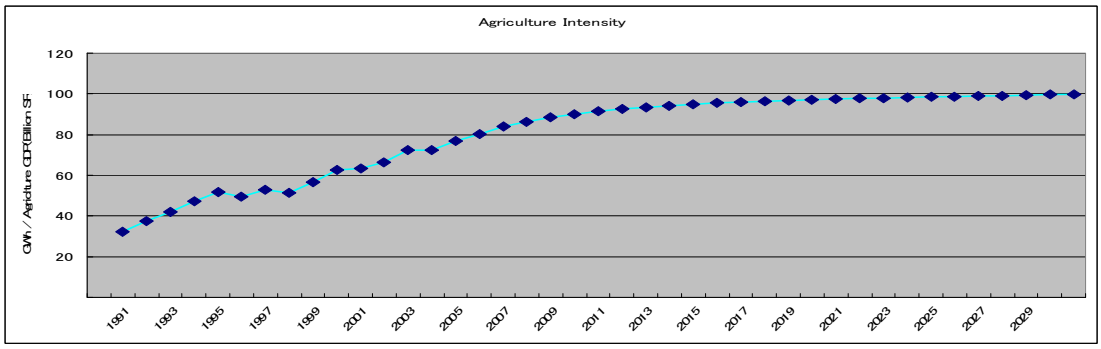


Figure 9-6 Trend of Electricity GDP Intensity in the Agriculture Sector

(b) Refinery & Petrochemical Sector

Electricity GDP intensity in the refinery & petrochemical sector is defined by "Electricity consumption in the refinery & petrochemical sector/GDP in the refinery & petrochemical sector". The electricity GDP intensity was 600 GWh/Billion SR in 1995, and 500 GWh/Billion SR in 2005 due to energy conservation efforts in the sector. The rate changes during the period from 1991-2005 were around 15 % and became zero in 2003. However, in recent year is has been minus 5%. The range of the rate change gradually narrows. Although the rate change in 2005 was minus 5%, the decrease in intensity will not last for a long time. It is assumed that the future rate change will converges to zero by 2016. As a result, the electricity GDP intensity in the refinery & petrochemical sector will change from 500 GWh/Billion SR in 2005 to 400 GWh/Billion SR in 2030, as follows.

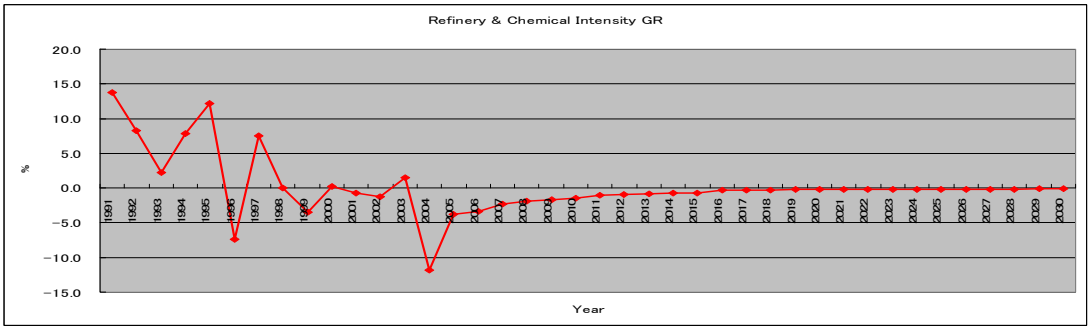


Figure 9-7 Annual Rate Change of Electricity GDP Intensity in the Refinery & Petrochemical Sector

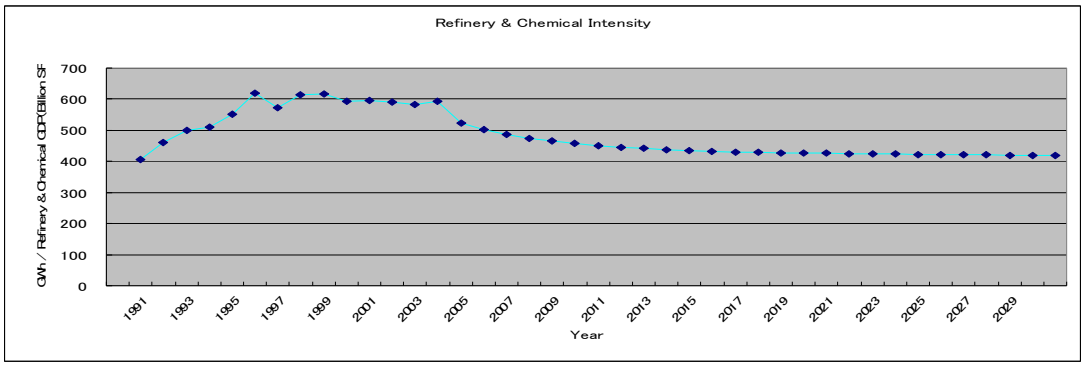


Figure 9-8 Trend of Electricity GDP Intensity in the Refinery & Petrochemical Sector

(c) Manufacturing Sector

Electricity GDP intensity in the manufacturing sector is defined by "Electricity consumption in manufacturing sector/GDP in manufacturing sector". The intensity was 160 GWh/Billion SR in 1995, and it became 150 GWh/Billion SR in 2005 (almost flat during the term). The rate change during 1991-2005 fluctuated from +10% to -10% in the term above (average rate change is zero). Although the rate change in 2006 was +3 %, it can be assumed that the future rate change after 2010 will be zero considering that the current average rate change is zero. As a result, the electricity GDP intensity in the manufacturing sector will change from 150 GWh/Billion SR in 2005 to 160 GWh/Billion SR in 2030, as follows.

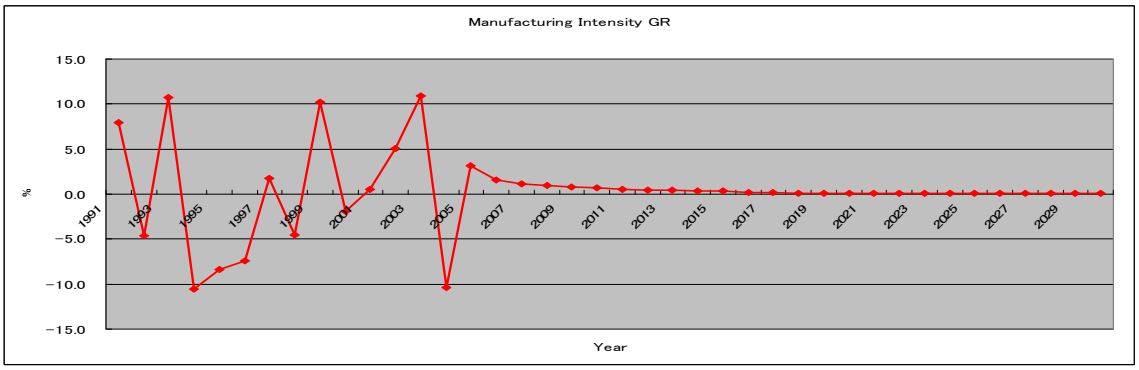


Figure 9-9 Annual Rate Change of Electricity GDP Intensity in the Manufacturing Sector

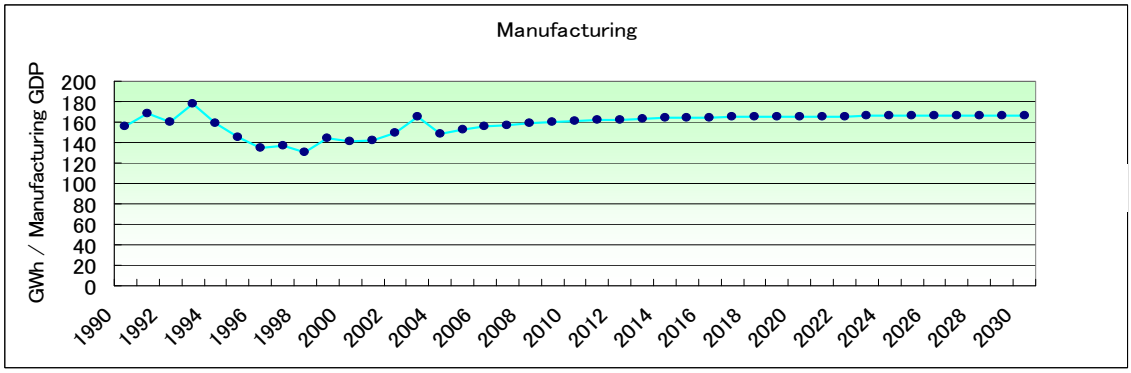


Figure 9-10 Trend of Electricity GDP Intensity in the Manufacturing Sector

(d) Commercial & Service Sector

Electricity GDP intensity in the commercial & service sector is defined by "Electricity consumption in the commercial & service sector/GDP in commercial & service sector". The intensity was 60 GWh/Billion SR in 1995, and became 90 GWh/Billion SR in 2006. It is believed that electricity GDP intensity increased due to the construction of large scale commercial buildings and an increase in IT devices. Rate changes during 1991-2005 are from +10% to minus 5% (+25% in 2005 is an abnormal case). Although the rate change in 2006 was +4 %, it is assumed that the future rate change converges to zero by 2016. After 2016, the rate change will remain at zero. As a result, the electricity GDP intensity in the commercial & service sector will change from 90 GWh/Billion SR in 2005 to 105 GWh/Billion SR in 2030, as follows.

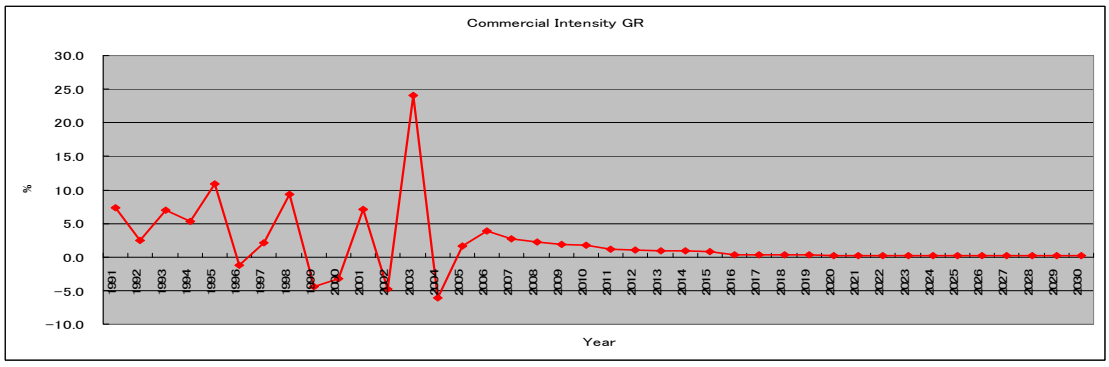


Figure 9-11 Annual Rate Change of Electricity GDP Intensity in the Commercial Sector

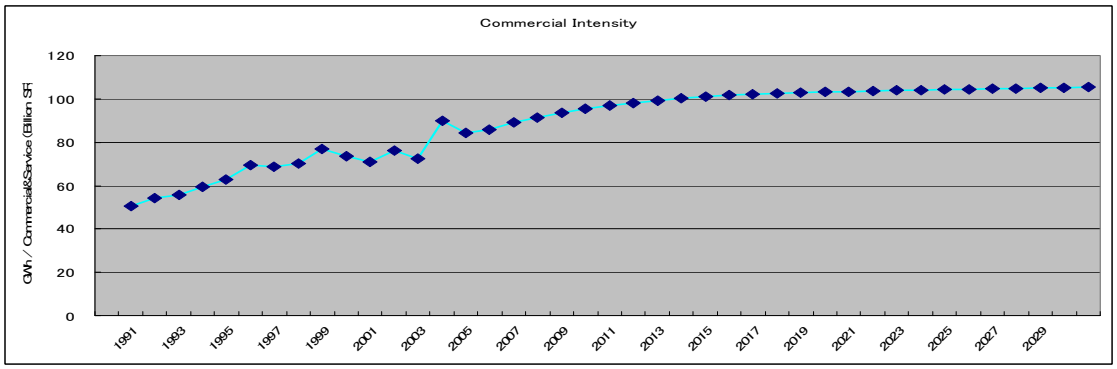


Figure 9-12 Trend of Electricity GDP Intensity in the Commercial Sector

(e) Government Sector

Electricity GDP intensity in the government sector is defined by "Electricity consumption in the government sector/GDP in the government sector". The intensity was 120 GWh/Billion SR in 1995, and became 140 GWh/Billion SR in 2006. Intensity is the electricity consumption ratio of public facilities, street lights, and religious buildings in comparison to the governmental GDP (Total cost and salary of government staff and public service payments are included in the government GDP). The rate changes during 1991-2005 are from +8% to minus 4%. Although the rate change in 2006 was minus 4%, it is assumed that future rate change converges to zero by 2009. After 2009, the rate change will be kept at zero. As a result, the electricity GDP intensity in the

government sector will not change from 2005 to 2030. The value will be fixed at 140 GWh/Billion SR even in 2030, as follows.

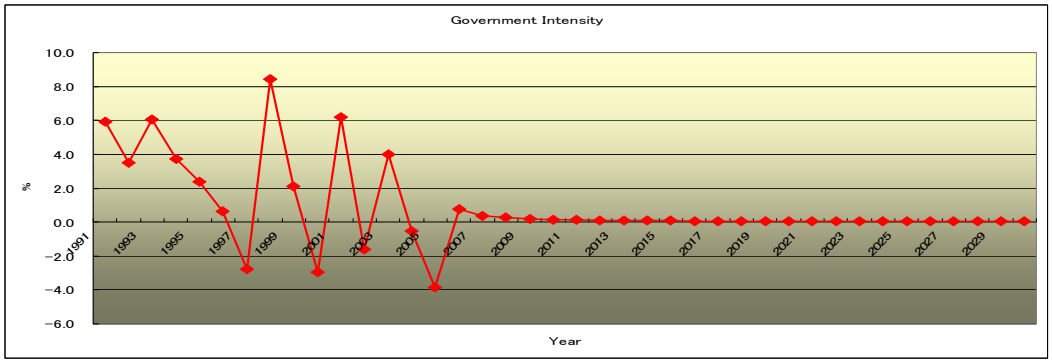


Figure 9-13 Annual Rate Change of Electricity GDP Intensity in the Government Sector

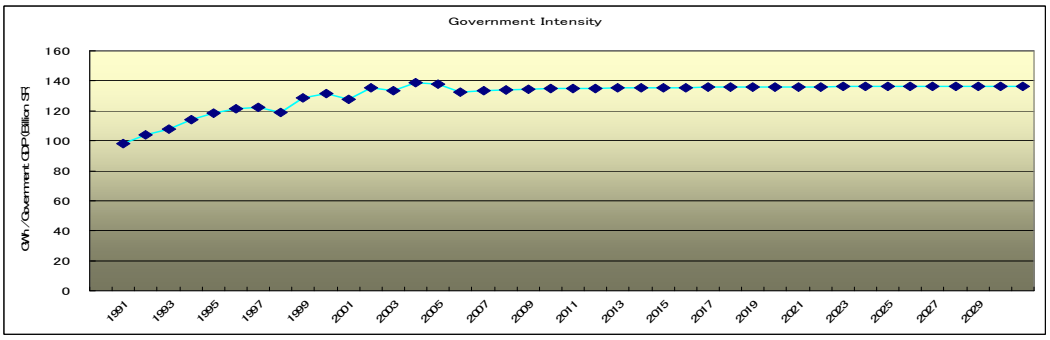


Figure 9-14 Trend of Electricity GDP Intensity in the Government Sector

(f) Residential Sector

Electricity GDP intensity in the residential sector is defined by “Electricity consumption in the residential sector/population in the KSA”. Intensity was 2,000kWh/person in 1991, and became 3,300kWh/person in 2006, with a liner increase. Looking at the Japanese experience, intensity in the residential sector has similar characteristics; it increases in a linear fashion with no relation to GDP or population trends. The rate changes during 1991-2005 ranged from +11% to + 5%. Although the rate change in 2006 was +5%, it is assumed that the future rate change will converge to 1.0 % because Japanese average electricity GDP intensity in the past 15 years has increased from 1.5 % to 2.0 %. As a result, the electricity GDP intensity in the residential sector in the KSA will change from 2,200kWh/person in 2005 to 5,000kWh/person by 2030, as follows.

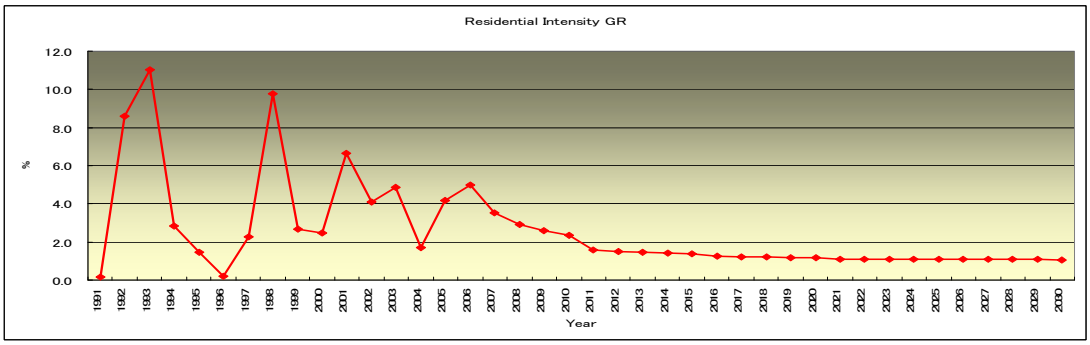


Figure 9-15 Annual Rate Change of Electricity GDP Intensity in the Residential Sector

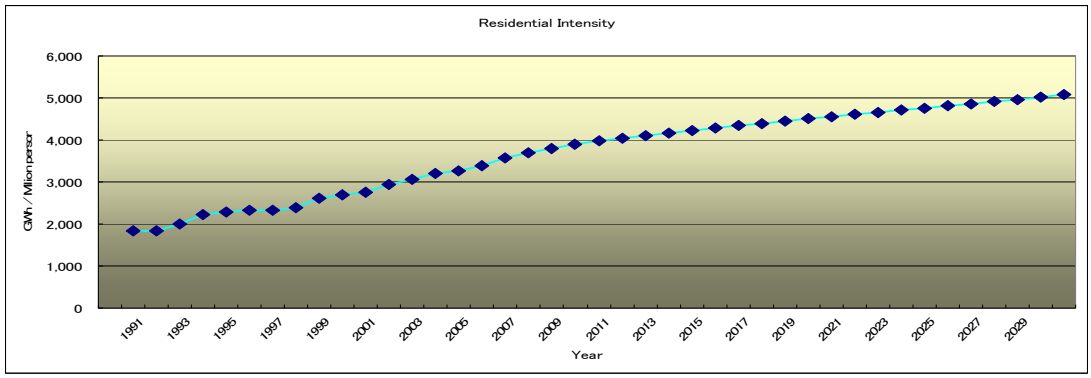


Figure 9-16 Trend of Electricity GDP Intensity in the Residential Sector

9.1.4 Considerations

The purpose of the power demand forecasts is to analyze the effects of the energy conservation principle. Concretely, these are (i) Check the validity of the energy conservation principle and EEC factors, and (ii) Check achievement rate of energy conservation targets. For these purposes, the model uses current electricity GDP intensity of electricity consumption as the starting point. It means that effects of new energy conservation policies are added to production sectors like Agriculture, Industry and Commercial sectors under the assumption that the electricity GDP intensities of the sectors before adding new energy conservation policies are converged to constant levels. Meanwhile, it is assumed that electricity consumption per capita in the residential sector continues to increase in company with increasing home appliances even though the speed of the increase becomes slower than the current.

However, as another case to be considered, there is a case that electricity GDP intensity continues to increase in production sectors in future as well as the current actual situation. In such case, the power demand in the KSA will increase more than the forecasts.

9.2 Power Demand Forecast Results

9.2.1 Countrywide Power Demand Forecasts

(1) Power Demand for the BAU Case and the EEC Base Case

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 9-8 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 9-9 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

(2) Comparison of Power Demand Forecasts between the Study and the ECRA Report

In 2005, ECRA (Electricity & Cogeneration Regulatory Authority) requested the Center for Engineering Research to survey the “Generation Planning for Saudi Electricity Sector” that includes a power demand forecast for the KSA. When comparing power demand forecasts among the BAU Case and the EEC Base Case and the ECRA Case, the results are shown as follows.

Table 9-10 Comparison Table of Power Demand Forecasts

	BAU Case	EEC Base Case	ECRA Case
GDP	2006-10 6.5% 2010-20 5.0% 2020-30 4.0%	2006-10 6.5% 2010-20 5.0% 2010-30 4.0%	2008-13 4.3% 2013-18 3.5% 2018-23 3.0%
Power Demand	‘13 236 TWh ‘18 289 TWh ’23 347 TWh	‘13 224 TWh ‘18 257 TWh ‘23 290 TWh	‘13 249 TWh ‘18 298 TWh ‘23 343 TWh
Peak Demand	‘13 42.3 GW ‘18 51.7 GW ’23 62.1 GW	‘13 40.0 GW ‘18 46.0 GW ‘23 52.0 GW	‘13 41.9 GW ‘18 50.2 GW ‘23 57.8 GW

The difference between the BAU Case and the ECRA Case is very small. However, the EEC Base Case is lower than the BAU Case and the ECRA case by 15 % in 2023.

9.2.2 Regional Power Demand

(1) Dispatched Power by Region

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 9-11 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 9-12 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

The share of COA (=COA dispatched power/total dispatched power) is stable with 22.7 % in the past years, then the same share is set for the future share of COA. The share of EOA was 44.7 % in 2005, the shares decrease by -0.3 % per year due to a future increase in the shares from WOA and SOA. The WOA share will increase by 0.2 % per year along with an increase in the SOA of 0.1 % from 5.9 % in 2005.

(2) Peak Demand

Peak demand by region should be forecast after daily load curves for COA, EOA, WOA and SOA have been forecast separately. When considering interconnection from EOA to COA, the peak demand of EOA includes power demand in COA. Therefore, EOA and COA cannot be forecast independently. For that reason, the daily load curves and the peak demand for EOA and COA are forecast in the totals of the EOA and COA. Moreover, WOA will send power to COA in the future. However, the plan has not been worked out yet. The daily load curve and peak demand in WOA is

forecast without the interconnection in the Study. SOA has independent power suppliers in the area. So, it is said that SOA statistics do not include electricity consumption in the independent networks. Therefore, there is no reason to forecast the peak demand of SOA.

(a) Peak Demand of COA+EOA

Peak demand in the BAU Case and the EEC Case is forecast as follows. The model forecasts the daily load curves and peak demands of COA+EOA after referring to the past changes and the past trends based on the data in 2005.

Table 9-13 Peak Demand of COA+EOA in the BAU Case and the EEC Base Case

Peak Hour	BAU Case	EEC Base Case
2005 Jul 15 pm	20,248 MW	20,963 MW
2010 Jul 15 pm	26,457 MW	27,054 MW
2015 Jul 15 pm	31,871 MW	30,574 MW
2020 Jul 15 pm	38,080 MW	34,218 MW
2025 Jul 15 pm	44,141 MW	37,128 MW
2030 Jul 15 pm	51,202 MW	40,272 MW

Since the first group of forecast data was calculated in proportion to data from 2005, it has a strong impact on the future daily load curves and peak demands as shown below, so all the future daily load curves have a similar shape. By judging the phenomenon, the daily load curves and peak demands obtained from the model should only be used as a reference in the Study since the accuracy of the estimation is not sufficient.

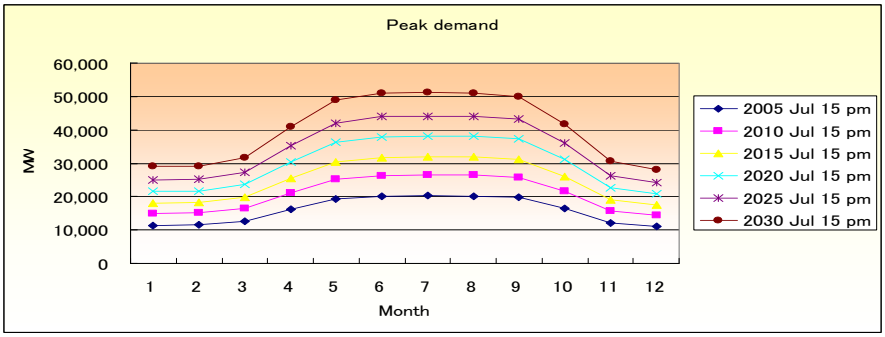


Figure 9-17 Daily Load Curve and Peak Demand of COA + EOA in the BAU Case

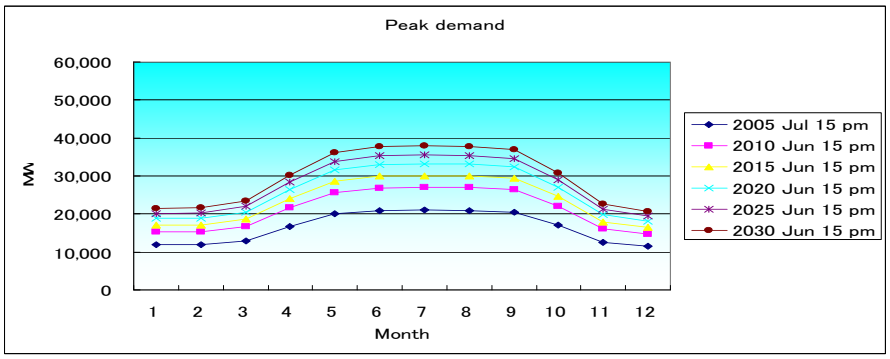


Figure 9-18 Daily Load Curve and Peak Demand of COA + EOA in the EEC Base Case

(b) Peak Demand of WOA

Peak demands of WOA in the BAU Case and the EEC Base Case are forecast as follows. The model forecasts the daily load curves and peak demands of WOA after referring to the past changes and the past trends based on the data for 2005. However, actual data is available for only two years (2005 and 2006), so the first group of forecasted data calculated in proportion to the data in 2005 has a stronger impact to future daily load curves and peak demands than in COA+EOA.

Table 9-14 Peak Demand of WOA in the BAU Case and the EEC Base Case

Peak Hour	BAU Case	EEC Base Case
2005 Aug 18 pm	8,643 MW	8,643 MW
2010 Aug 18 pm	10,667 MW	10,507 MW
2015 Aug 18 pm	15,164 MW	13,862 MW
2020 Aug 18 pm	19,196 MW	16,417 MW
2025 Aug 18 pm	23,561 MW	18,853 MW
2030 Aug 18 pm	28,926 MW	21,628 MW

Therefore, the future changes in the daily load curves form the same shape as those in 2005, as shown below. Taking this phenomenon into consideration, the daily load curves and peak demands obtained from the model should only be used as a reference for the Study for the same reason mentioned in the case of COA+EOA.

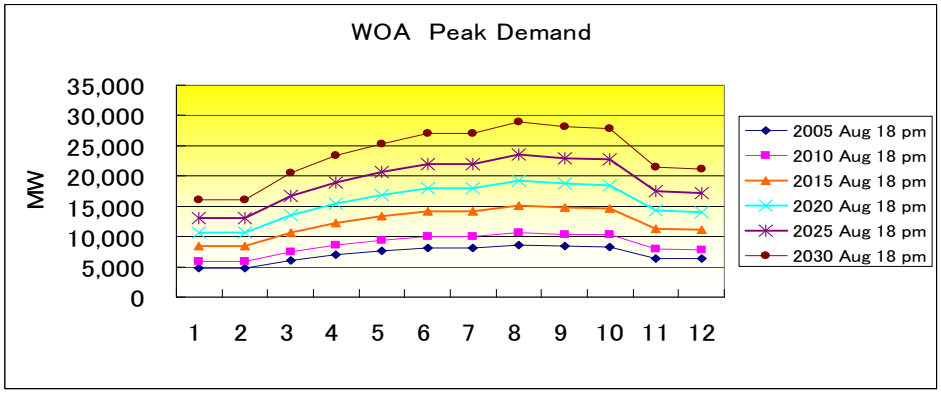


Figure 9-19 Daily Load Curve and Peak Demand of WOA in the BAU Case

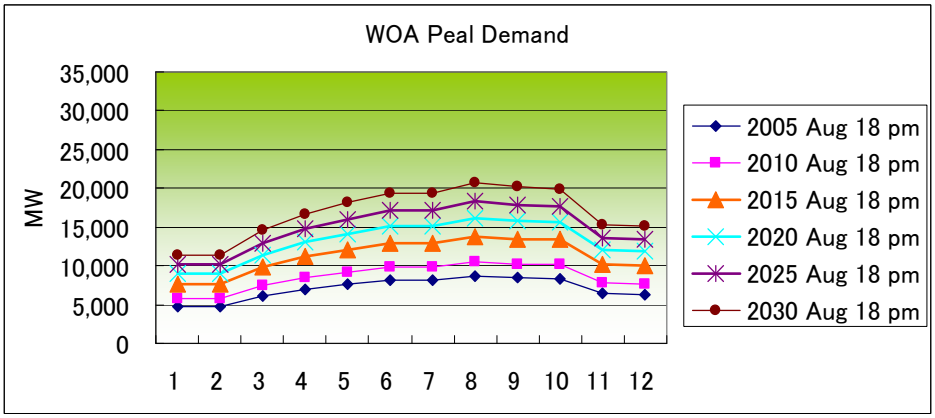


Figure 9-20 Daily Load Curve and Peak Demand of WOA in the EEC Base Case

9.2.3 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 9-15 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 9-16 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	

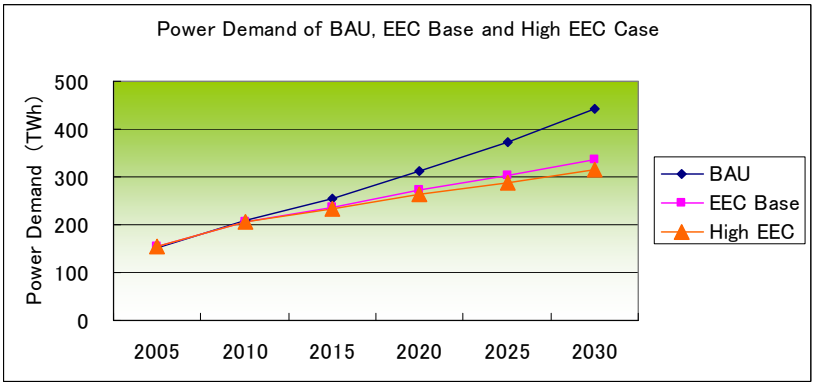


Figure 9-21 Power Demand of the EEC High Promotion Scenario, the BAU Case and the EEC Base Case

(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 9-17 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 9-18 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	

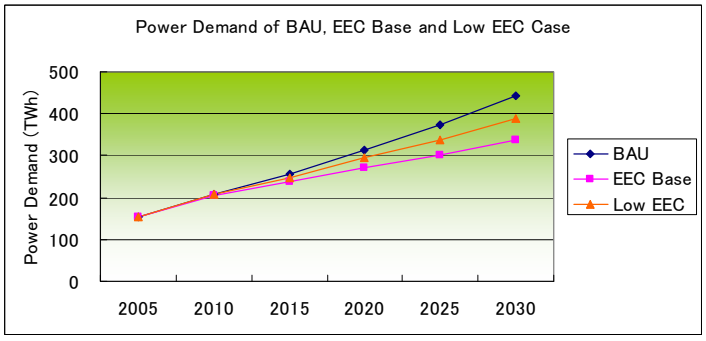


Figure 9-22 Power Demand of the EEC Low Promotion Scenario, the BAU Case and the EEC Base Case

9.3 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 in Chapter 8 is reviewed. The proposed targets are as follows.

Table 9-19 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)

9.3.1 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.

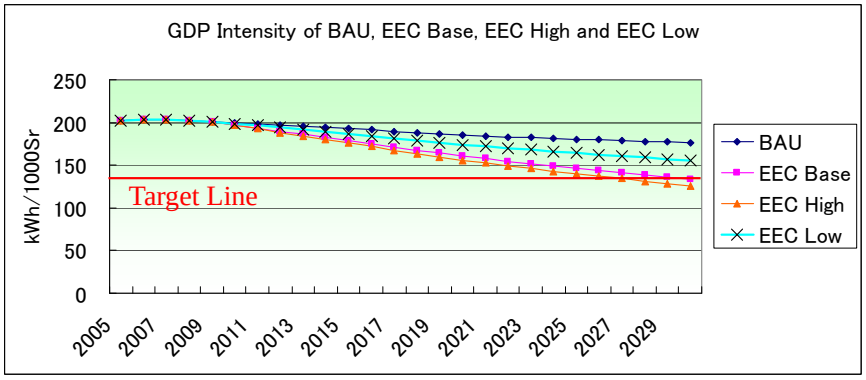


Figure 9-23 Electricity GDP Intensity in Each Case and Option Scenario

Table 9-20 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!

9.3.2 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.

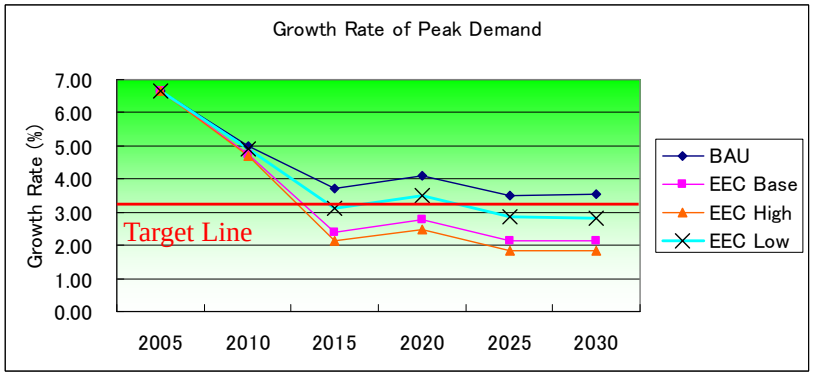


Figure 9-24 Growth Rate of Peak Demand

9.4 Power Demand Forecast Risks

Risk of Unstable Crude Oil Price and Economic Growth

The KSA economy has greatly relied on crude oil exports for a long time. The share of crude oil production in the total GDP of the KSA is approximately 40%. This is direct economic reliance on crude oil, but the economic reliance, including indirect economic activities, in the KSA economy is higher than the 40 %. Recent high crude oil price have been favorable for the KSA economy. However, it is unknown how long current crude oil prices will be kept in the international market. Although it is unclear how long the current status of the KSA economy can be maintained as mentioned above, when looking at the LTS 2025 published in 2002 and the most recent publication of the EDP, governmental economic policies can be perceived to a certain extent. In the Study, assuming a soft landing of the crude oil price (US$ 60/bbl), the status of the economy is estimated and used as a base to forecast power demand.

Risk of the Inability to Adjust Demand due to Low Oil Prices in the Domestic Market

Generally, energy demand changes with the fluctuation of crude oil and petroleum product prices. This is called “Demand Elasticity to Price”. In the case of the KSA, as the government keeps energy prices low, including the power tariff, the increase (not so large) so that the prices of oil products and power tariffs do not effect domestic power demand. However, worldwide energy efficiencies of energy consuming appliances are improving due to high oil prices and electric tariffs, and such appliances will be imported by the KSA in the future. Domestic factors (energy prices) alone do not lead to the improvement of appliances; they are also decided by international

energy prices. If the crude oil price is kept at US$ 60/bbl in the future, it is believed that high energy performing type equipment, facilities, and electric appliances will be imported. As the KSA foreign trade balance is remains stable when crude oil price is US$ 60/bbl, the KSA can introduce high energy performance electric appliances faster than other counties. Considering the conditions above, it can be said that there is a high probability that the EEC factors adopted in the model can be achieved.

Energy Conservation Activity Risks in the Residential Sector

Half of all electricity consumption in the KSA is consumed by the residential sector. As it may be difficult for consciousness of energy conservation to effectively penetrate the residential sector, the government is expected to lead these efforts. For example, even if energy conservation makes progresses in the residential sector, there is still the possibility that energy demand will not decrease due to an increase in private income and the population. In the model used for this Study, the future growth rate of power consumption per person for the residential sector is assumed to be 1 %. However, there is a possibility that the future growth rate may grow to 2 %. In that case, power demand is forecast to increase greatly. Thus, the promotion of energy conservation in the residential sector is especially needed.

Estimation Risks of Peak Demand and Daily Load Curve

It cannot be said that the estimation of regional peak demand is completely accurate. A problem with sufficient collection of data for daily load curves and regional GDP has been pointed out. In this Study, auto regression analysis is used to formulate the forecasting equations. As a result, future daily load curves have a similar figure to the daily load curves in 2005 daily load curve. Therefore, time-trend-changes in future daily load curves cannot be estimated for the reasons mentioned above.

Part 5 Implementation Plan of Energy Conservation Measures

Chapter 10 High Priority Measures

10.1 Making Implementation Plan for Each High Priority Measures

10.1.1 Methodology

(1) Format of Implementation Plan Paper

As described in 8.5.4, 13 high priority measures that were selected have been divided into 5 groups and discussed with each responsible sub-committee. To formulate each measure, a format of implementation plan paper was prepared by the JICA Study Team, and based on this paper, discussions with each sub-committee took place during each local research period.

The format of the implementation plan paper includes the following items.

Name of EC Measure
(1) Program Name
(2) Objective
(3) Outline of the Scheme and Each Phase
(4) Executing Agency
(5) Relating Agency
(6) Target of the Scheme
(7) Workflow
(8) Required Permanent Human Resources
(9) Required Items
(10) Expected Legislation for Enforcement
(11) Expected Action Plan
(12) Attachment (Relating Documents or Format)
(13) Items to be Further Studied

Figure 10-1 Format of the Implementation Plan Paper

(2) Discussion Schedule for Making Implementation Plan Paper

For making an implementation plan paper, discussions with each sub-committee was made by the following discussion cycle over 3 local research periods from November 2007 to May 2008.

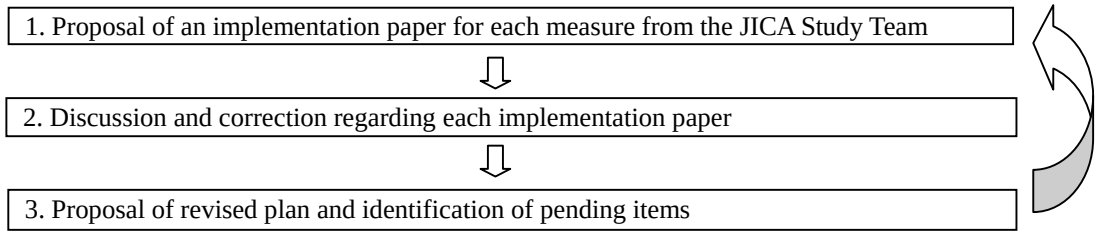


Figure 10-2 Discussion Cycle for Formation of Implementation Plan Paper

10.1.2 Implementation Plan Paper

Through the above methodology, implementation plan papers for each high priority measure were finalized by May 2008. Those plans are summarized as follows. The details of implementation plan papers are attached in Annex 2.

Some of high priority measures are expected to be implemented by Saudi Energy Efficiency Center (SEEC) that is newly established as a central institute of energy conservation activities. Before establishment of SEEC, preparatory works are also recommended in these papers. The preparatory work should be done by a "Preparation Team" consisting of MOWE or any other concerning agency of the measure. The status of preparatory work is an optional work to smoothly proceed to official stages (pilot stage and final stage) after establishment of SEEC.

(1) Energy Management System

(a) Objective

- Improvement of efficiency of factories and buildings in governmental, industrial and commercial sector
- Improvement of energy management skill through certified energy manager system

(b) Outline of the Scheme

- Receipt of assignment of energy manager
- Receipt of annual report (energy use report and middle-term plan)
  - 1.5% improvement of energy intensity is recommended.
- Inputting consumer's report and plan into database
- Checking the report and plan
- Giving instruction in case of poor management
  - Expected Penalty: On-site inspection, rationalization guidance, public disclosure and compliance order (under mandatory program)

(c) Executing Agency

- Saudi Energy Efficiency Center (SEEC)

(d) Target of the Scheme

(Preparation Stage)

- 10 voluntary consumers

(Pilot Stage)

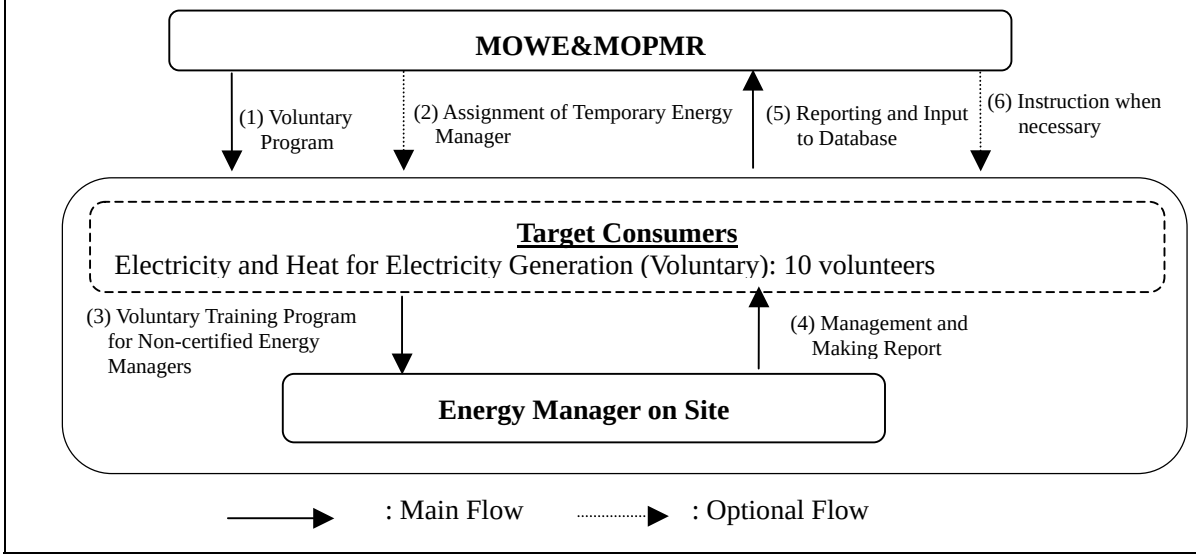
- Consumers who use above 3,000 kL-oe (12 GWh)/year in electricity and heat for electricity generation

(Final Stage 1&2)

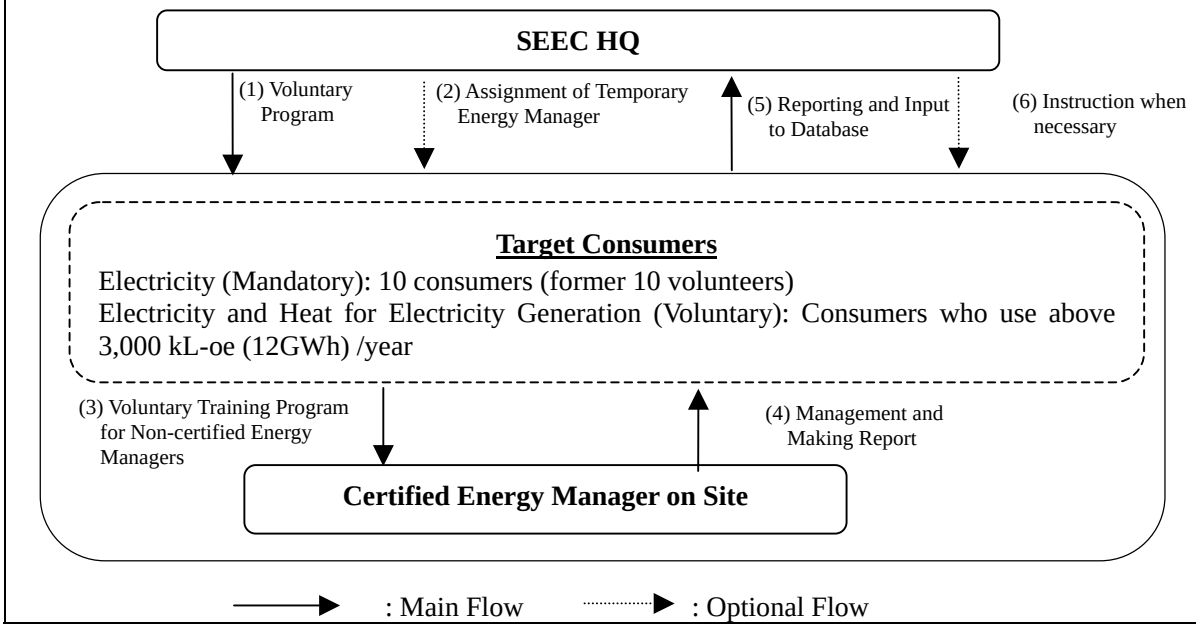
- Consumers who use 3,000 kL-oe (12GWh) /year in electricity and heat

(e) Workflow

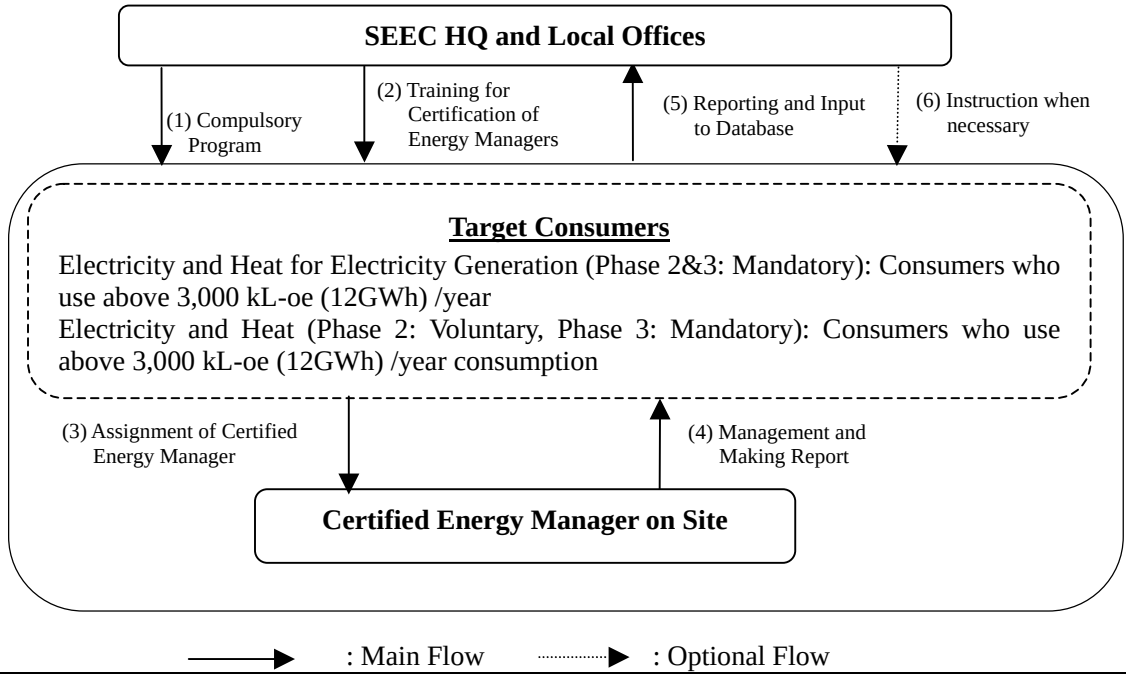
Phase 0 (Preparation Stage)



Phase 1 (Pilot Stage)



Phase 2 (Final Stage 1)
Electricity and Heat for Electricity Generation (Mandatory): Consumers who use above 3,000 kL-oe (12GWh) /year
Electricity and Heat (Voluntary): Consumers who use above 3,000 kL-oe (12GWh) /year consumption
Phase 3 (Final Stage 2)
Electricity and Heat (Mandatory): Consumers who use above 3,000 kL-oe (12GWh) /year



(f) Required Permanent Human Resources (at the final stage)

- SEEC HQ: Energy management staff: 3
- SEEC Local Offices: Energy management staff for 2 local offices: each 2

(g) Required Items

- Database soft ware
- Internet access system to the database
- Training for temporary energy manager (for 20 persons)

(h) Expected Legislation for Enforcement

- Evaluation of Criteria for Business Operators
- Guidance and Advice
- Designation of Designated Energy Management Factories and Buildings
- Energy Managers
- Duty of Energy Manager
- Preparation of Medium Term Plan
- Periodical Reports

- Instructions and Orders on Rationalization Plans
- Penalty

(i) Expected Schedule

- Phase 0: Preparation Stage (MOWE&MOPMR): 2008/10-2010/12
- Phase 1: Pilot Stage (SEEC HQ): 2011-2014
- Phase 2: Final Stage 1 (SEEC HQ and Local Offices): 2015-2017
- Phase 3: Final Stage 2 (SEEC HQand Local Offices): 2018-

	Phase 0 (Preparation Stage)	Phase 1 (Pilot Stage)	Phase 2 (Final Stage 1)	Phase 3 (Final Stage 2)
	2008/10-2010/12 2+1/4 years	2011-2014 4 years	2015-2017 3 years	2018-
10 Voluntary Consumers	Voluntary		Mandatory	
Electricity and Heat for Electricity Generation		Voluntary	Mandatory	
Electricity and Heat			Voluntary	Mandatory

(2) Energy Efficiency Labels and Standards (EELS)

(a) Objective

- Promotion of supply of high efficiency appliances to the market
- Raising energy conservation awareness of customers

(b) Outline of the Scheme

- Test of local/import product in accordance with SASO standard
- Sending local/import product information to SASO
- Registration of performance data
- Display of performance data at retail shops
- Making database
- Random inspection
- Monitoring and awareness survey

(c) Executing Agency

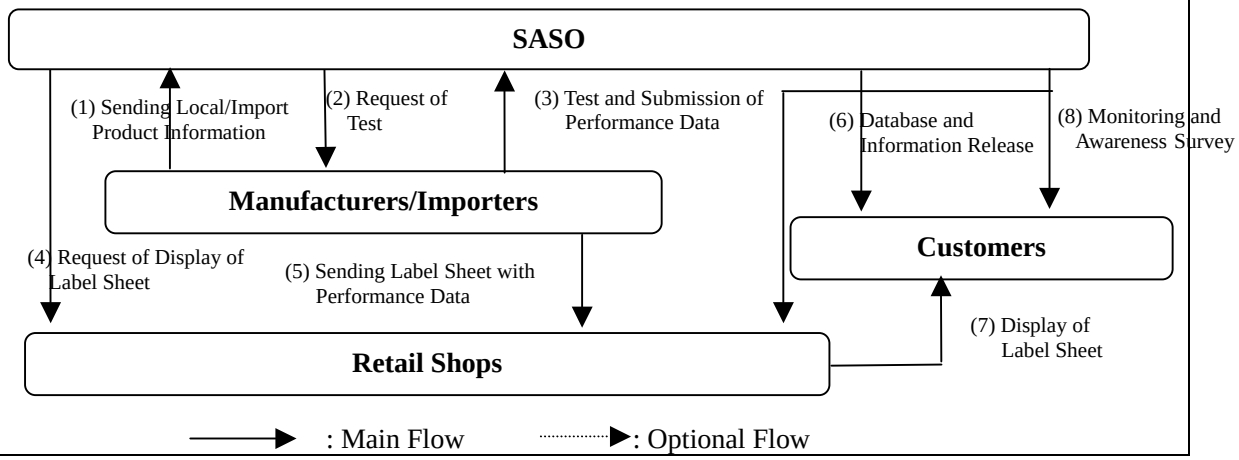
- Saudi Arabian Standards Organization (SASO)
- Saudi Energy Efficiency Center (SEEC)
- Ministry of Commerce and Industry (MOCI)

(d) Target of the Scheme

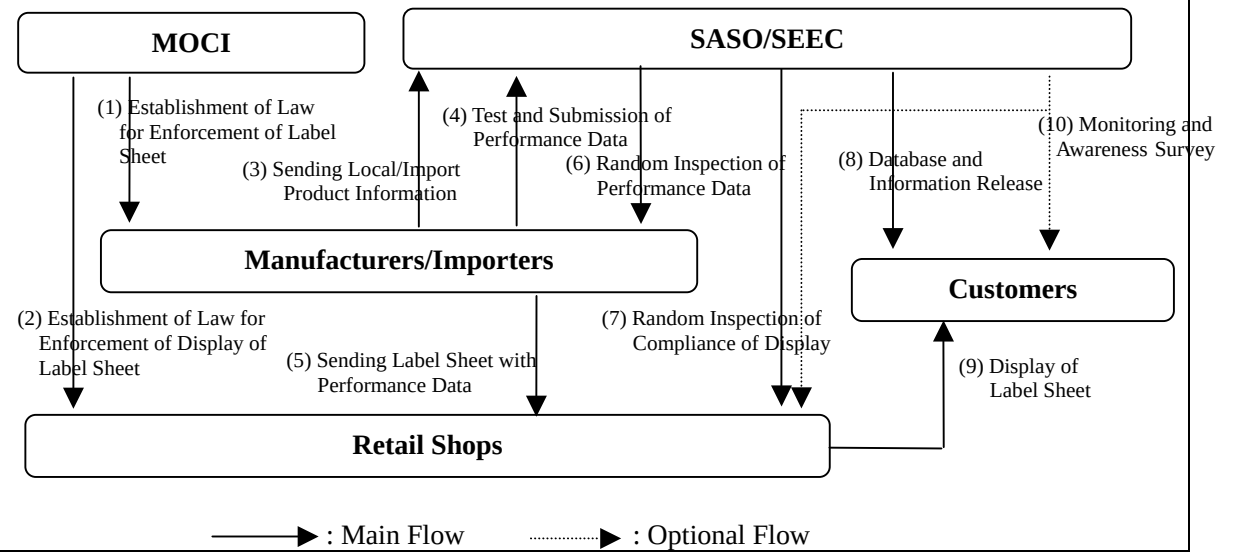
- Manufacturers and Importers (M&Is) of AC, Washing Machine, Refrigerator and Freezer
- Retail Shops selling AC, Washing Machine, Refrigerator, and Freezer

(e) Workflow

Phase 1 (Pilot Stage)



Phase 2 (Final Stage)



(f) Required Permanent Human Resources (at the final stage)

- SEEC HQ: Inspection: 1, Dissemination and publication: 1
- SASO New Department: Registration: 1, Database engineer: 1

(g) Required Items

- Database soft ware

- Internet access system to the database
- Testing cost for random inspection of performance data

(h) Expected Legislation for Enforcement

- Role of Manufacturers and Importers
- Standards of Judgment for Manufacturers /Importers and Registration of the Performance
- Recommendation and Orders concerning Improvement of Performance
- Labeling and Obligation to Manufacturers /Importers
- Recommendation and Orders concerning Labeling
- Provision of Information to General Consumers
- Penalty

(i) Expected Schedule

- Phase 1: Pilot Stage (SASO): 2008/7-2010/12
- Phase 2: Final Stage (SASO/SEEC): 2010/4-

(3) Training Program for Energy Manager

(a) Objective

- Qualifying Energy Managers in line with the Energy Management System (EMS)
- Improving technical level on energy conservation in factories and/or buildings
- Promoting basic understanding of legislation regarding energy conservation

(b) Outline of the Scheme

- Dissemination of the training programs in line with EMS
- Preparation of training materials
- Making arrangements and implementation of free training programs (at pilot stage)
- Making arrangements and implementation of chargeable training including hands-on practice (at final stage)
- Issuing Qualified Energy Manager’s license

(c) Executing Agency

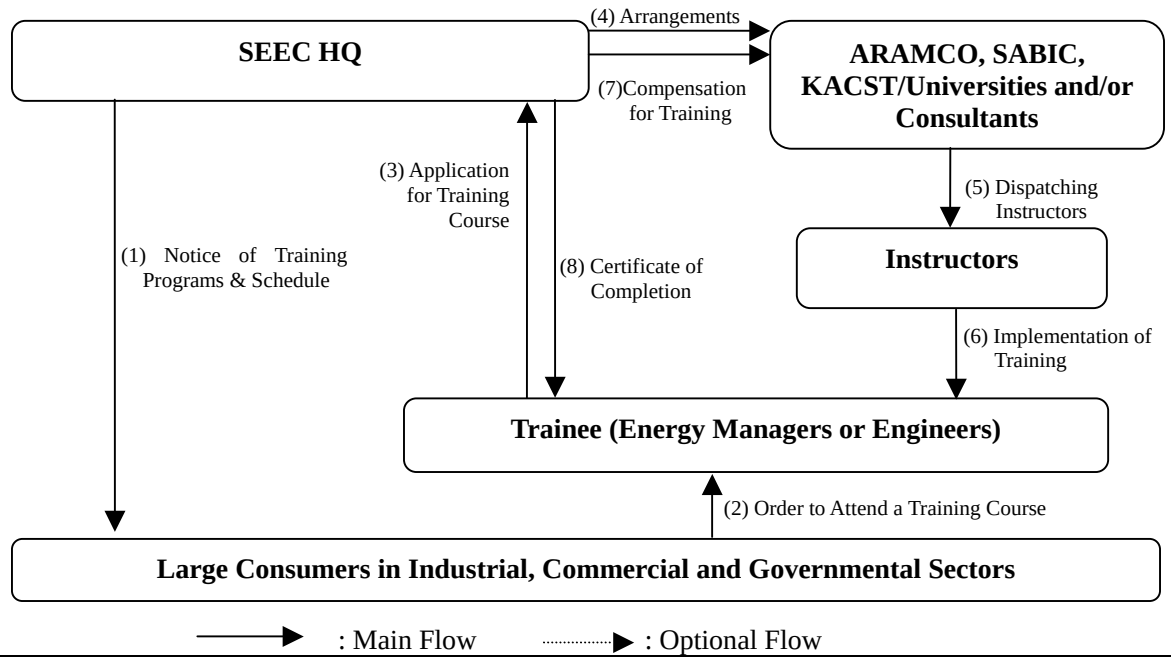
- Saudi Energy Efficiency Center (SEEC)

(d) Target of the Scheme

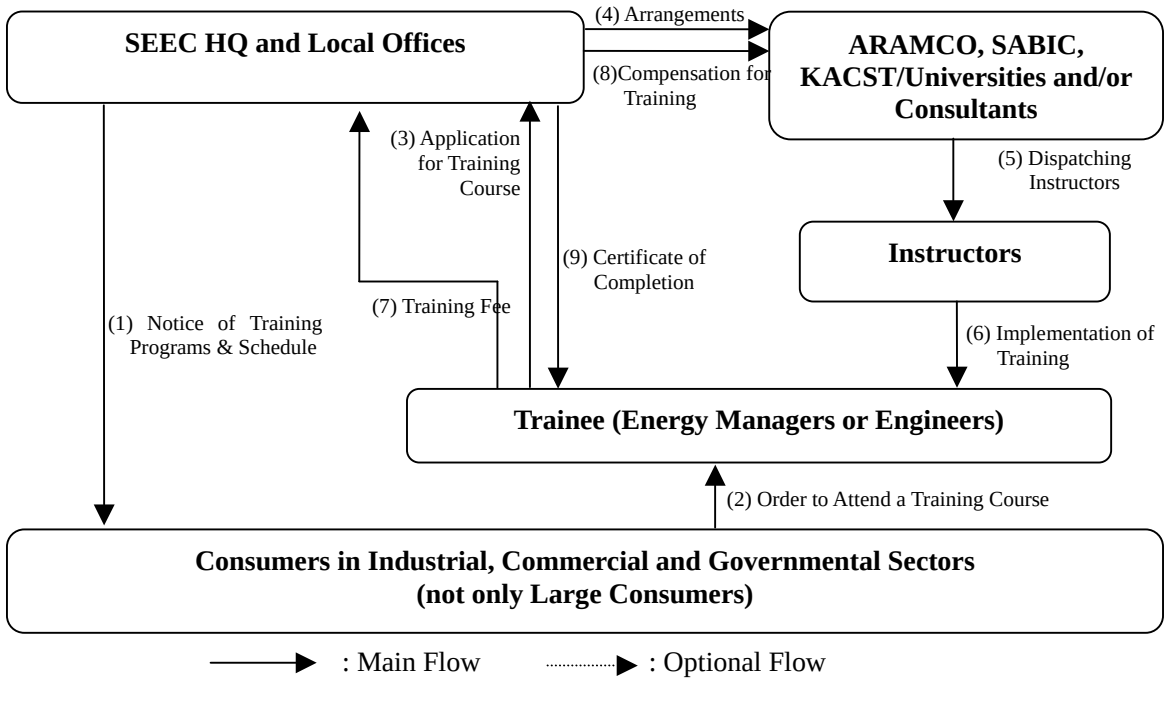
- Managers and engineers
- Field engineers from AC maintenance service companies

(e) Workflow

Phase 1 (Pilot Stage)



Phase 2 (Final Stage)



(f) Required Permanent Human Resources (at the final stage)

- SEEC HQ: Planning and administration: 1, Training arrangement: 1, EC technology information: 1
- SEEC Local Offices in Dammam and Jeddah: Training arrangement: 1 x 2

(g) Required Items

- Training of Trainer (TOT) fee and expense
- Training equipment (Interactive Whiteboards (IWBs) including basic software, AV, PCs and others for lecture and/or practice excluding lecture rooms) at HQ
- Design and construction of training facilities for hands-on practice
- Material preparation (textbooks and brochures)
- Compensation for instructors
- Direct expenses for local site training (venue lease and others)
- Operating and maintenance cost for hands-on training facilities
- Training equipment for SEEC local offices

(h) Expected Legislation for Enforcement

- Qualified Energy Manager's license

(i) Expected Schedule

- Phase 0: Preparation Stage (MOWE): 2009/4-2010/12
- Phase 1: Pilot Stage (SEEC HQ): 2010/4-2013/6
- Phase 2: Final Stage (SEEC HQ and Local Offices): 2013/7-

(4) Energy Assessment Service (EAS)

(a) Objective

- Encouraging energy conservation activities in private enterprises
- Dissemination of energy conservation technology

(b) Outline of the Scheme

- Making consultant list and recruiting stand-by consultants to implement the assessment and consultation
- Announcement of the program to industrial and commercial sector in cooperation with COC
- Application from industrial and commercial sector to SEEC
- Selection from the applicants
- Requesting required data (basic information, single line diagram, energy & electricity data, etc) in advance to selected applicants
- Dispatching suitable two consultants to the site of selected applicant for one day survey
- Making an energy conservation recommendation report within one month by the

consultants

- Conducting follow-up questionnaire within 2 years and urging actions if necessary

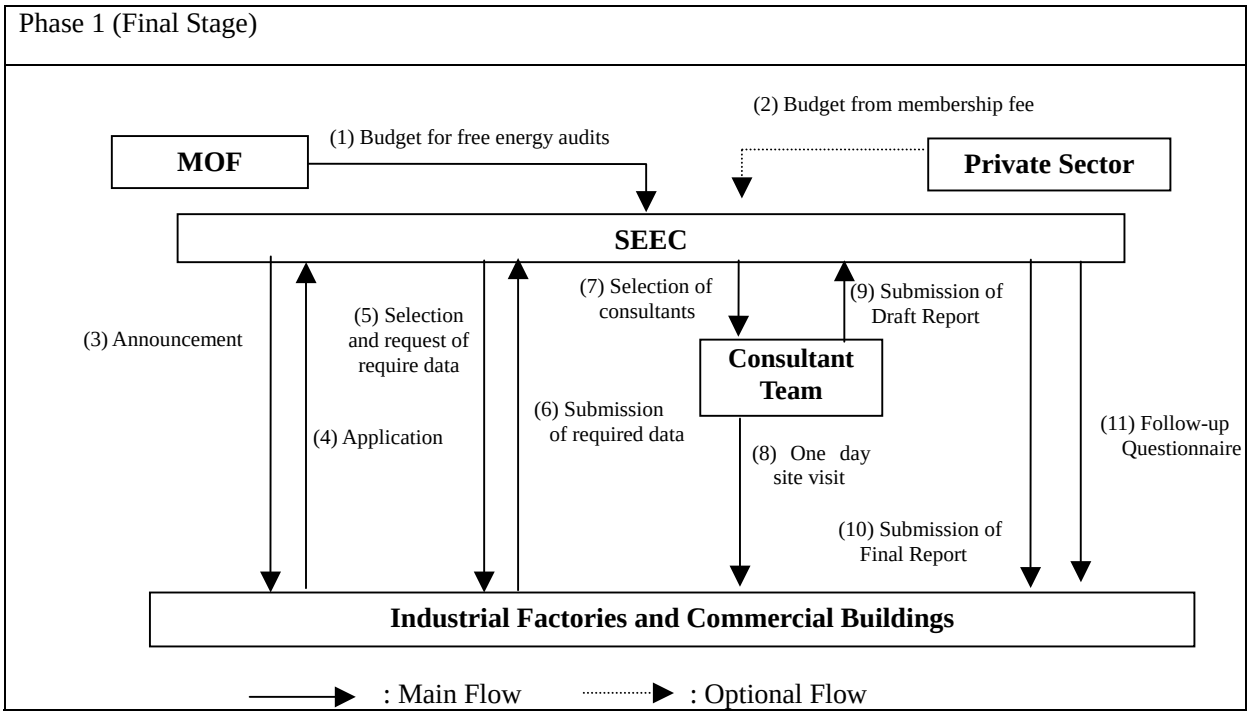
(c) Executing Agency

- Saudi Energy Efficiency Center (SEEC)
- Consultant (in the name of SEEC)

(d) Target of the Scheme

- Factories and commercial buildings

(e) Workflow



(f) Required Permanent Human Resources (at the final stage)

- SEEC HQ: Assessment management: 2, Consultant management: 1, Database Engineer: 1

(g) Required Items

- Budget for training course of consultants: 10 days course
- Budget for free assessment service: 10 cases/year
- Database software

(h) Expected Legislation for Enforcement

None

(i) Expected Schedule

- Phase 0: Preparation Stage (MOWE): 2009/4-2010/3
- Phase 1: Final Stage (SEEC): 2010/4-

(5) Publication and Award System (PAS)

(a) Objective

- Dissemination of promising energy conservation practice an/or measure by publishing successful energy conservation cases
- Giving award for superior energy conservation activity and effort conducted by organization

(b) Outline of the Scheme

- Establishment of national and local referee committees
- Collection of energy conservation activity information on a routine basis through associations / organizations, such as Chamber of Commerce (COC) and Saudi Council of Engineers (SCE), Ministry of Commerce and Industry (MOCI) Ministry of Islamic Affairs (MOIA) and Ministry of Education (MOE), etc.
- Establishment and maintenance of database by adding collected energy conservation information periodically
- Announcement to collect applicants
- Receiving application
- Selection of superior ones as the local successful cases at local referee committee
- Evaluation of the local awardees and selection of the most superior ones as the national successful cases at national referee committee
- Publishing the outlines of awardees at SEEC homepage and compiling in annual awarding pamphlet
- Holding awarding ceremony at 3 Days Big Fair in the “EC month”

(c) Executing Agency

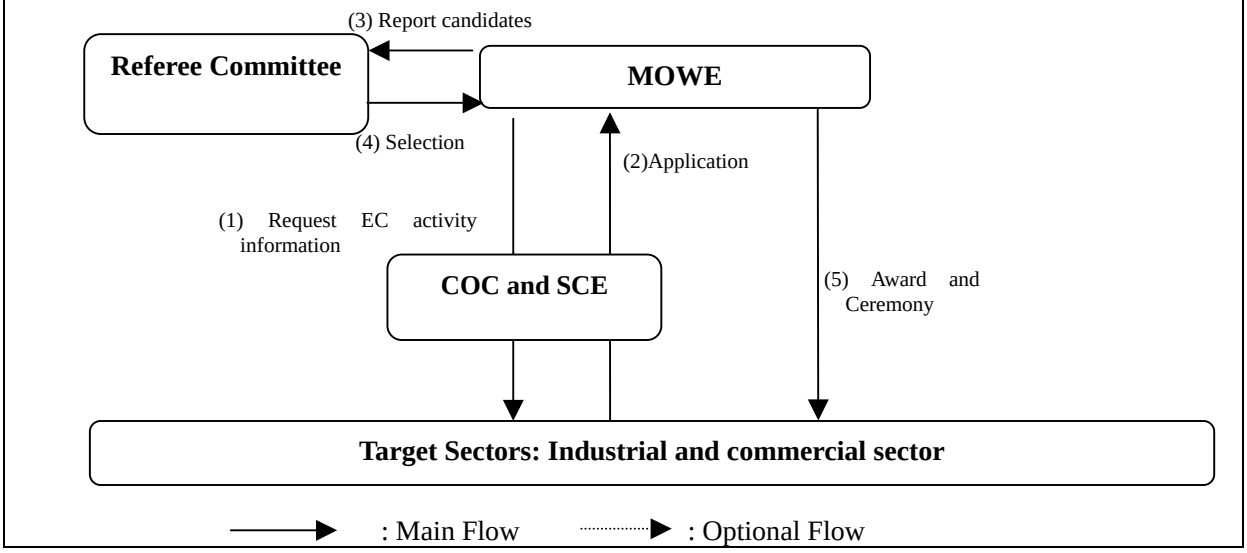
- Saudi Energy Efficiency Center (SEEC)
- National and Local Referee Committee

(d) Target of the Scheme

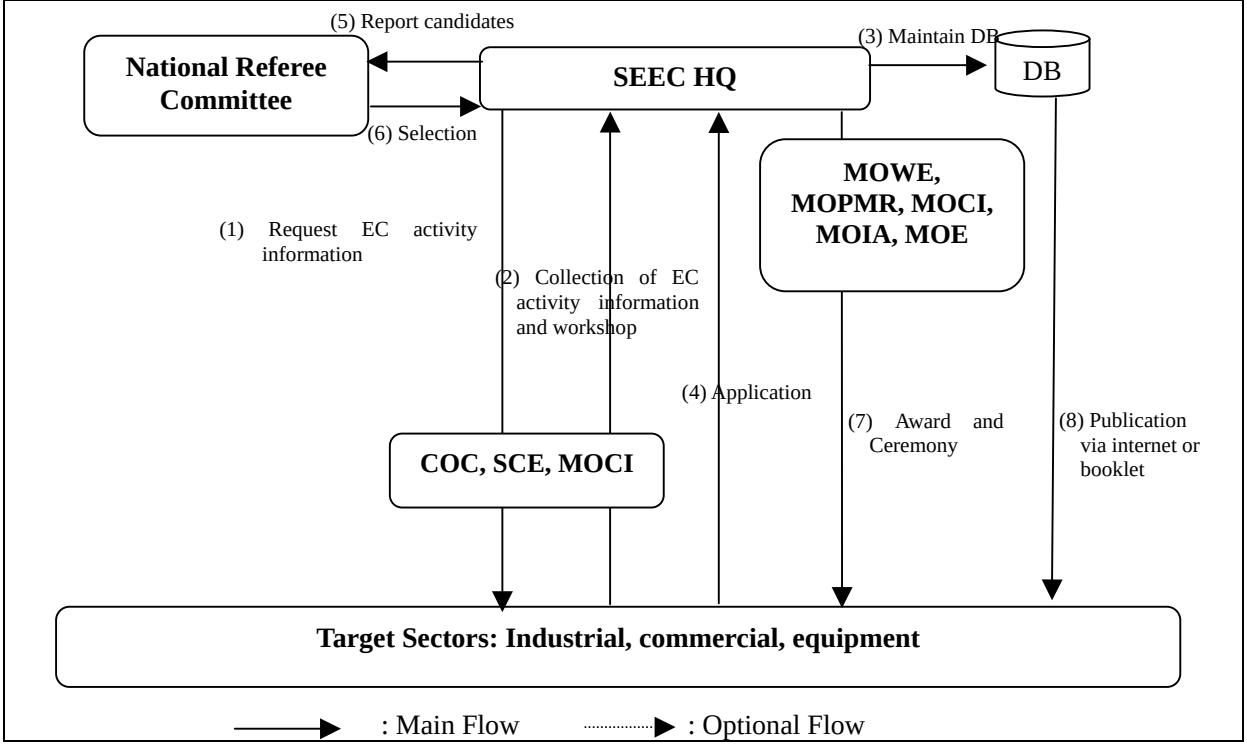
- Successful case in industrial/commercial/equipment/school/university/mosque sector

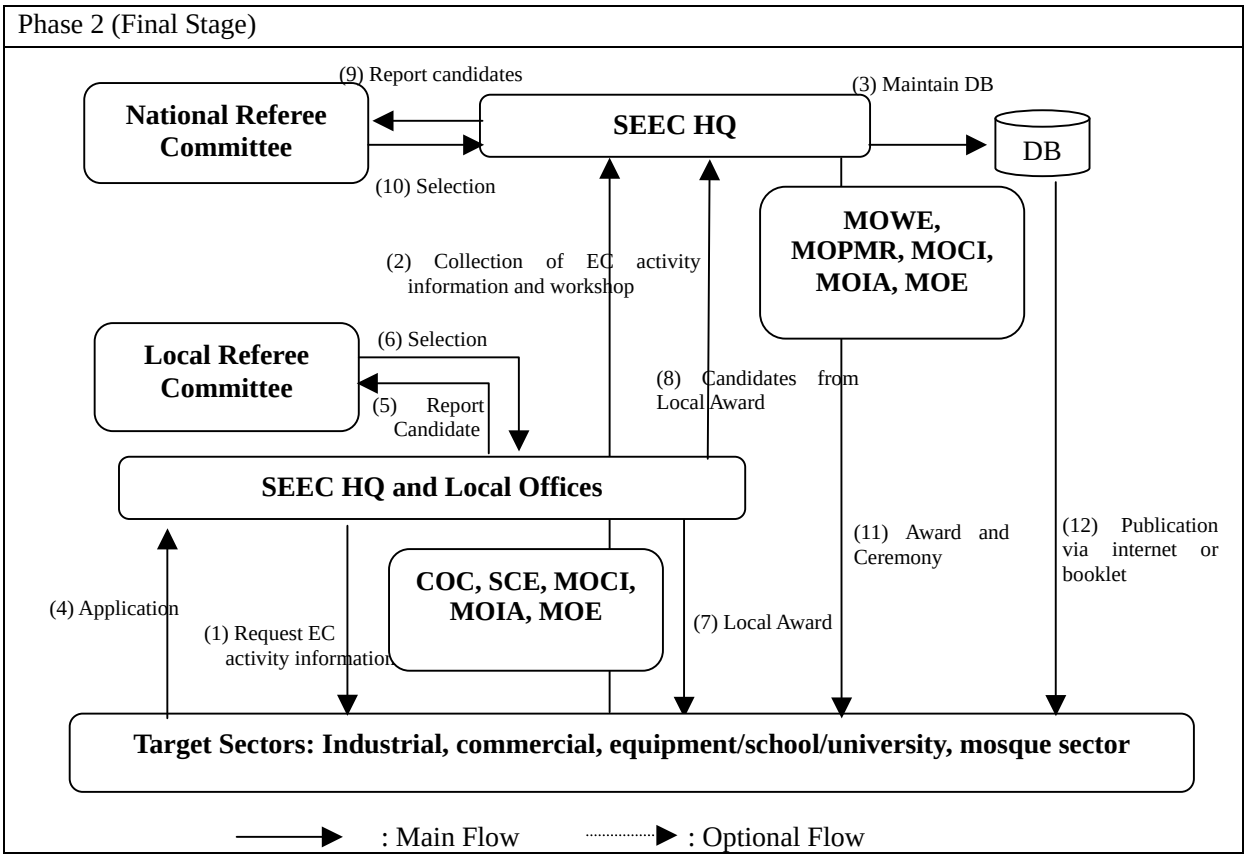
(e) Workflow

Phase 0 (Preparation Stage)



Phase 1 (Pilot Stage)





(f) Required Permanent Human Resources (at the final stage)

- SEEC HQ: Dissemination and publication : 1, Database engineer: 1, EC activity monitor:1
- SEEC Local Offices: EC activity monitor:1x2

(g) Required Items

- Database software
- Internet access system to the database

(h) Expected Legislation for Enforcement

None

(i) Expected Schedule

- Phase 0: Preparation Stage (MOWE): 2009/1-2010/3
- Phase 1: Pilot Stage (SEEC HQ): 2010/4-2014/3
- Phase 2: Final Stage (SEEC HQ and Local Offices): 2013/7-

(6) EC Campaign

(a) Objective

- Raising energy conservation awareness of all consumers
- Check of annual energy conservation activities
- Strengthening a connection between private sector and government sector to promote energy conservation technology

(b) Outline of the Scheme

1. Existing Program

- MOWE has already implemented the "National EC Campaign", but it is not periodically.
- MOWE launched the water and electricity exhibition, "WE-Power" at 2003. The 4th Exhibition holds in April 2008.

2. New Program to be merged into the Existing Program

- Establishment of "Saudi Energy Conservation Month (the EC Month)" in a year basis
- Special energy conservation events concentrated in the EC Month as follows:
  - "3 Days Big Fair" which can be merged into the existing WE-Power.
  - Workshop for Mosque Campaign
  - EC Education for Schools, etc.
- Holding the "3 Days Big Fair (to be merged into the WE-Power)" including energy conservation technology exhibition, announcement of some campaign, award ceremony, workshop/seminar, etc.

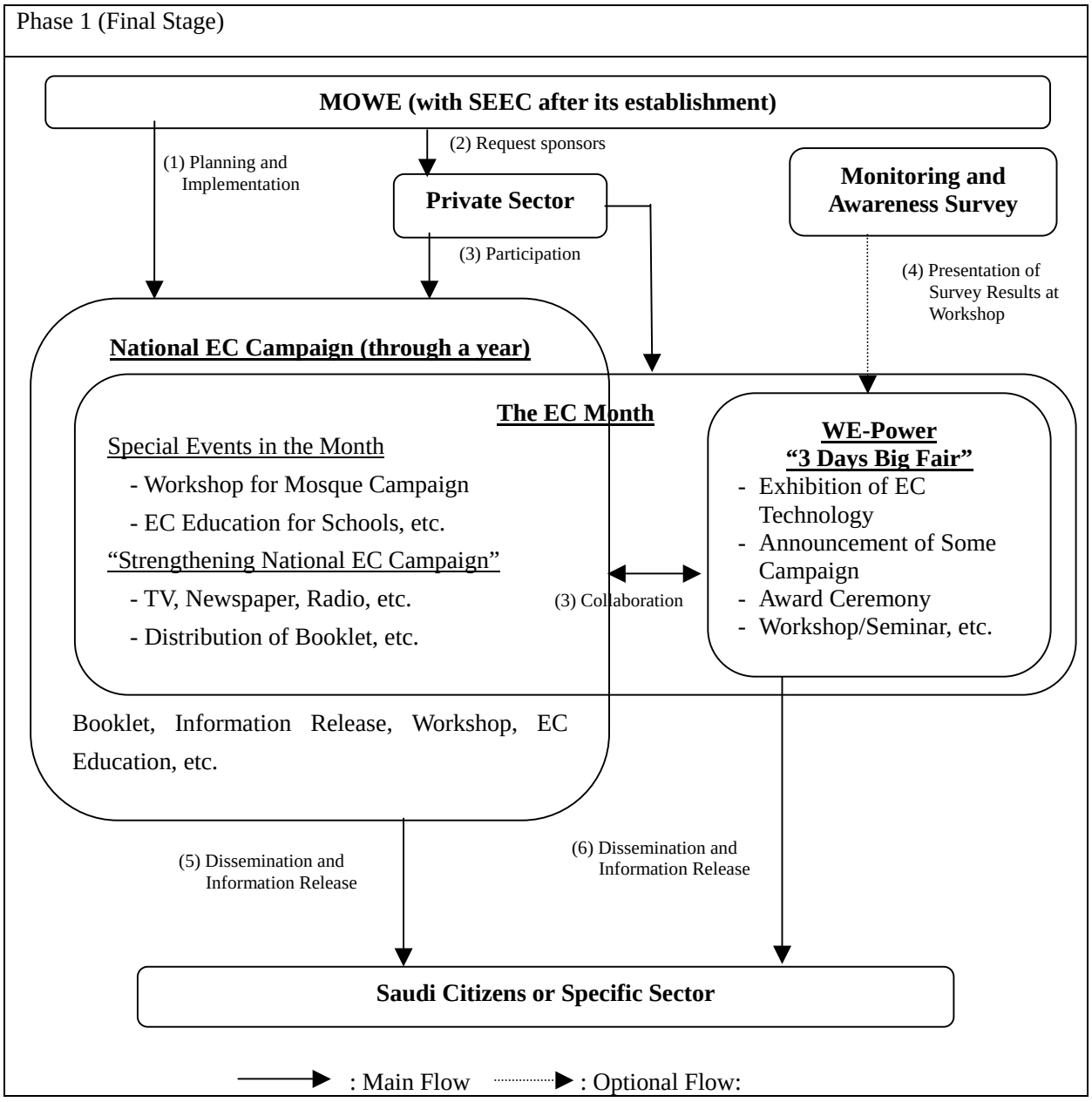
(c) Executing Agency

- Ministry of Water and Electricity (MOWE)
- Saudi Energy Efficiency Center (SEEC)

(d) Target of the Scheme

- All sectors
- Private Sectors

(e) Workflow



(f) Required Permanent Human Resources (at the final stage)

SEEC HQ: Dissemination and publication: 1

(g) Required Items

- Cost of national campaign, EC month and exhibition is expected to be covered by sponsors (private sector)

(h) Expected Legislation for Enforcement

None

(i) Expected Schedule

- Phase 1: Final Stage (MOWE): 2008/10-
- Phase 1: Final Stage (MOWE/SEEC): 2010/4-

(7) Check System of Customer Records

(a) Objective

- Raising energy conservation awareness of all customers
- Grasping the past electricity consumption easily
- Grasping customers' behavior and needs through internet survey

(b) Outline of the Scheme

1. Existing System

- SEC has already formulated monthly bill access system (past 18 months) by internet. But it is Islamic calendar.

2. New System

- Making check system of customer records by revising the current system
- Making a list of customers who access to the SEC's Check System site (for internet survey)
- Implementation of internet survey to collect opinions and needs using the customer's list
- Feedback of the internet survey results to the cooperative customers

(c) Executing Agency

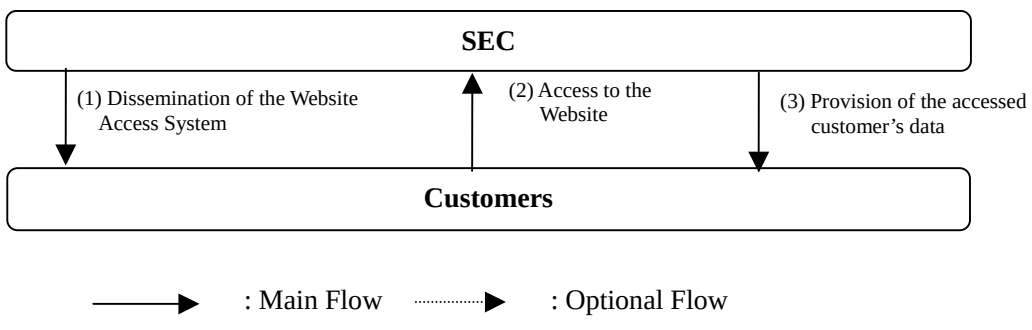
- Saudi Electricity Company (SEC)

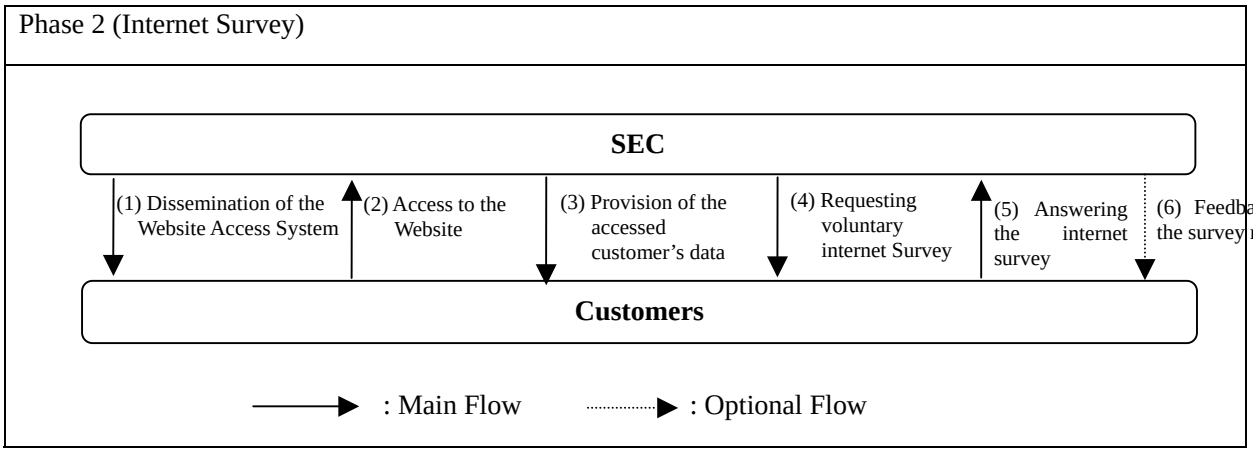
(d) Target of the Scheme

- All sectors (especially residential sector)

(e) Workflow

Phase 1 (Check System)





(f) Required Permanent Human Resources (at the final stage)

- SEC (Check System): No incremental staff
- SEC (Internet Survey): Data collection, making report and publication: 1

(g) Required Items

- Database
- Internet access system

(h) Expected Legislation for Enforcement

None

(i) Expected Schedule

- Phase 1: Check System (SEC): 2008/7-
- Phase 1: Internet Survey (SEC): 2009/7-

(8) EC Education for Schools

(a) Objective

- Raising energy conservation awareness of primary school students

(b) Outline of the Scheme

1. Existing Scheme

- An Education Team (MOWE/SEC/KACST) dispatches lectures and directly makes a seminar for students and teachers at junior high school.

2. Direct Teaching (DT) Scheme

- Making education materials and teaching standard for primary school students by Direct Teaching (DT) scheme by the Education Team
- Implementation of an EC education in classroom(s) in a primary school by the Education Team

- Arrangement of SEC's P/S visitation for students as a part of education

3. Training of Trainer (TOT) Scheme

- Making education materials by revising DT scheme
- Workshop and demonstration to teachers for TOT scheme
- Selection of cooperative teachers and giving a special training seminar
- Implementation of an EC education in teachers' classroom by cooperative teacher, supported by the Education Team (only first time)

(c) Executing Agency

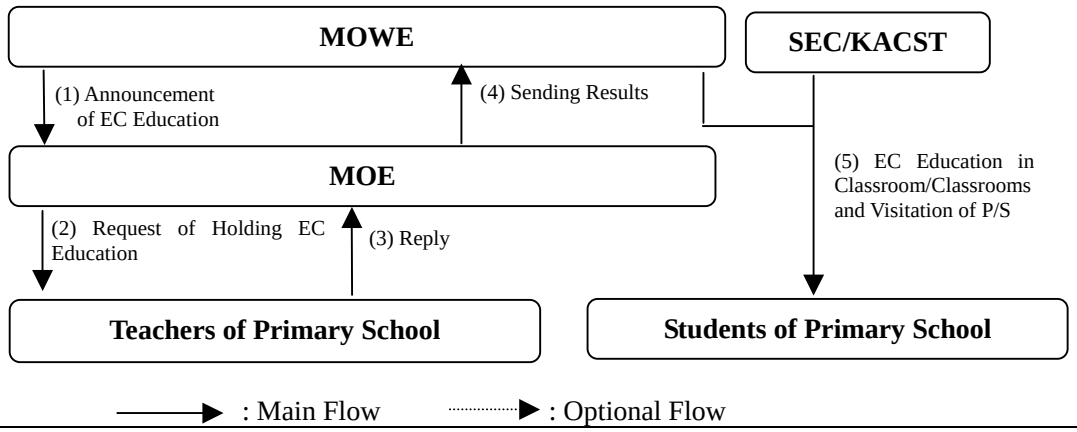
- Ministry of Water and Electricity (MOWE)
- Ministry of Education (MOE)

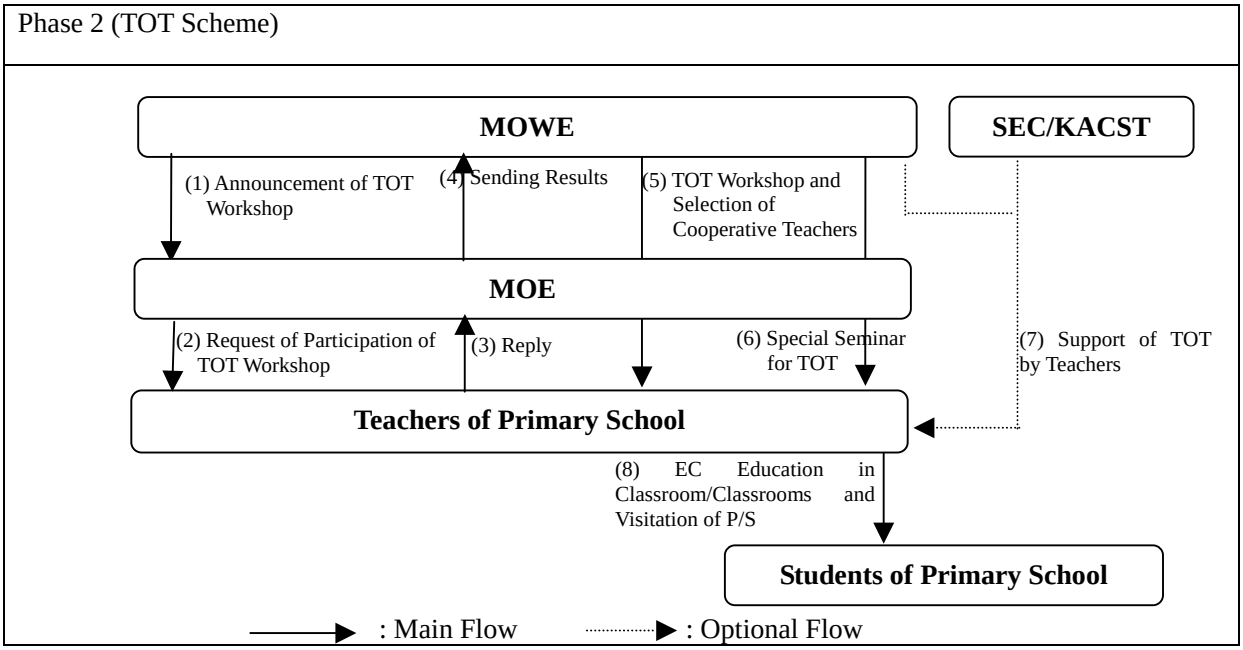
(d) Target of the Scheme

- DT Scheme: Primary school students
- TOT Scheme: Primary school teachers

(e) Workflow

Phase 1 (DT Scheme)





(f) Required Permanent Human Resources (at the final stage)

No incremental staff is necessary

(g) Required Items

- Small gifts for students
- Transportation costs for visitation of P/S
- Workshop and special training seminar

(h) Expected Legislation for Enforcement

None

(i) Expected Schedule

- Phase 1: DT Scheme (MOWE/MOE): 2008/7-2011/9
- Phase 2: TOT Scheme (MOWE/MOE): 2011/1-

(9) EC Museum

(a) Objective

- Education for electricity and energy conservation
- Dissemination of energy conservation appliances (How to select and use)
- Communication to customers

(b) Outline of the Scheme

1. F/S Stage

- Making a concept design including objective, target layer, required area, display plan,

organization, O&M plan, etc.

- Basic design and feasibility study including site selection
- Preparation of a tender document for detailed design

2. D/D and Construction Stage

- Procurement of a consultant for detailed design
- Detailed design and preparation of tender documents for (i) building construction including interior facilities, (ii) display, (iii) consulting service for construction supervision
- Procurement of contractors and a consultant for construction
- Construction

3. Operation Stage

- Securing human resource and operation budget
- Making an operation manual including responsibility, daily operation and staff allocation, display and seminar planning, training program for guidance staff, etc.
- Training guidance staff in social manner, explanation way, technical knowledge (1 month)
- Opening the Museum

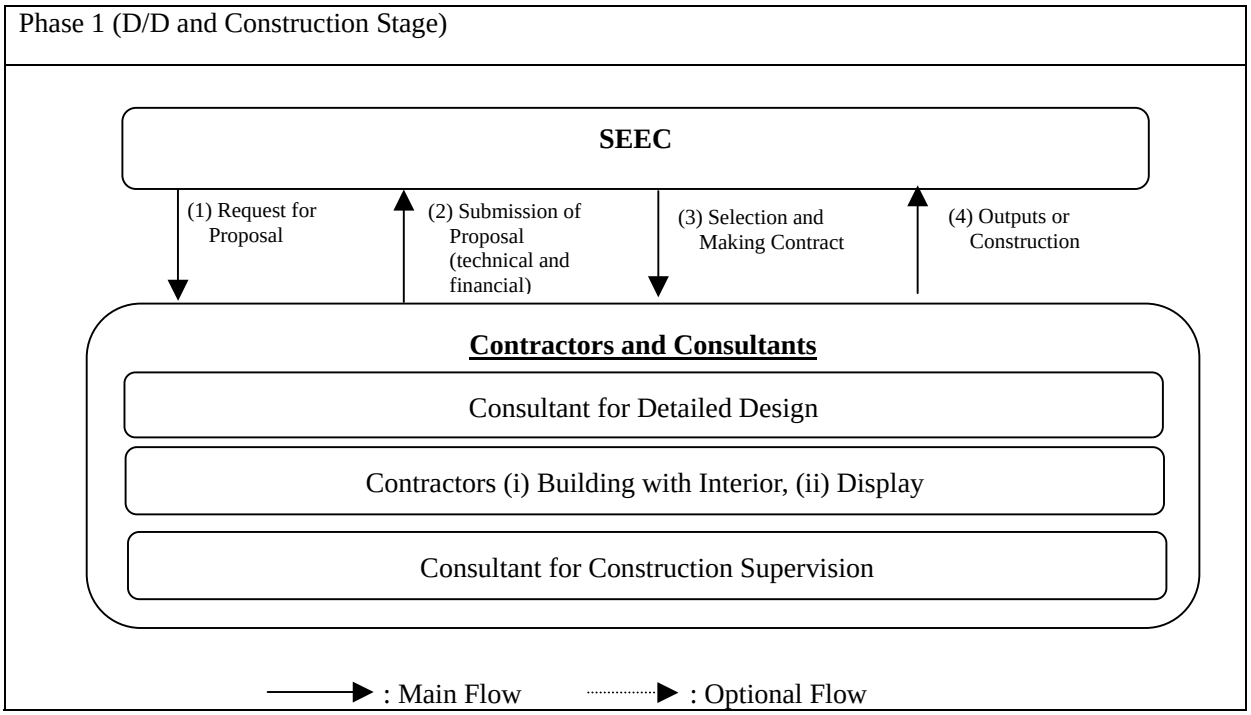
(c) Executing Agency

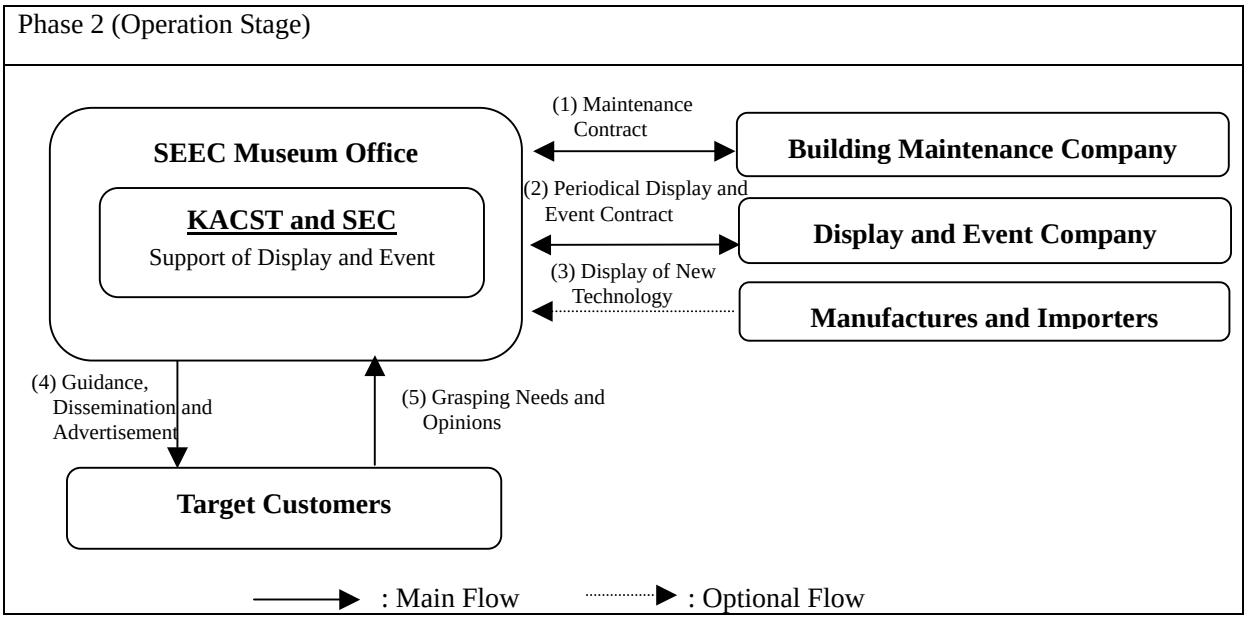
- Saudi Energy Efficiency Center (SEEC), etc.

(d) Target of the Scheme

- Kids and household wives, and adults

(e) Workflow





(f) Required Permanent Human Resources (at the final stage)

- SEEC Museum Office: General manager: 1, General affairs: 3, Planning: 5, Guidance: 16

(g) Required Items

- Feasibility study
- Consulting service for detailed design
- SEEC Building construction (6F+B1, 2 floors for the museum)
- Display construction
- Consulting service for building and display construction
- Building maintenance
- Periodical display (every 3 months)
- Weekly seminar

(h) Expected Legislation for Enforcement

None

(i) Expected Schedule

- Phase 0: F/S Stage (MOWE): 2008/10-2010/3
- Phase 1: D/D and Construction Stage (SEEC): 2010/4-2013/6
- Phase 2: Operation Stage (SEEC Museum Office): 2012/4-

(10) Promotion of Architectural Technology (Building Material Energy Performance Indication System (BEPIS))

(a) Objective

- Promotion of energy efficient houses/buildings construction
- Standardization and rating of building material energy performance
- Enforcement of certified building material use for construction

(b) Outline of the Scheme

1. Existing System

- SASO has already established standards for various products, including building material.
- Saudi Building Code (SBC) is now waiting for its approval. In two years it will be expected to become mandatory.

2. This Scheme

- Setting of target building material in accordance with SBC
- Setting of performance standards in accordance with existing SASO standards and SBC
- Sending material information to SASO
- Registration of performance data
- Printing BEPIS mark on building material products
- Making database
- Random inspection
- Monitoring and awareness survey

(c) Executing Agency

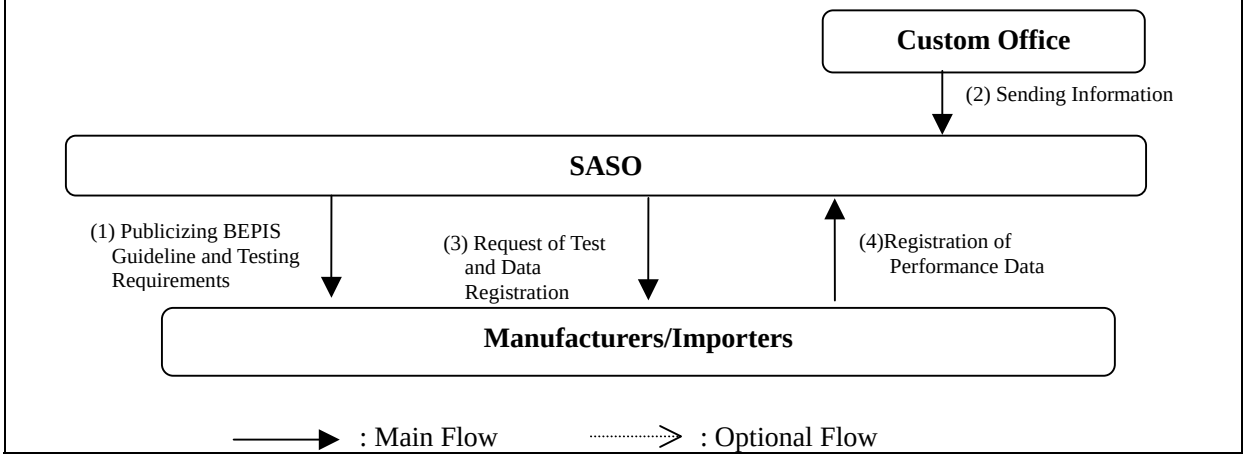
- Saudi Arabian Standards Organization (SASO)
- Saudi Energy Efficiency Center (SEEC)
- Ministry of Commerce and Industry (MOCI)
- Ministry of Municipality and Rural Affairs (MOMRA)

(d) Target of the Scheme

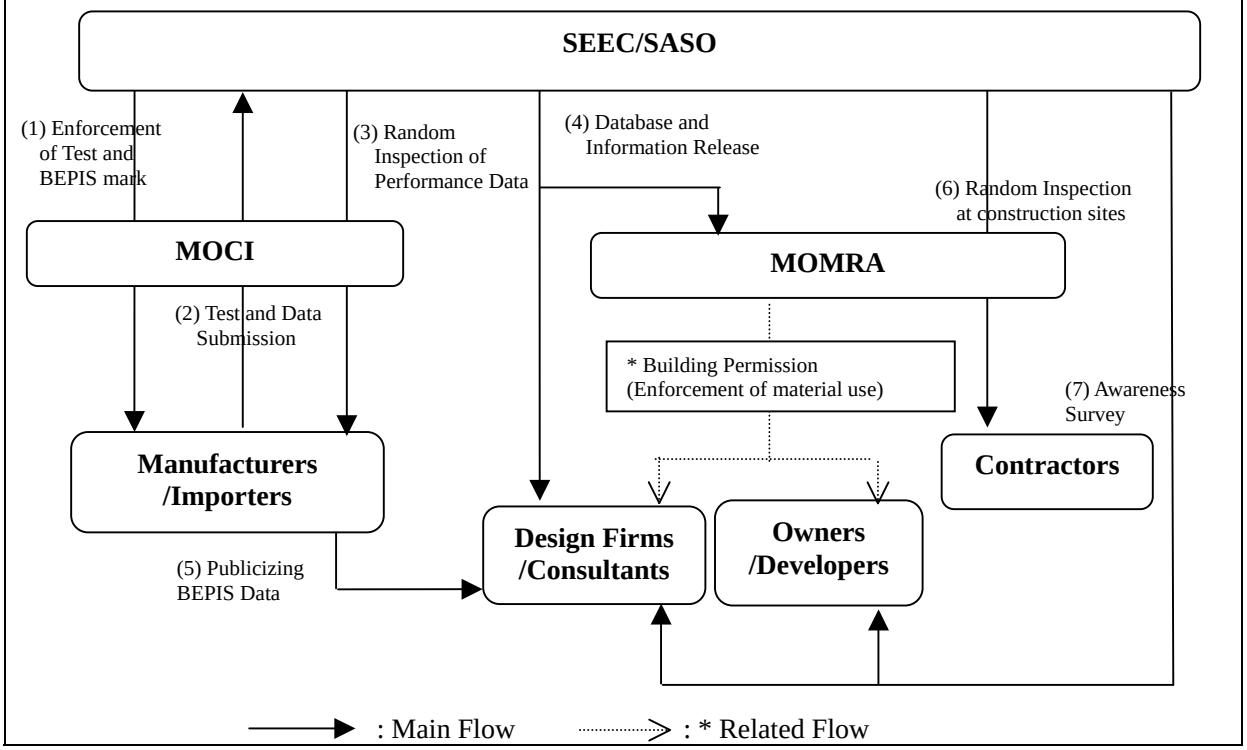
- Manufacturers and Importers (M&Is)
- Housing/Building design firms and consultants
- Housing/Building constructors
- Housing/Building owners/developers

(e) Workflow

Phase 1 (Pilot Stage)



Phase 2 (Final Stage)



(f) Required Permanent Human Resources (at the final stage)

- SEEC HQ: Inspection: 1, Dissemination and publication: 1
- SASO New Department: Registration: 1, Database engineer: 1

(g) Required Items

- Database software
- Internet access system to the database
- Format of BEPIS mark
- Testing cost for random inspection of performance data
- Inspection cost at construction site

(h) Expected Legislation for Enforcement

- Role of Manufacturers and Importers
- Standards of Judgment for Manufacturers /Importers and Registration of the Performance
- Recommendation and Orders concerning Improvement of Performance
- Indication marking and obligation to Manufacturers /Importers
- Recommendation and Orders concerning Printing BEPIS Marking
- Provision of Information
- Penalty

(i) Expected Schedule

- Phase 1: Pilot Stage (SASO): 2008/7-2011/6
- Phase 2: Final Stage (SASO/SEEC): 2011/7-

(11) Monitoring and Awareness Survey

(a) Objective

- Monitoring and evaluation of energy conservation progress in nation wide
- Grasping energy conservation consciousness of KSA people

(b) Outline of the Scheme

- Identification of necessary survey
- Development of questionnaire sheet for each survey
- Implementation of questionnaire survey by interview and/or internet
- Presentation of the surveyed result at a workshop in EC month and via internet
- Making database for the surveyed results
- Analyzing the surveyed results and making recommendation for the future steps
- Continuously implementation of the surveys annually

(c) Executing Agency

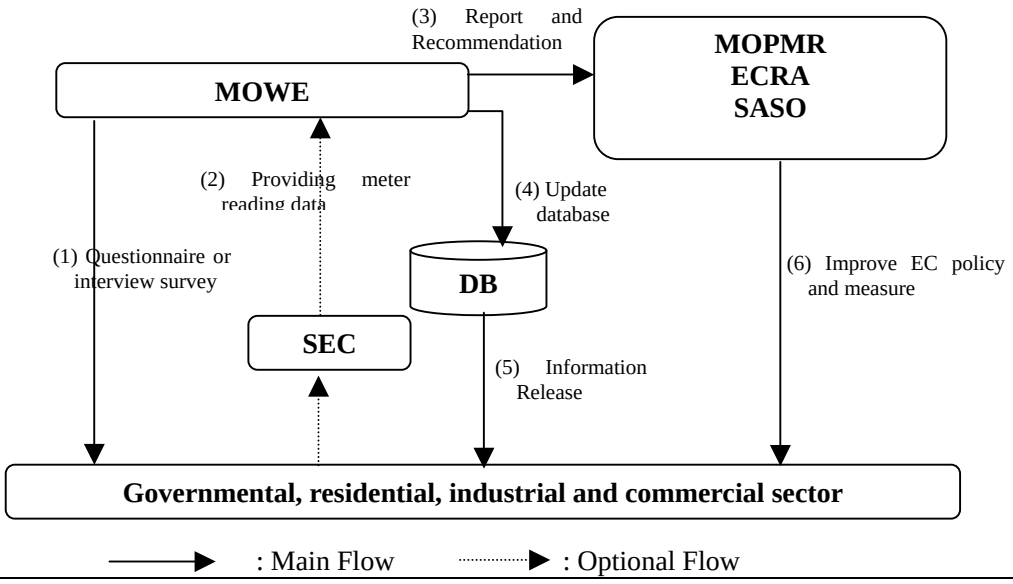
- Ministry of Water and Electricity (MOWE)
- Saudi Energy Efficiency Center (SEEC)

(d) Target of the Scheme

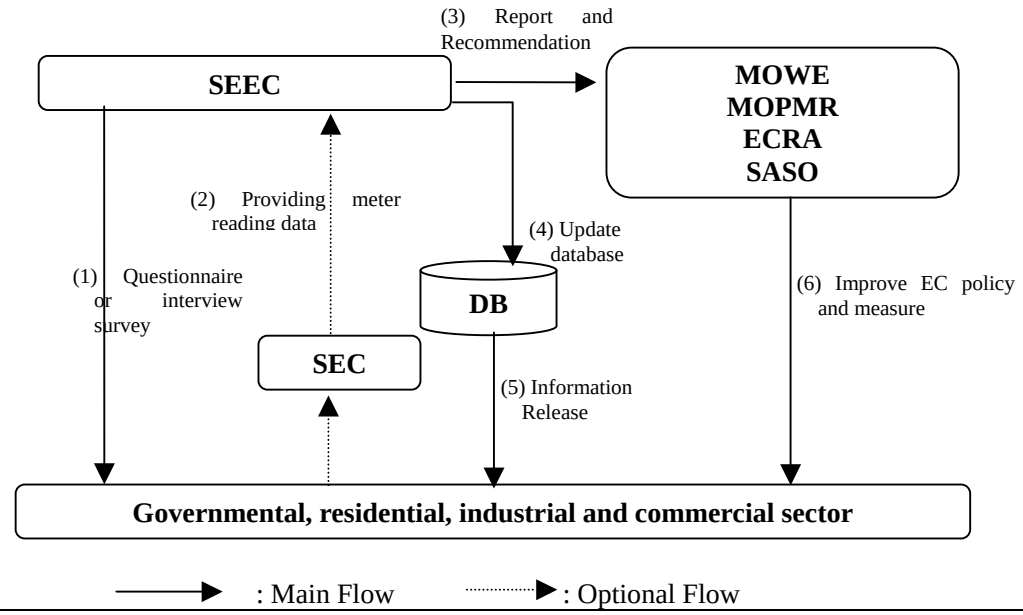
- Industrial sector
- Government and Commercial sector
- Residential sector
- Customers for home appliances

(e) Workflow

Phase 1 (Pilot Stage)



Phase 2 (Final Stage)



(f) Required Permanent Human Resources (at the final stage)

- SEEC: Questionnaire designer and analyst: 2, Database engineer: 1

(g) Required Items

- Database software
- Internet access system to the database
- Cost of each survey

(h) Expected Legislation for Enforcement

None

(i) Expected Schedule

- Phase 1: Pilot Stage (MOWE): 2008/10-2010/12
- Phase 2: Final Stage (SEEC): 2010/4-

(12) Load Management

(a) Objective

- Load adjustment in case supply shortage is expected in peak hours
- Avoiding supply shortage and maintaining supply reliability

(b) Outline of the Scheme

- In order to mitigate the current situation of supply shortage in peak hours, a new optional contract called “Emergency Load Adjustment Contract”, in which SEC offers tariff discount for customers who are ready to reduce peak demand upon SEC’s request, is expected.
- Full-scaled implementation of this scheme starts following the approval by ECRA, which is also responsible for monitoring the scheme’s performance after implementation and for arbitration when a dispute between SEC and customers takes place.

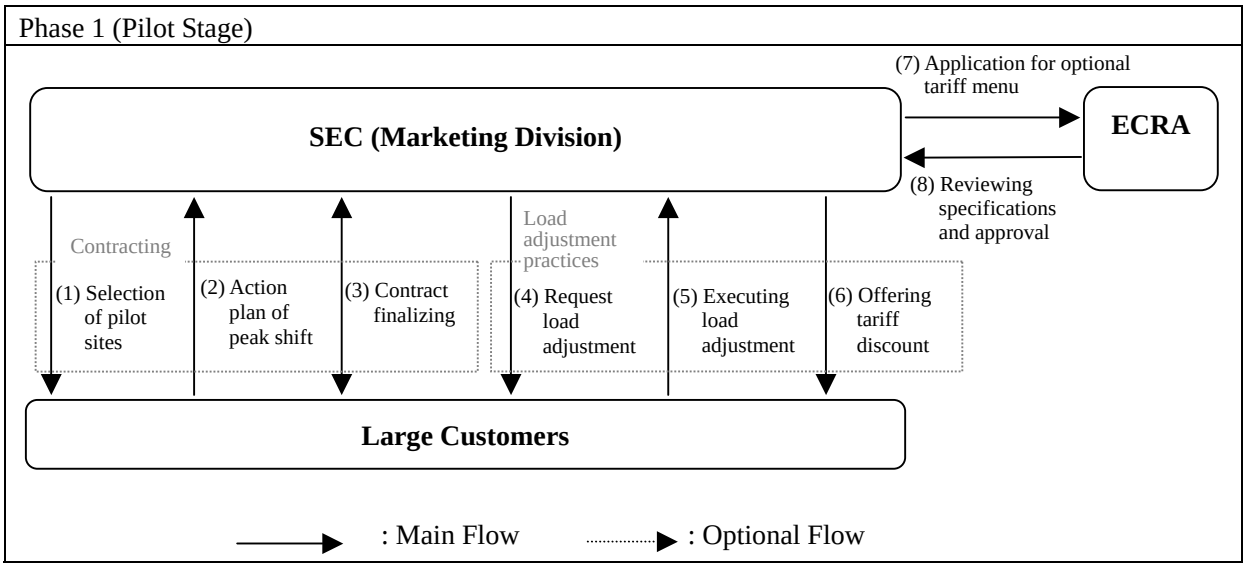
(c) Executing Agency

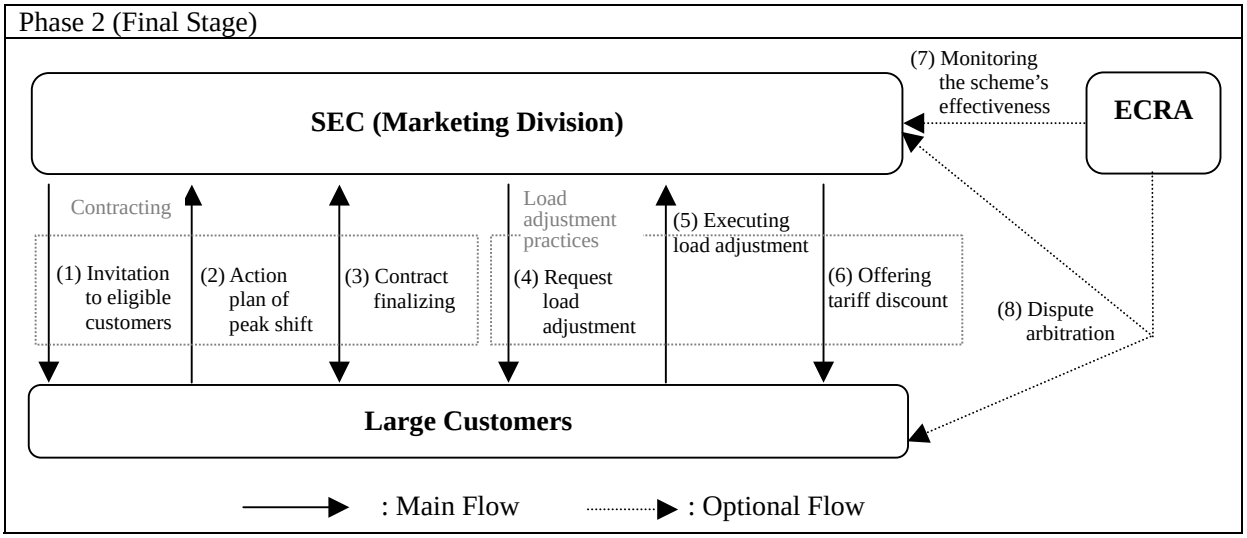
- Saudi Electricity Company (SEC)

(d) Target of the Scheme

- Large Consumers

(e) Workflow





(f) Required Permanent Human Resources (at the final stage)

No incremental staff

(g) Required Items

- Tariff discount

(h) Expected Legislation for Enforcement

None

(i) Expected Schedule

- Phase 1: Pilot Stage (SEC): 2008/7-2010/9
- Phase 2: Final Stage (SEC): 2009/4-

(13) Promotion of R&D Scheme

(a) Objective

- Building energy efficient house/building
- Development of high efficiency equipment in industrial and commercial sector

(b) Outline of the Scheme

- Request for proposal to academy and industry, etc.
- Submission of proposal (application)
- Selection of applicants by R&D Committee to be established
- Making contract
- Implementation and submission of completion report
- Evaluation and review
- Follow-up survey (2 years after completion)

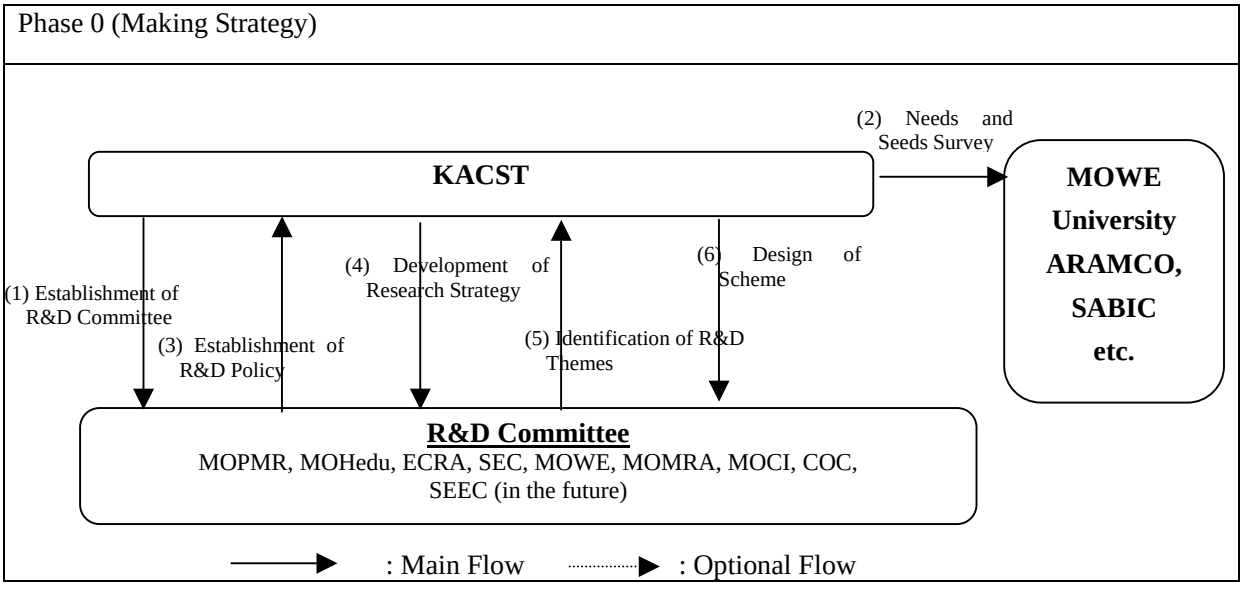
(c) Executing Agency

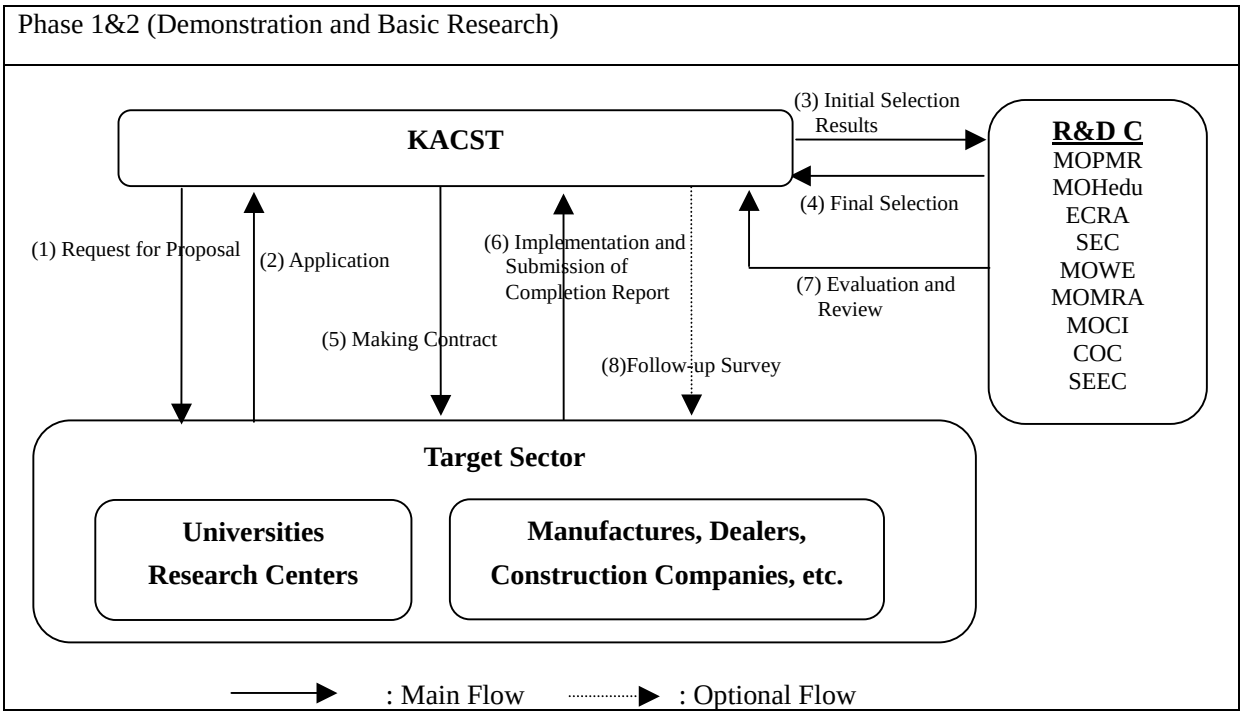
- King Abdulaziz City for Science and Technology (KACST), etc.

(d) Target of the Scheme

- Universities, Research Centers, Manufacturers, Dealers, Construction Companies, etc.

(e) Workflow





(f) Required Permanent Human Resources (at the final stage)

No incremental staff

(g) Required Items

- Needs and seeds survey
- Budget for R&D projects

(h) Expected Legislation for Enforcement

None

(i) Expected Schedule

- Phase 0: Making Strategy (KACST): 2008/10-2010/12
- Phase 1: Demonstration Project (KACST): 2011-
- Phase 2: Basic Research (KACST): 2013-

10.2 Summary

This section summarizes implementation plan papers of the 13 high priority measures by various aspects such as executing agency, human resources schedule, budget estimation and required legislation.

10.2.1 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 10-1 List of Executing Agency

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

10.2.2 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 10-2 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 3 3	3 3 3 3	3 3 3 3	3 3	3 3	3 3	3 3
	SEEC Local Offices								4 4	4 4	4 4	4 4
2 Energy Efficiency Labels and Standards	SASO	5 5	5 5 5 5	5 5 5 5	2 2 2 2	2 2 2 2	2 2 2 2	2 2 2 2	2 2	2 2	2 2	2 2
	SEEC HQ				2 2 2 2	2 2 2 2	2 2 2 2	2 2 2 2	2 2	2 2	2 2	2 2
3 Training Program for Energy Manager	SEEC HQ			3 3 3	3 3 3 3	3 3 3 3	3 3 3 3	3 3 3 3	3 3	3 3	3 3	3 3
	SEEC Local Offices						2 2	2 2 2 2	2 2	2 2	2 2	2 2
4 Energy Assessment Service	SEEC HQ			4 4 4	4 4 4 4	4 4 4 4	4 4 4 4	4 4 4 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 3 3	3 3 3 3	3 3 3 3	3 3	3 3	3 3	3 3
	SEEC Local Offices						2 2	2 2 2 2	2 2	2 2	2 2	2 2
6 EC Campaign	SEEC HQ				1 1 1 1	1 1 1 1	1 1 1 1	1 1 1 1	1 1	1 1	1 1	1 1
7 Check System of Customer Records	SEC		1 1	1 1 1 1	1 1 1 1	1 1 1 1	1 1 1 1	1 1 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 2 2	2 2					
	SEEC Museum Office					9 9 9	9 25 25 25	25 25 25 25	25 25	25 25	25 25	25 25
10 Promotion of Architectural Technology	SASO	2 2	2 2 2 2	4 4 4 4	4 4 2 2	2 2 2 2	2 2 2 2	2 2 2 2	2 2	2 2	2 2	2 2
	SEEC HQ				2 2	2 2 2 2	2 2 2 2	2 2 2 2	2 2	2 2	2 2	2 2
11 Monitoring and Awareness Survey	SEEC HQ			1 1 1	3 3 3 3	3 3 3 3	3 3 3 3	3 3 3 3	3 3	3 3	3 3	3 3
12 Load Management	SEC	(No incremental staff)										
13 Promotion of R&D Scheme	KACST	(No incremental staff)										

10.2.3 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 10-3 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)	SASO		0.4									
	(Test cost for random inspection)	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)	MOWE		1.26									
	(Training equipment and facilites)	SEEC			5.35								
	(Operation of training program in the pilot stage)	SEEC				0.344	0.344						
	(Operation of training program in the final stage)	SEEC							0.68	0.68	0.68	0.68	0.68
4	Energy Assessment Service												
	(Training for consultants)	MOWE		0.04									
	(Assessment service operation)	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)	MOWE	0.1										
	(DT scheme)	MOWE			0.06	0.06							
	(TOT scheme)	MOWE					0.126	0.126	0.126	0.126	0.126	0.126	0.126
9	EC Museum												
	(Feasibility Study)	MOWE		3									
	(Detailed Design and Construction)	SEEC			177								
	(Museum and building operation)	SEEC						3.86	7.72	7.72	7.72	7.72	7.72
10	Promotion of Architectural Technology												
	(Database, internet access system)	SASO			1.5								
	(Inspection cost)	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)	MOWE			1.5								
	(Survey cost in the pilot stage)	MOWE		1.1	1.1								
	(Survey cost in the final stage)	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)	SEC		0.06									
	(Tariff discount in the final stage)	SEC			20	20	20	20	20	20	20	20	20
13	Promotion of R&D Scheme												
	(Needs and seeds survey)	KACST		1									
	(Demonstration project)	KACST					9		9		9		9
	(Basic Research)	KACST							24		24		24

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

Table 10-4 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

10.2.4 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 10-5 Measures which Need Legal Basis

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

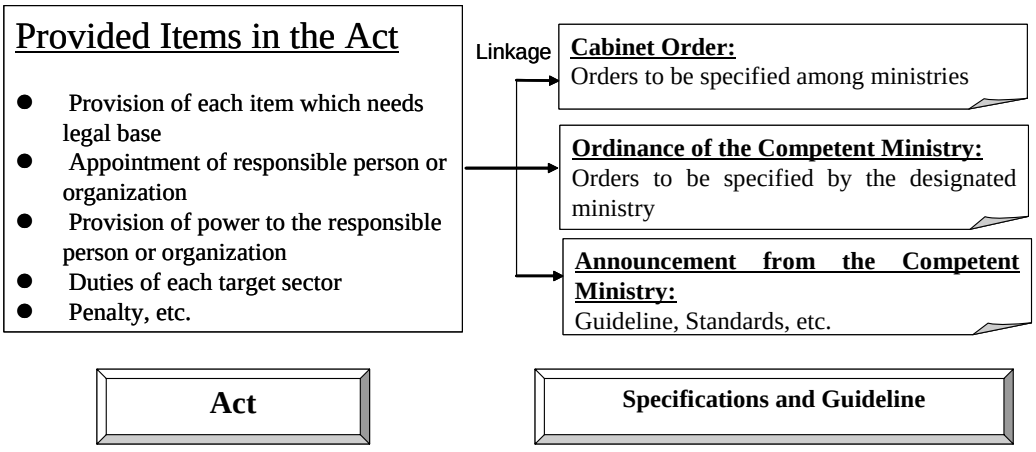


Figure 10-3 Structure of Legal Basis

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 10-6 Provision of the Act for Energy Management System

Item to be Stipulated in Act	Expected Contents
Evaluation of Criteria for Business Operators	● 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	● Provision of power to correct improper implementation (to the Minister)
Designation of Designated Energy Management Factories and Buildings	● Definition of the designated Factories and Buildings ● Provision of obligation of reporting
Energy Managers	● 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	● How to manage energy-consuming facilities, improve and supervise methods by the Energy Manager
Preparation of Medium Term Plan	● Obligation of preparation of Middle Term Plan ● How to prepare Middle Term Plan (Guideline)
Periodical Reports	● Obligation of preparation of Periodical Report ● How to prepare Periodical Report (Guideline)
Instructions and Orders on Rationalization Plans	● Instruction and Order to improper Factory and Building
Penalty	● 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 10-7 Provision of the Act for Energy Efficiency Labels and Standards

Item to be Stipulated in Act	Expected Contents
Role of Manufacturers and Importers	● 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	● 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	● 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	● Labeling method and its obligation
Recommendation and Orders concerning Labeling	● 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	● Provision of retail shops' endeavor to provide information with regard to designated machinery and equipment (label display)
Penalty	● 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 10-8 Provision of the Act for Training Program for Energy Manager

Item to be Stipulated in Act	Expected Contents
Qualified Energy Manager's License	● 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 10-9 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)	● Incorporation, status, and office location ● Vision and mission
Governance	● 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	● Department and its role ● Maximum number of each department ● Status of staff
SEEC's Activities and SEEC's Role in Each Activity*1	● Energy Assessment Service ● Publication and Award System ● EC Campaign ● EC Museum ● Monitoring and Awareness Survey
Finance	● 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.

10.3 Recommendation for Formulation of Each High Priority Measure

10.3.1 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.

10.3.2 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 10-10 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.

10.3.3 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 11 Proposal of Saudi Energy Efficiency Center (SEEC)

11.1 SEEC Overview

11.1.1 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 Chapter 10, 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.

11.1.2 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.

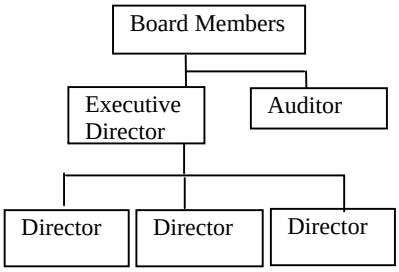
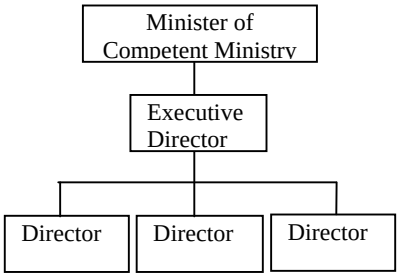
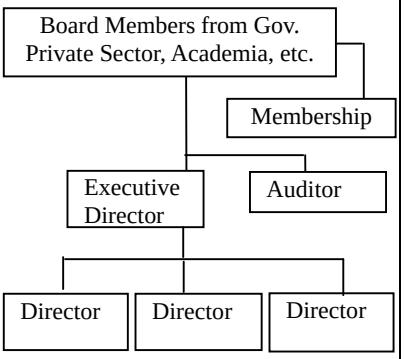
(Mission)
SEEC will be an independent national agency to provide integrated services in making policy, planning, managing, implementing, promoting, supporting, and coordinating energy conservation measures in electricity and heat for all public and private sectors.

11.1.3 Governance

(1) Options

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

Table 11-1 Options of SEEC's Governance

Option A (New Government Authority)	**Option B** (A Part of an Existing Ministry)	**Option C** (New Autonomous Authority)
		
(Advantage) It is a conventional style in KSA. Board members can consist of Government sector, as well as private sector.	**(Advantage)** It seems to be easier to formulate a new organization because this option is an expansion of an existing ministry.	**(Advantage)** Involvement of private sector is stronger than Option A. Strong cooperation of private sector is expected.
(Disadvantage) It is an issue to get strong cooperation from private sector.	**(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.	**(Disadvantage)** Security of enforcement power is an issue if it is a Non -governmental organization.

(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.

(New Government Authority)

- Board Members are selected from each sector (government, private sector, academia, consumer representative, etc.)
- Representative of private sector is selected from membership companies

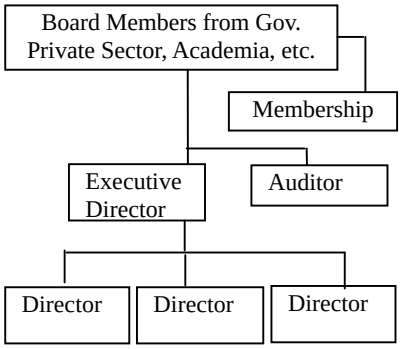


Figure 11-1 Proposed Governance

11.1.4 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 11-2 Expected SEEC's Measures

High Priority Measures	Main Agency	Supporting Agency
Energy Management System	SEEC	SEC, etc.
Energy Efficiency Labels and Standards	SASO/SEEC	MOWE, SEC
Training Program for Energy Manager	SEEC	ARAMCO, SABIC, etc.
Energy Assessment Service	SEEC	COC
Publication and Award System	SEEC	COC, etc.
EC Campaign	MOWE	SEEC, SEC, etc.
EC Museum	SEEC	MOWE, SEC, etc.
Promotion of Architectural Technology	SASO/SEEC	MOCI, SBCC, MOMRA, KACST
Monitoring and Awareness Survey	SEEC	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 11-3 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).

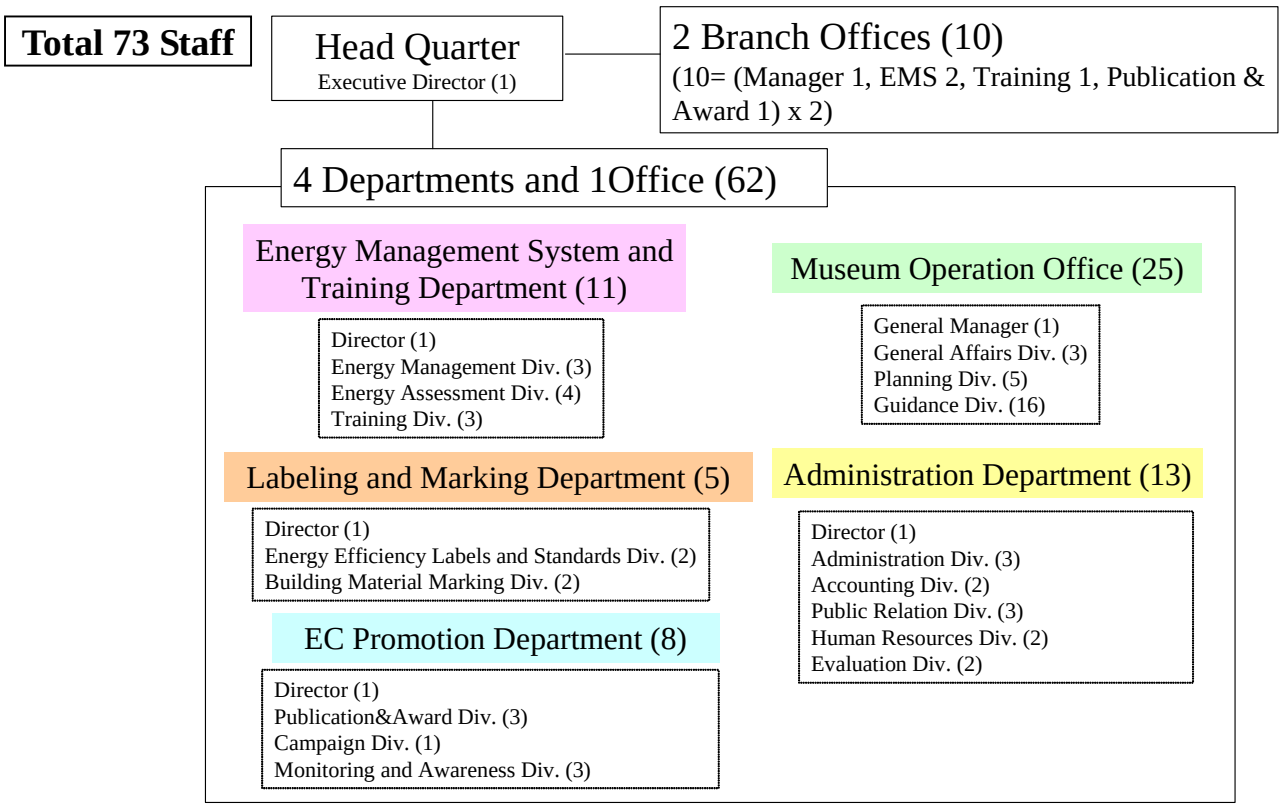


Figure 11-2 Proposed Organization Chart (at the Final Stage 2015)

11.2 Implementation Plan of SEEC

11.2.1 Overall Implementation Plan

According to implementation plan papers of the 13 high priority measures (as described in 10.1.2), 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.

As described in 10.3, 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	Finalizationof Legislation					
Energy Management System		Drafting Act and Relating Documents	Finalizationof Legislation					
Energy Efficiency Labels and Standards		Drafting Act and Relating Documents	Finalizationof Legislation					
Training Program for Energy Manager		Drafting Act and Relating Documents	Finalizationof Legislation					
Promotion of Architectural Technology		Drafting Act and Relating Documents	Finalizationof Legislation					
Preparation and Implementation of Each EC Measure		Preparation Team	SEEC					
SEEC Activity as an Executing Agency								
S1 Energy Management System		Preparation of Regulation	Finalization of Regulation	Pilot Stage				Final Stage 1&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	

	2008	2009	2010			2011				2012				2013				2014	2015
Human Resource Arrangement (Persons)																			
HQ																			
Executive Director			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Department Directors			3	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Department Staff			21	21	21	31	31	33	33	33	33	33	33	35	35	33	33	33	33
EC Museum Staff (incl. General Manager)											9	9	9	9	25	25	25	25	25
Local Offices																2	2	2	2
Office Manager																4	4	4	8
Office Staff																			
Total			25	25	25	36	36	38	38	38	47	47	47	49	65	69	69	69	73
Budget Arrangement (million SR)																			
Direct Costs for Measures																			
Measures Implementation Costs (1)			42.1			59.7				58.6				34.2				10.6	10.6
(out of which, HQ Building and EC Museum Costs)			(177)													(3.9)		(7.7)	(7.7)
Human Resource Costs																			
Personnel Expense (25,000SR/month/person) (2)			5.6			11.1				13.4				18.9				20.7	21.9
General Administration Costs																			
General Adm. Cost (= ((1)+(2)) x 15%)			7.2			10.6				10.8				8.0				4.7	4.9
Total			54.9			81.4				82.8				61.1				35.9	37.3

Figure 11-3 Overall Implementation Plan of SEEC

11.2.2 Human Resources and Organization Plan

(1) Summary of Human Resources and Organization Plan

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

Table 11-4 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 11-2).

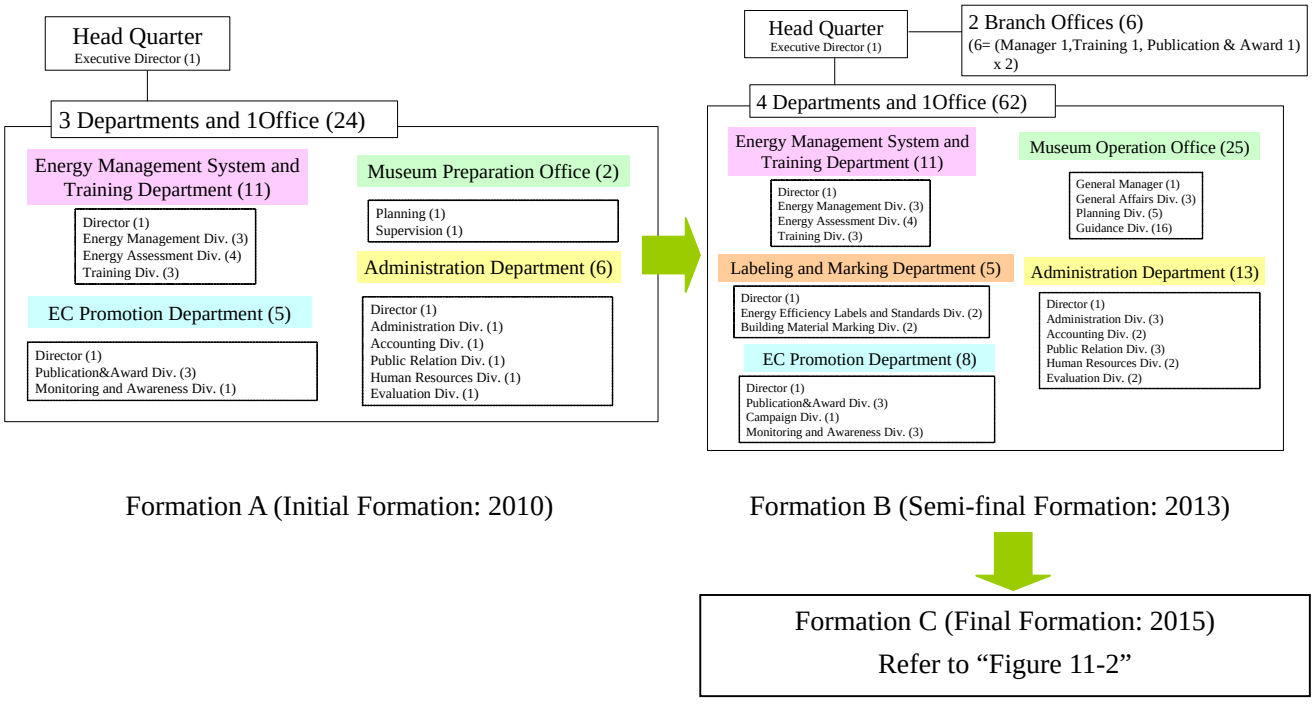


Figure 11-4 Transition of SEEC Organization

(2) Departments and Offices

Each department in headquarters and offices will be expanded based on the progress of each measure. Required staff in each department and office is proposed below.

(Unit: Persons)

Energy Management System and Training Department and Local Offices

Handling Measure	Site	Required Staff	2010	2011	2012	2013	2014	2015	2016	2017	2018
Energy Management System	HQ	Energy management staff 3	3 3 3	3 3 3 3	3 3 3 3	3 3 3 3	3 3 3 3	3 3	3 3	3 3	3 3
Energy Management System	LO	Energy management staff 2x2						4 4	4 4	4 4	4 4
Training Program for Energy Manager	HQ	Planning and administration 1 Arrangement staff 1 EC technology information staff 1	3 3 3	3 3 3 3	3 3 3 3	3 3 3 3	3 3 3 3	3 3	3 3	3 3	3 3
Training Program for Energy Manager	LO	Arrangement staff 1x2				2 2	2 2 2 2	2 2	2 2	2 2	2 2
Energy Assessment Service	HQ	Assessment management 2 Consultant management 1 Database engineer 1	4 4 4	4 4 4 4	4 4 4 4	4 4 4 4	4 4 4 4	4 4	4 4	4 4	4 4
		Sub-total	**10 10 10**	**10 10 10 10**	**10 10 10 10**	**10 10 12 12**	**12 12 12 12**	**16 16**	**16 16**	**16 16**	**16 16**

Labeling and Marking Department and Local Offices

Handling Measure	Site	Required Staff	2010	2011	2012	2013	2014	2015	2016	2017	2018
Energy Efficiency Labels and Standards	HQ	Inspection 1 Dissemination and publication 1		2 2 2 2	2 2 2 2	2 2 2 2	2 2 2 2	2 2	2 2	2 2	2 2
Promotion of Architectural Technology	HQ	Inspection 1 Dissemination and publication 1		2 2	2 2 2 2	2 2 2 2	2 2 2 2	2 2	2 2	2 2	2 2
		Sub-total		**2 2 4 4**	**4 4 4 4**	**4 4 4 4**	**4 4 4 4**	**4 4**	**4 4**	**4 4**	**4 4**

EC Promotion Department

	Site	Required Staff	2010	2011	2012	2013	2014	2015	2016	2017	2018
Publication and Award System	HQ	Dissemination and publication 1 Database engineer 1 EC activity monitor 1	3 3 3	3 3 3 3	3 3 3 3	3 3 3 3	3 3 3 3	3 3	3 3	3 3	3 3
Publication and Award System	LO	EC activity monitor 1x2				2 2	2 2 2 2	2 2	2 2	2 2	2 2
EC Campaign	HQ	Dissemination and publication 1		1 1 1 1	1 1 1 1	1 1 1 1	1 1 1 1	1 1	1 1	1 1	1 1
Monitoring and Awareness Survey	HQ	Questionnaire designer and analyst 2 Database engineer 1	1 1 1	3 3 3 3	3 3 3 3	3 3 3 3	3 3 3 3	3 3	3 3	3 3	3 3
		Sub-total	**4 4 4**	**7 7 7 7**	**7 7 7 7**	**7 7 9 9**	**9 9 9 9**	**9 9**	**9 9**	**9 9**	**9 9**

Museum Operation Office

Handling Measure	Site	Required Staff	2010	2011	2012	2013	2014	2015	2016	2017	2018
EC Museum (D/D and Construction)	HQ	Planning and supervision 2	2 2 2	2 2 2 2	2 2 2 2	2 2					
EC Museum (Operation)	HQ (M)	General manager 1 General affairs 3 Planning 5 Guidance 16			9 9 9	9 25 25 25	25 25 25 25	25 25	25 25	25 25	25 25
		Sub-total	**2 2 2**	**2 2 2 2**	**2 11 11 11**	**11 27 25 25**	**25 25 25 25**	**25 25**	**25 25**	**25 25**	**25 25**

Management and Administration (HQ and Local Offices)

Handling Measure	Site	Required Staff	2010	2011	2012	2013	2014	2015	2016	2017	2018
Executive Director	HQ	Executive Director 1	1 1 1	1 1 1 1	1 1 1 1	1 1 1 1	1 1 1 1	1 1	1 1	1 1	1 1
Director of Administration Department	HQ	Director 1	1 1 1	1 1 1 1	1 1 1 1	1 1 1 1	1 1 1 1	1 1	1 1	1 1	1 1
Administration Division	HQ	Division staff 1->2->3	1 1 1	2 2 2 2	2 2 2 2	3 3 3 3	3 3 3 3	3 3	3 3	3 3	3 3
Accounting Division	HQ	Division staff 1->2	1 1 1	2 2 2 2	2 2 2 2	2 2 2 2	2 2 2 2	2 2	2 2	2 2	2 2
Public Relation Division	HQ	Division staff 1->2->3	1 1 1	2 2 2 2	2 2 2 2	3 3 3 3	3 3 3 3	3 3	3 3	3 3	3 3
Human Resources Division	HQ	Division staff 1->2	1 1 1	2 2 2 2	2 2 2 2	2 2 2 2	2 2 2 2	2 2	2 2	2 2	2 2
Evaluation Division	HQ	Division staff 1->2	1 1 1	2 2 2 2	2 2 2 2	2 2 2 2	2 2 2 2	2 2	2 2	2 2	2 2
Director of EMS and Training Department	HQ	Director 1	1 1 1	1 1 1 1	1 1 1 1	1 1 1 1	1 1 1 1	1 1	1 1	1 1	1 1
Director of L&M Department	HQ	Director 1		1 1 1 1	1 1 1 1	1 1 1 1	1 1 1 1	1 1	1 1	1 1	1 1
Director of EC Promotion Department	HQ	Director 1	1 1 1	1 1 1 1	1 1 1 1	1 1 1 1	1 1 1 1	1 1	1 1	1 1	1 1
Local Office Managers	LO	Office manager 1x2				2 2	2 2 2 2	2 2	2 2	2 2	2 2
	Sub-total		**9 9 9**	**15 15 15 15**	**15 15 15 15**	**17 17 19 19**	**19 19 19 19**	**19 19**	**19 19**	**19 19**	**19 19**

Figure 11-5 Human Resources Plan in Headquarters and Offices

HQ: Headquarters
HQ (M): EC Museum Office
LO: Local Offices

11.2.3 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 facilites)		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	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 11-6 Budget Plan Breakdown

Chapter 12 Middle and Low Priority Measures

12.1 General

12.1.1 Selected Measures

The following middle and low priority measures were selected by the Steering Committee (as described in 8.5.2). Middle priority measures were selected as existing measured that have already been introduced in the KSA or the next measure after high priority measures. Low priority measures were selected as a far future program. Concept papers of all middle and low priority measures are attached in Annex 3.

Middle Priority Measure (Underlined are "Existing Measures" in the KSA)

- Subsidy for Energy Conservation Project and Demonstration Project and Subsidy for Installation of High Efficiency System (Large scale subsidy)
- Subsidy for Specific Equipment (Small scale subsidy)
- Instruction Booklet (by Government or Association)
- Announcement of Daily Demand and Supply
- Instruction Booklet and Lifestyle Laboratory Report (by Utility)
- Consulting Service for Energy Conservation and ESCO Business
- Energy Conservation Consulting Service for Residential Sector
- Joint Development of Energy Conservation Equipment and Household Appliances
- Laboratory Testing for Performance Check

Low Priority Measure

- Preferable Interest Rate Loan for Energy Conservation Project
- Tax Incentive to Install Energy Conservation Equipment
- Information Release of Energy Conservation Equipment

12.1.2 Study of Middle Priority Measures

In this Study, as for existing measures which have already been developed by the KSA, introduction of KSA and Japan's methods, and recommendations from the comparison between the two are made. On the other hand, as for the next measures after high priority measures, Japan's methods and recommendations are introduced.

12.1.3 Study of Low Priority Measures

A concept paper for each measure will be prepared in the future.

12.2 Middle Priority Measures

12.2.1 Existing Measures

(1) Instruction Booklet (by MOWE and SEC)

(a) Overview of KSA's Method

The most popular booklet is "User's Guide for Rationalization of Electricity and Load Displacement" that has been issued by MOWE together with SEC. This booklet has been distributed in MOWE and SEC offices or some event sites.

Figure 12-1 Instruction Booklet by MOWE

The contents of the booklet is shown below. According to the contents, the target of the booklet seems to be the commercial (building) sector.

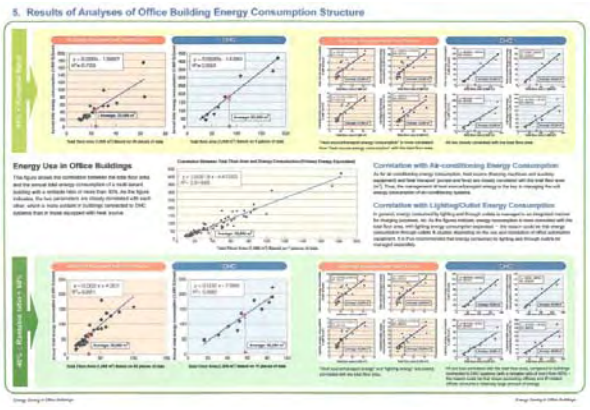
Figure 12-2 Contents of the Instruction Booklet

(b) Overview of Japan's Method

(i) Government Publication

In Japan, there are various instruction booklets which target each sector or specific customers. The most popular booklets have been issued by Energy Conservation Center, Japan (ECCJ), supported by the Ministry of Trade, Economy and Industry (METI). ECCJ's booklets contain data and information collected by measurement survey, energy conservation good practices, instruction of energy conservation method, and the explanation of main measures such as Energy Management System and Labels and Standards System of Japan.

Sample 1: Energy Saving in Office Building

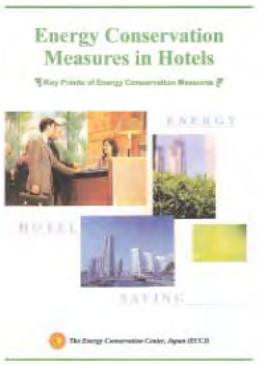


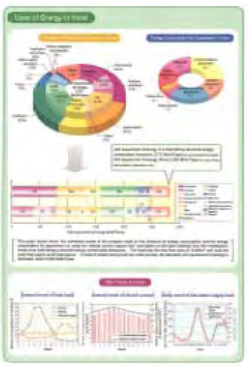
(Source: ECCJ Booklet)

Contents:

1. The Number of Commercial Buildings and Survey Data
2. Types of Office Buildings and Their Energy Consumption
3. Analysis of Office Building Energy Consumption Structure
4. Results of Surveys of Office Building Energy Consumption Structure
5. Results of Analyses of Office Building Energy Consumption Structure
6. Key Energy-saving Measures Based on Time-series Data
7. Energy-saving Check List

Sample 2: Energy Conservation Measures in Hotels





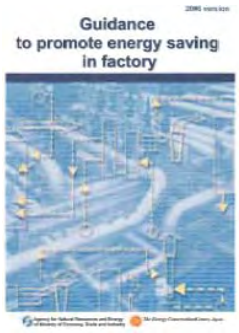
(Source: ECCJ Booklet)

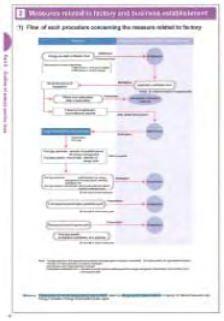
Contents:

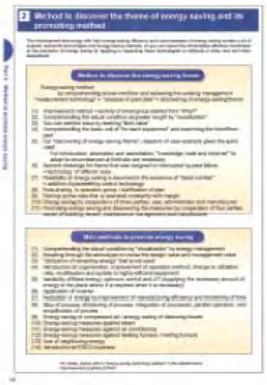
1. Energy Conservation by Control Center
2. Energy Conservation by Energy Manager
3. Hotel Energy Consumption Structure
4. Energy Consumption Trend by Purpose

Figure 12-3 Sample of Instruction Booklet (ECCJ) (1/3)

Sample 3: Guidance to Promote Energy Saving in Factory







Contents: (Source: ECCJ Booklet)

Part 1. Significance of energy saving
1. Significance of energy saving
2. Method to promote the energy saving management
3. Energy cost rate for each industry sector
4. Average energy-saving rate and energy-saving volume for each industry sector of diagnosed factory

Part 2. Outline of energy-saving laws
1. System of energy-saving laws
2. Measures related to factory and business establishment
(1) Flow of each procedure concerning the measure related to factory
(2) Employers who have to present various documents and return day
(3) Judgment standard of factory and business establishment
(4) Simple calculating table for amount of used energy
(5) Qualified person for energy management / clerk institution
(6) Interim measure to select qualified person for energy management (clerk)
(7) Interim measure of participation of people who has license of qualified person for energy management when a mid and long term plan is created

Part 3. Method to promote energy saving
1. Factory's energy-saving measure check item
2. Method to discover the theme of energy saving and its promoting method
3. Presented case examples of improvement of energy saving
(1) Food manufacturing industry / adjustment of combustion air rate of boiler
(2) Waterworks industry / change of ventilation strategy of power receiving and transforming room
(3) Chemical industry / creation of cooling water in winter by free cooling
(4) Metallic product manufacturing industry / humidity retention for non-heat insulating steam line etc.
(5) Ceramic industry, soil and stone product manufacturing industry / exhaust heat recovering of high-temperature oven
4. Outline of ESCO business
5. Subsidy device for tax system and finance

Part 4. Q & A related to method of energy saving

Figure 12-4 Sample of Instruction Booklet (ECCJ) (2/3)

Sample 4:Guidance for Promotion of Energy Conservation in Office Buildings

(Source: ECCJ Booklet)

Contents:

Sample 5: Instruction for Labels and Standards System and Data Book

(Source: ECCJ Booklet)

Figure 12-5 Sample of Instruction Booklet (ECCJ) (3/3)

(ii) Power Utility Publication

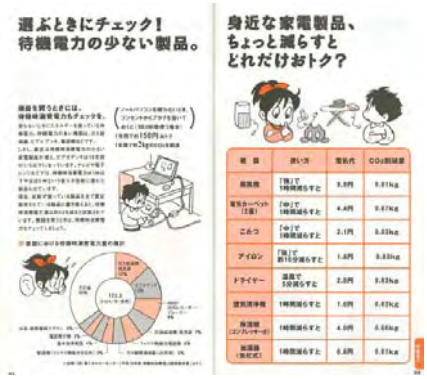
From TEPCO that is a power utility in Japan, 2 types of instruction booklets are introduced. These booklets contain image characters, quizzes, results of experiment data, monetary effects, and so on.

Sample 1: TEPCO Energy Conservation Booklet (for Household Wives and Kids)

Front Cover

Let's look for mistakes!

Smart selection of lamps



Effect on monetary and CO2 emission reduction

Insulation and its effect

Sample 2: Lifestyle Laboratory Reports (for Household Wives)

Experimental Report in AC

Experimental Report in Lamp

Figure 12-6 Sample of Instruction Booklet (Power Utility)

(c) Recommendation

(i) Government Publication

In Japan's case, there are various instruction booklets such as:

- Measured data and trend in each sector
- Instruction for energy conservation activities in business unit
- Examples of energy conservation project
- Instruction for mandatory programs (Energy Management System and Labels and Standards System)

These instruction booklets link the results of the monitoring and awareness surveys, results of publication and award system, and so on. It is made possible by the concentration of information and data on one agency. Therefore, in the KSA survey results should be accumulated in SEEC as a data-keeping agency.

(ii) Power Utility Publication

In Japan's case, some instruction booklets put priority on the residential sector, especially household wives and kids. Recommendations are made as follows:

- Easy to read by using an image character, showing monetary effect, data & graph, etc.
- Instruction of smart use and selection by each home appliance (AC, Refrigerator, TV, Lamps, etc.)
- Persuasiveness of energy conservation by using experiment results
- Well understanding of "Energy Efficiency Labels and Standards"
- Easy access by distribution at a family spaces in public areas

(2) Consulting Service for Energy Conservation and ESCO Business

(a) Overview of KSA's Method

(i) Consulting Service

Consulting service for energy conservation has already been conducted by local consultants or foreign consultants, which target the industrial and commercial sectors

Through this Study, the JICA Study Team visited some factories and commercial buildings. From these visits, it was discovered that some factories have conducted energy assessment using consultants. According to a report made by a local consultant, the following measures were recommended.

- Reduction of air-conditioner electricity consumption (improvement of operation manner, installation of additional equipment, etc.)
- Reduction of lamp electricity consumption (timer installation, reduction of brightness and quantity, etc.)
- Power factor improvement

Furthermore, in some hotels, Building Energy Management System (BEMS) is recognized as a useful energy conservation technology. This technology has been mainly promoted by foreign manufacturers as consultants.

(ii) ESCO in the KSA

As for ESCO business, when ESCO business is defined as a performance guarantee contract, such a business model has not been diffused in KSA yet.

Through visits of some buildings and factories, some issues for ESCO business are assumed by the JICA Study Team as follows.

- Not all drawings were provided. The reason is guessed that the owner changes often and renovation of the building is carried out by each new owner, therefore recent drawings cannot be obtained.
- In some cases, the engineers/technicians stationed in the building do not possess a high technical level (or there are cases where no engineer was stationed), so that makes it difficult to gain basic information to comprehend the energy saving potential.
- For an ESCO business, money is given and taken to measure and validate the base line or energy saving effect. Customers might distrust these measurements.
- The average electricity rate is very low. This means the incentive for building/factory owners might be weak.
- Depending on the conditions of the contract with a tenant in the building, reduction of the electricity rate through saving energy can be to the owner's disadvantage.

(b) Overview of Japan's Method

(i) Consulting Service

In Japan, there are types of consulting services for the commercial and industrial sectors, as follows. ESCO is one of the consulting services.

- Assistance for making reports (obligation of Energy Management System)
- Energy assessment service
- ESCO projects
- Energy center business

(ii) ESCO Business Model

In general, ESCO business is made by a performance guarantee contract by ESCO (Energy Service Company). ESCO proposes energy conservation potential (by installation of efficient equipment, improvement of operation methods, etc.) and guarantees its performance.

During a long-term contract period, reduction of energy costs will be shared by the customer and ESCO. In other words, ESCO recovers initial costs including consulting service fee from reduction of energy costs as shown in the figure.

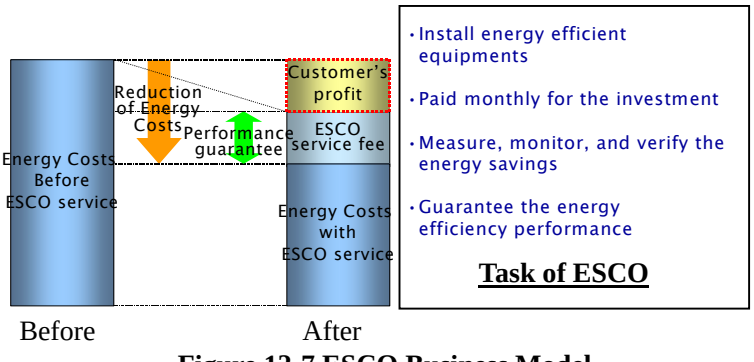


Figure 12-7 ESCO Business Model

(iii) Japan's Trend in ESCO Business

The following figures are trends of ESCO projects in Japan. Currently the industrial sector has increased its share.

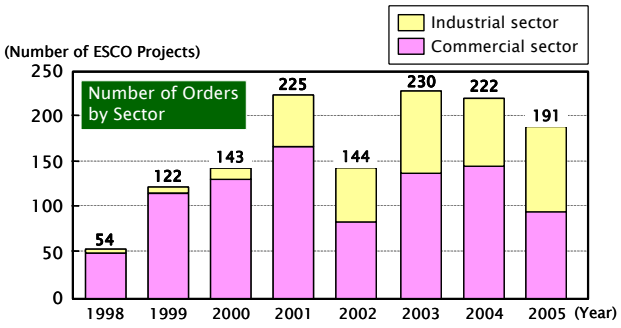


Figure 12-8 Number of Orders by Sector

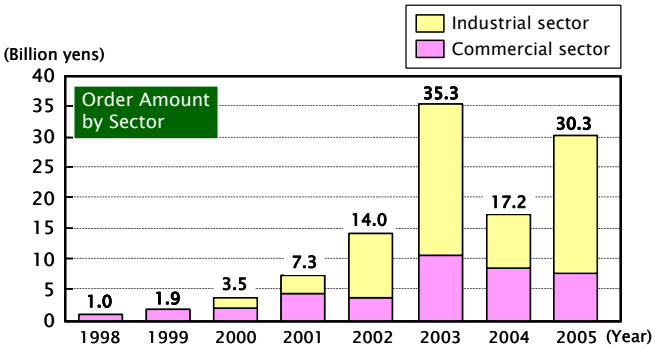


Figure 12-9 Number of Amount by Sector

(Source: Japan Association of ESCO)

(3) Recommendation

(i) Consulting Service

To enhance a market of consulting service in the KSA, the following recommendation is made.

- Energy Management System to be introduced can be assisted by local consultants for making reports or energy management activities. This contributes to market growth.
- Energy Assessment Service to be introduced expects use of local consultants. This will also expect market growth.
- Monitoring and Awareness Survey to be introduced can be conducted by local consultants. This will expect market growth as well as consultant's capacity building.
- Government should start energy conservation activities or installation of high efficiency equipment using local consultants. This will expect a demonstration effect on Saudi citizens as well as consultant's capacity building.

(ii) ESCO Business

To overcome the supposed issues, the following measures are recommended.

- Instruct the building engineers to compile drawings and data and understand energy saving points in order to improve their technical level.
- Develop and openly disclose model projects to enhance trust in ESCO business.
- For measurement and method verification of the energy saving effect serving as the basis of giving and taking of money, draw up a guideline to enhance contractual trust. In particular, when demand fluctuates or when the owner insists on his own energy saving efforts, it can be difficult to delineate. Therefore, it is absolutely necessary to establish valid methods for measurement of an energy saving effect for each energy-saving device targeted.

12.2.2 Next Measures after High Priority Measures

(1) Subsidy for Energy Conservation Project and Demonstration Project and Subsidy for Installation of High Efficiency System

(a) Japan's Method

This measure provides a large amount of subsidy. The following schemes are samples of methods used in Japan. These schemes are executed by New Energy and Industrial Technology Development Organization (NEDO), which is a government agency.

(Target: Energy Conservation Project)

- Target sector is industry and commercial sectors.
- Subsidy for 1/3 of total project cost (limit: 500 million Yen/year)
- Annual budget in FY2006 was 24,150 million Yen
- Expected effect: Reduction of 600,000 kl toe/year
- ESCO can also apply to this scheme.

(Target: Demonstration Project)

- Target sector is local government and commercial buildings.
- Subsidy for 1/2 of total project cost (limit: 100 million Yen)
- Annual budget in FY2006 was 1,672 million Yen.

(Target: Installation of High Efficiency System)

- Target sector is commercial and residential sectors
- Subsidy for 1/3 of total project cost (limit: 27 million Yen)
- Annual budget in FY2006 was 4,512 million Yen.
- Expected effect: Reduction of 189,000 kl toe/year
- Expected technology: heat pump, BEMS, lamp, insulation materials, etc.
- 15 % reduction - 25 % reduction is the standard for qualification.

Energy Conservation Project

	FY2002	FY2003	FY2004	FY2005
Application	199	231	161	339
Qualified	120	111	80	314

Demonstration Project

	FY2004	FY2005
Application	89	44
Qualified	17	15

High Efficiency System

FY2004	FY2005
849	1,237
760	991

(Source: NEDO Website)

Figure 12-10 Features of Subsidy Scheme of NEDO

(b) Recommendation

From the experiences of Japan's scheme, the following recommendation is made.

- To choose applied projects, evaluation standards should be established and open to the public.
- Simple and efficient selection procedures should be made to smoothly implement projects in an annual basis cycle.
- A check system for proper use of money is necessary.
- Target sectors should be selected.

(2) Subsidy for Specific Equipment

(a) Japan's Method

This measure is a small scale of subsidy (fixed amount or simple formula). As a target technology is diffused more widely, subsidy rates will be adjusted or closed.

(Target Equipment)

- Ice storage system (ECO-Ice)
- Heat pump hot water server (ECO-Cute)
- Solar panel, Solar heat, etc.

(Subsidy Procedure)

- Application, qualification, reporting actual results and refund

(Executing Agency)

- Association is sometimes an implementing agency, entrusted by Government

Eco-Ice Installation Record

	1998	1999	2000	2001	2002
No. of Unit	2,374	4,617	6,700	5,102	5,177
Total Subsidy (million JY)	1,439	2,877	3,178	1,363	1,264
Average Subsidy per Unit (JY)	606,150	623,132	474,328	267,150	244,157

Eco-Cute Installation Record

	2002	2003	2004	2005	2006
No. of Unit (estimate)	20,000	35,000	35,000	100,000	190,000

Figure 12-11 Feature of Subsidy Scheme for Specific Equipment

(b) Recommendation

From the experiences of Japan's scheme, the following recommendation is made.

- Target can be considered not for only high efficiency equipment but also load leveling equipment.
- Simple and clear procedure is better.
- Subsidy rate is reviewed by penetration rate.

(3) Announcement of Daily Demand and Supply Forecast

(a) Japan's Method

It has been introduced by TEPCO since 2003 which was a critical year in terms of power supply. To request the public's cooperation for energy saving, announcement of the day's power supply-demand forecast is made through the media and internet.

(Information of the Announcement)

- Available power supply on the day
- Maximum power demand forecast on the day
- Request for lowering power consumption

(How to Announce)

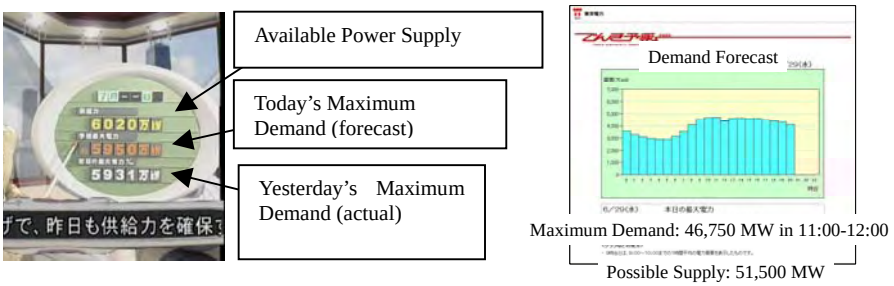


Figure 12-12 Feature of Announcement of Daily Demand and Supply Forecast

(b) Recommendation

From the experiences of Japan's scheme, the following recommendation is made.

- Announcement should be made in the morning of the day.
- Comparison of yesterday's record and today's forecast is informative.
- When a critical situation is forecasted, energy conservation is requested in the announcement. In this case, the government sector including SEC should initially practice energy conservation in their buildings.

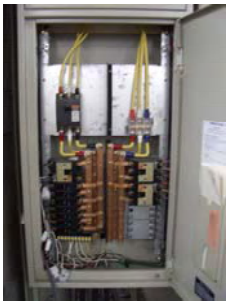
(4) Energy Conservation Consulting Service for Residential Sector

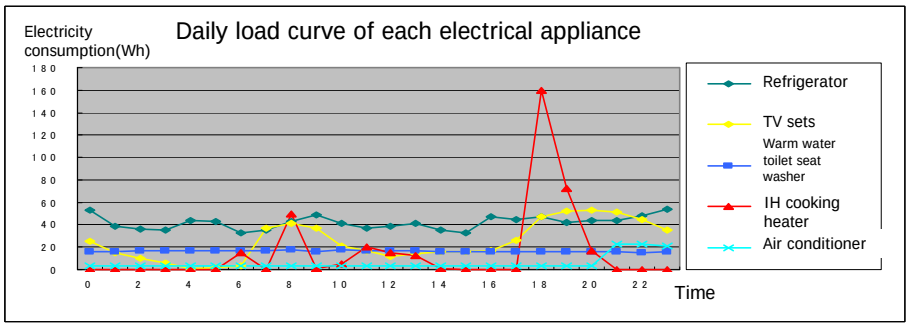
(a) Japan's Method

To meet the needs of the residential sector in energy conservation, a consulting firm provides the following services.

(Contents of Consulting Service)

- Load survey for the whole house, for each equipment, for each circuit
- Sales of energy conservation goods (watthour meter for household appliances, tool for cutting waiting power, reflecting panel in florescent lamp, etc.)
- Dispatching a teacher for energy conservation education, etc.





Load Survey Results in a House (Sample)

Reflecting Panel

Cutting Waiting Power Tool

Figure 12-13 Feature of Energy Conservation Consulting Service for Residential Sector

(b) Recommendation

From the experiences of Japan's scheme, the following recommendation is made.

- In the beginning stage, it seems difficult to be a business base without some subsidy.
- In this context, SEEC or SEC is a candidate entity to implement such residential consulting service.
- Trading energy conservation goods can be one of the consulting activities.

(5) Joint Development of Energy Conservation Equipment and Household Appliances

(a) Japan's Method

A Japanese power utility jointly develops equipment or household appliances with manufacturers. In general a power utility has much information regarding the needs and requests of various equipment or household appliances. This is because customers often ask questions or make comments about such appliances directly to a power utility.

Although a power utility does not sell developed products, energy conservation equipment using electricity can contribute to the increase of electricity sales as well as energy conservation.

On the other hand, manufacturers can also gain benefits from joint development because a jointly developed product can, to some extent, obtain customers' credibility.

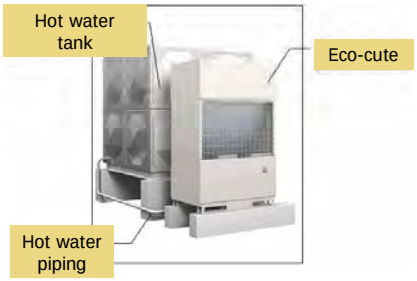
(Procedure in case of TEPCO)

- R&D center of power utility collects needs and requests from customers through branch offices and sales offices.
- R&D center selects themes for development of equipment and appliances form such needs and requests.
- R&D center (or Headquarters) announces joint development of selected themes to manufacturers.
- Some manufacturers propose joint development by theme and makes a selection.
- R&D center and manufacturers jointly develop energy conservation equipment or appliances.

(Expected Equipment and Appliances)

- HVAC system, Ice storage system, Hot water server, Induction Heating (IH) system, etc.

Eco Ice-Mini (Mini Ice Storage System)



Eco-Cute (Hot Water Server)

Super Flex Module Chiller

Figure 12-14 Feature of Joint Development of Energy Conservation Equipment and Household Appliances

(b) Recommendation

From the experiences of Japan's scheme, the following recommendation is made.

- Needs and requests from customers should be reflected in R&D development strategy.
- Such needs and requests can be collected in museums, exhibitions, branch offices, etc.
- Local customized technology should also be focused on.

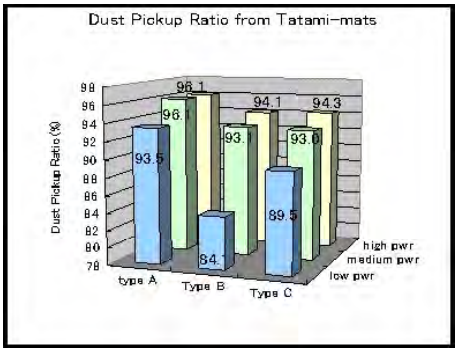
(6) Laboratory Testing for Performance Check

(a) Japan's Method

A Japanese power utility has a laboratory test group for promotion of joint development with manufacturers, and evaluates the performance of household appliances (20 types in TEPCO's case) to make a recommendation for efficient electricity use. Results of such tests are disseminated through instruction booklets, internet, etc. In case of TEPCO, the test site is located in TEPCO R&D Center.

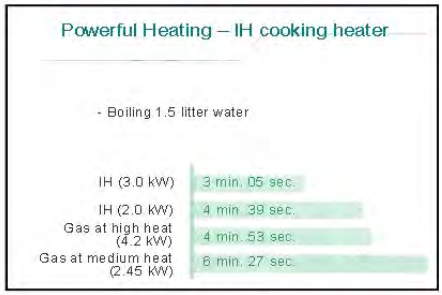
Samples of laboratory test and test facilities are shown below.

Laboratory Test Sample 1: Vacuum Cleaner



A vacuum cleaner may be of the cyclone, cordless, or exhaust recirculation type and may come in any of a rich variety of styles (e.g., self-standing). In the above sample, cleaners are tested for their suction performance, and the results are shown in terms of how well they remove dust according to different floor types.

Laboratory Test Sample 2: IH Cocking Heater



Using pots of the same material and construction, water was boiled on an IH cooking heater as well as on a gas stove. The results prove the superiority of IH cooking heaters by their speedy boiling of water.

Figure 12-15 Sample of Laboratory Testing

Twin House	Objective
 	Twin house can evaluate and compare energy consumption of target appliances under the same condition. It can also evaluate heat insulation performance.
AC Unit Test Facility	**Objective**
	It can measure electricity consumption, evaluate rated and real COP in actual use pattern.
Washing Machine Test Facility	**Objective**
	It can measure electricity consumption and water use volume.

Figure 12-16 Sample of Test Facilities

(b) Recommendation

From the experiences of Japan's scheme, the following recommendation is made.

- Tests provide know-how of smart use or smart selection of household appliances.
- Obtained know-how for efficient use should be disseminated through instruction booklets, internet, etc.
- Test standards should be established together with SASO.

12.3 Low Priority Measures

Summary of Japan's method is introduced below. Concept papers for KSA are attached in Annex 4.

12.3.1 Summary of Low Priority Measures

(1) Preferable Interest Rate Loan for Energy Conservation Project

Banks supported by the Government provides preferable interest loans for improvement of energy efficiency. The scheme is as follows.

(Target Project)

- General energy conservation projects
- Energy-saving promotion projects for the industrial sector
- Energy-saving promotion projects for buildings
- Electric power load leveling projects

(Qualification)

- Improvement rate: 10 % for the commercial sector, 20 % for the industrial sector

(Terms of Condition)

- Financing rate: 50 %
- Interest rates and payment periods are decided by project feature.

(2) Tax Incentive to Install Energy Conservation Equipment

Implementation is entrusted to associations by the Government. The implementing agencies (associations) issue a certificate for eligible equipment based on an evaluation criteria.

(Target Technology: Total 69 types of equipment)

- Factory process equipment for energy efficiency
- Energy efficiency equipment (Air-conditioner, lamp, transformer, window, etc.)
- Load leveling equipment (Gas air-conditioner, thermal storage system)
- Renewable energy, etc.

(Incentive)

- Tax exemption from corporate tax, equivalent to 7 % of the equipment acquisition cost
- Or, special depreciation of 30 % of the equipment acquisition cost in the year of acquisition, in addition to ordinary depreciation

(3) Information Release of Energy Conservation Equipment

Information release of energy conservation equipment is done by ECCJ, manufacturer's catalogues, power utility instruction booklets, etc. Information release is one of the tasks of Labels and Standards System of Japan as well.

Part 6 Environmental and Economic Impact

Chapter 13 Effects of Energy Conservation on Global Warming Protection

13.1 Global Warming Policy and Organization in the KSA

In the KSA, Metrological Environmental Protection Administration (MEPA) had implemented environment and global warming measures until to 2000. However MEPA changed the name to Presidency of Meteorology and Environment (PME) in 2001. The head office of PME is located in Jeddah, and there are branch offices in Riyadh and other main cities. The historical development process of environment and global warming policies conducted by the government are as follows.

13.1.1 Process on Establishing the Organizations and the Polices

In 1951, the KSA needed accurate meteorological data due to the development of aircraft. To collect and analyze meteorological data, the “Department of Meteorology” was established by Civil Aviation Directorate. The organization is a predecessor of PME.

As meteorological data had become essential information for the Industry, Agriculture, and Transportation sectors, in 1966 the government established the “General Directorate of Meteorology” in the Ministry of Defense and Civil Aviation by Royal Decree on 1.7.1386, (15. 10. 1966). The General Directorate of Meteorology is the organization that is developed from the Department of Meteorology.

In 1981, there were environmental problems on land, water, and air which accompanied the significant development of the economy, especially industry. A new integrated organization was required in order to solve the environmental problems. In response, the government enacted Royal Decree N0.7/M/8903 (Feb 25th 1981) and established the “Meteorological and Environmental Protection Administration (MEPA)”. The head office is located in Jeddah where the MEPA practices meteorological and environmental observations.

MEPA had identified its operational tasks, and its coordinating and supportive roles in Royal Decree No.7/M/8903. It is to achieve the following targets.

① The improvement of safety, health, and human welfare of the citizens of the KSA, through the provision of services in meteorology, climatology and environmental protection.

② The development and preparation of environmental policies, and providing management, investment and application of natural resources for the welfare of the Saudi community.

③ The improvement of MEPA programs by raising the standards of production, accuracy, services, and by establishing the most up-to-date laboratories, maintenance workshops, computer facilities and regional centers.

④ The growth of public awareness of the citizens concerning the importance of environmental affairs, the natural heritages of the countryside, and seas. This is done by developing the understanding that there is the necessity of personal

participation in environmental protection. This should be carried out through media services and by incorporating into school and university curricula, the purposes and benefits of environmental protection.

⑤ The improvement of citizens participation in MEPA's activities, by supporting staff on long-term studies in the KSA and in other countries. Also, by encouraging research and other studies in universities and research institutes.

⑥ Establish relevant data-banks and provide meteorological, climatologic and environmental support to plan and develop major projects and national economic affairs. .

⑦ To increase the efficiency and effectiveness of meteorological and environmental programs by participating in regional activities, through the Gulf Cooperation Council (GCC) and other regional authorities and agencies. Specifically, the encouragement of advancing technical capabilities for meteorological and environmental aspects and activity within the public and private sectors of the KSA. Also, support of academic establishments and research centers, to execute all programs or projects in environmental protection to which the KSA is committed to under international agreements and associations in accord with development of the private sector in national affairs.

Dec 1994, the KSA ratified United Nations Framework Convention on Climate Change (UNFCCC) that regulates GHG emissions. At the time, UNFCCC was a treaty to decrease GHG emissions in 2000 to as much as1990 levels.

Oct 2001, PME (MEPA changed the name to PME around this time) issued "General Environmental Regulations and Rules for Implementation". In these regulations, air pollutant materials regulated are SO2, Suspended particulates, Ozone, NO2, CO, H_2S and Fluorides. Regarding water, drinking water quality and wastewater from coolers, boilers, and factories are regulated.

In 2005, the KSA ratified the "Kyoto Protocol" which regulates Greenhouse Gas (GHG) emissions. However, as the KSA is a country that is not listed in Annex I (Countries and Economic areas with GHG emissions regulated by the Kyoto protocol). The KSA does not have any regulation on GHG emissions. In the same year, PME submitted the "First National Communication Report" to UNFCCC office in line with Decree 12 in UNFCCC. The reports were studied and edited by scientists and experts in the KSA under PME coordination. The contents consist of "National Circumstances" in the First Chapter, "National Inventory of Anthropogenic Emissions" in the Second Chapter and "Vulnerability Assessment and Adaptation Measures" in the Third Chapter.

Nov 2007, the Organization of the Petroleum Exporting Countries (OPEC) summit was held in Riyadh. The summit decides to contribute funds for Global warming research. The total contribution is US$ 750 million; the KSA contributed US$ 300 million, Kuwait, Qatar and, UAE

contributed US$150 million respectively.

As mentioned above, the KSA has been implementing Meteorological observation, Air and Water pollution prevention, and global warming counter-measures with GCC countries and non-GCC countries since 1951. Up to today, the KSA has been in the position as expressed in COP13 (Conference of Parties No.13) that “The developed countries should compensate oil producing countries if crude oil demand decreases because of their global warming measures.” It is one of the negative opinions against global warming measures. Meanwhile in 2007, the KSA shows a new stance to establish a fund (US$ 300 million) for global warming research with GCC countries. This is at the same time as USA changing their stance on global warming measures. Therefore, it can be considered that KSA’s position on global warming is halfway changing in the direction of cooperating with the developed countries.

13.1.2 Changes of Temperature and Rainfall Due to Global Warming

(1) GHG Emissions

The First National Communication Report is edited in line with Decree 12 of UNFCCC. The contents are Emission location, National inventory of anthropogenic emission, Natural absorption of GHGs, Vulnerability assessment and Adaptation measures as follows. The data and analysis use 1990 figures.

① Total CO2 emissions in the KSA in 1990 was 140.9 million ton-CO2 and CO2 absorption was 15.2 million ton-CO2.
② Energy sector contributed 90 % of the total CO2 emissions, followed by the industrial process sector (8 %) such as Cement, Iron & Steel, Glass, Soda & Ammonia, Petrochemical and Food processing and the agriculture sector (2 %).
③ Major sectors contributing to the CO2 emissions were electricity generation (26 %), road transport (25%), desalination (15 %), petroleum refining (10 %), cement industry (8 %), petrochemical industry (3 %), aviation (3 %), iron & steel production (2 %), and others (8 %).
④ Chemical production was the sole contributor to CH_4 emissions. GHG emissions from Agriculture sector includes livestock (enteric fermentation and manure management), agricultural soils and field burning of crop residues were considered.
⑤ Cattle, sheep, goats, camels, and poultry constituted the livestock population in the KSA. CH_4 emissions were the major important greenhouse gases emitted by the activities related to livestock. However, the volume of CH_4 from the livestock cannot be counted exactly in the current. CH_4 emissions from enteric fermentation, manure management, and field burning of crop residues were estimated at 74,560 ton-CH_4, 8,540 ton-CH_4, and 4,900 ton-CH_4 respectively.

⑥ N_2O from enteric fermentation, manure management, and field burning of crop residues are 6,980 ton-N_2O, 23,590 ton-N_2O, 90 ton-N_2O respectively. (Meanwhile, field burning of crop residues exhausts 2.692 million ton-CO2.)

⑦ Changes of forest and other woody biomass provided absorption of 93,000 ton-CO2 in 1990.

⑧ The KSA has a fourth of the world's oil reserves, and crude oil produced in the KSA is exported to the world. Therefore, the KSA has a limitation regarding regulation of GHGs caused from crude oil production. It is considered that GHG emissions from crude oil production depends on the world's energy consumption.

⑨ The average growth rate of CO2 emission in 1990-2004 has increased 5.4 % per year. It can be considered that the average growth rate is not so large in developing countries. However, CO2 emission per capita in the KSA is higher than other countries. A reason for this is that the KSA has rich oil resources and can supply it to the domestic market cheaper due to national policy.

(2) Changes of Temperature and Rainfall Caused by Global Warming

The First National Communication Report estimates past changes of temperature and rainfall in the KSA by using past observation data. At the same time, the report forecasts future changes of temperature and rainfall by using the Intergovernmental Panel on Climate Changes (IPCC) global warming forecasting model. The results of the estimations are as follows.

(a) Increase in Temperature

From 1991 to 2003, there is warming all over KSA that varies from a minimum of 0.15 ℃ (Tabouk, Makkah, Al Ahssa), to a maximum of 0.75 ℃ (Khamis Mushait, Wadi Al Dawasser, Yonbu). The average warming in KSA is estimated to be 0.40 ℃, and the interior part of the country is 0.40 ℃. However, the western and eastern coasts show weaker warming with 0.20℃ than the interior part.

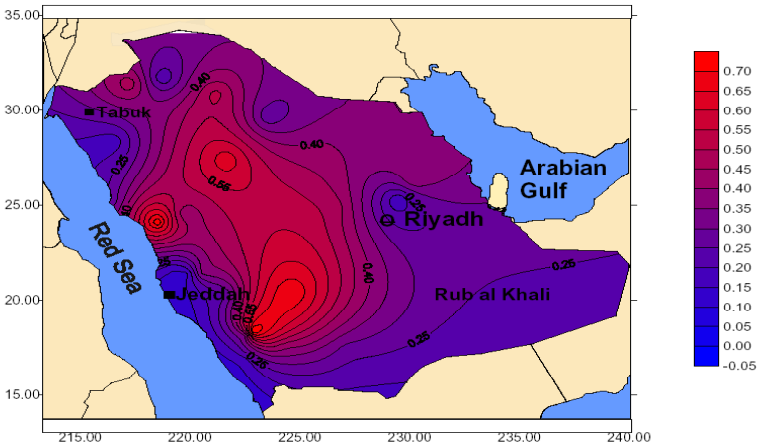


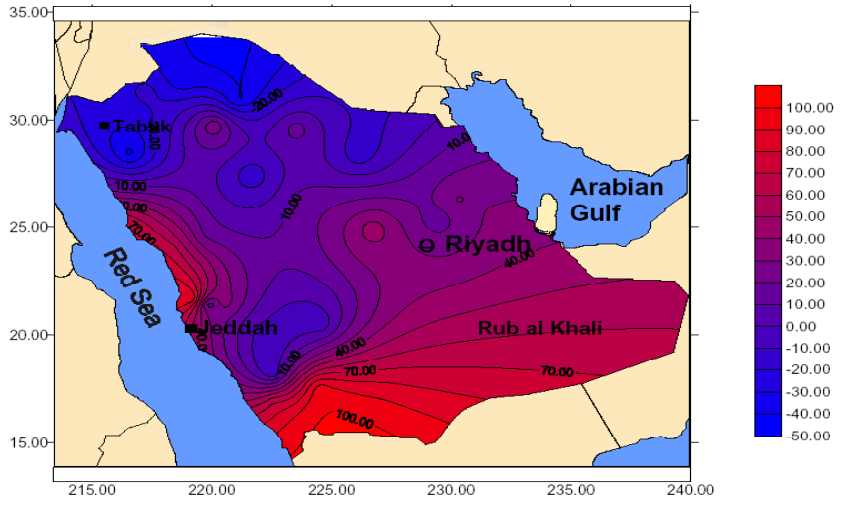
Figure 13-1 Change in Temperature (1991-2003) Blue: Decrease (℃), Red: Increase (℃)

(Source: First National Communication Report, edited by PME)

The average warming in the KSA for the year of 2041 is estimated to be higher than the global average. The highest warming (2.2-2.7 ℃) occurs during summer season at the north western region, while the lowest (0.2-0.40 ℃) occurs in both the south and the southwest in summer. These are forecasted by MAGICC/SCENGEN software（Version 4.1）that was developed originally by the Climate Research Unit at the University of East Anglia of U.K, and it has been used in all IPCC assessments distributed by IPCC. The warming in the summer season in 2041 is forecasted from other climate change software (Example, Hadley Centre Global Model, Canadian Climate Centre Model, Global Climate Model by National Centre for Air Research, Australian Global Model) are from 3.9 ℃ C to 4.1 ℃

(b) Changes in Rainfall

As for rainfall trends, there is a vast area of rainfall deficit covering all of the northern part of the KSA (decrease of 40 % in Tabouk and Arar). Another area that experienced a decrease in rainfall is the eastern slope of the Asir mountains (decrease of 14 % in Abha). Areas recording maximum increase of rainfall are the western coasts (increase of 92 % in Jeddah), the central part (increase of 45 % in Riyadh), the eastern coasts (increase of 32 % in Dhahran), and the southern part (increase of 109 % in Sharourah). Overall, rainfall decreased in the northern part and increased in the southern.



(Source: First National Communication Report, edited by PME)

Figure 13-2 Changes in Rainfall（1970-2003）Blue: Decrease (%), Red: Increase (%)

According to the First National Communication Report, rainfall all over the country in 2041 increases 14.4-24.6 % in the summer. However, it decreases to 14.0-18.0 % in spring, 2.8-1.3 % in autumn, and 1.6-1.9 % in winter. It decreases to an average of 13.9-16.4 % in the whole country. Rainfall increases in the whole country in the summer season. This is not a problem, because most of the regions have little rain currently. However, rainfall peaks are divided into the spring and summer seasons in the south and southwest regions which may have a negative impact on agriculture business.

As mentioned above, climate change of the KSA will be very severe in the future. Even though it has high temperatures and little rainfall currently, the temperature will become higher and rainfall fewer in the future.

13.2 GHG Emissions after Energy Conservation Measures and International Comparison

Herein, CO2 emissions up to 2030 are estimated based on fossil energy consumption in the KSA and CO2 emission factors advocated by IPCC. CO2 emissions are calculated in the BAU case and the EEC base case, and the results are compared to the current CO2 emissions of main countries.

13.2.1 Fossil Energy Consumption

In the KSA, power, oil refinery & petrochemical, manufacturing, residential and transportation sectors are using fossil energies as a base (agriculture and commercial & service sectors only use electricity). The kinds of fossil energies used in the sectors are gasoline, kerosene, diesel, fuel oil, LPG and natural gas. Fossil energy demands are forecasted in the same way of power demand forecast as described in Chapter 9. That is, future energy intensities are converged to around current levels in the BAU Case, and in the EEC Base Case, those are decreased 1.0-1.5 % per year from the BAU Case. The energy consumption in the BAU Case and EEC Base Cases are in the following tables. Energy consumption in the transportation sector is estimated by GDP elasticity 1.0 for the BAU Case and EEC Base Case.

Table 13-1 Energy Demand in the BAU Case （Unit：kTOE）

BAU Case

	1990	1995	2000	2005	2010	2015	2020	2025	2030	2005-30
Power supply	21,921	35,231	41,385	52,797	75,450	91,525	108,433	124,958	147,277	4.2%
Refinery & Petrochemical	13,613	19,210	20,831	21,230	27,921	34,401	43,932	53,573	65,426	4.6%
Manufacturing	11,506	12,017	15,016	22,000	35,956	49,638	67,154	86,398	110,709	6.7%
Residential	921	1,084	1,205	1,420	1,686	1,925	2,181	2,445	2,739	2.7%
Transpotation	17,685	19,383	21,599	27,200	36,614	46,181	58,335	70,453	85,154	4.7%
Total	65,646	86,925	100,036	124,647	177,626	223,671	280,035	337,828	411,304	4.9%

Note 1: Actual values in 1990-2000 and forecast values in 2005-2030
Note 2: Each sector does not contain electricity consumption
Note 3: Energy consumption in power sector is based on Power Development Plan of ECRA.
Note 4: Energy consumption in Non-energy use sector are not contained.

Table 13-2 Energy Demand in EEC Base Case（Unit：kTOE）

EEC Base Case

	1990	1995	2000	2005	2010	2015	2020	2025	2030	2005-30
Power supply	21,921	35,231	41,385	52,797	74,707	86,143	96,601	105,009	116,893	3.2%
Refinery & Petrochemical	13,613	19,210	20,831	21,230	27,502	31,419	37,203	42,066	47,633	3.3%
Manufacturing	11,506	12,017	15,016	22,000	35,417	45,335	56,689	67,434	80,087	5.3%
Residential	921	1,084	1,205	1,420	1,669	1,813	1,953	2,082	2,218	1.8%
Transpotation	17,685	19,383	21,599	27,200	36,614	46,181	58,335	70,453	85,154	4.7%
Total	65,646	86,925	100,036	124,647	175,909	210,891	250,782	287,044	331,984	4.0%

Note 1-4 are to the previous table.
Note 5: Energy conservation measures are not applied to transportation sector in the BAU Case and EEC Base Case.

In the case of power demand in 2030, the EEC Base Case decreases 25 % when comparing it to the BAU Case. However, in the case of total (final) energy consumption in 2030, the EEC Base Case decreases 20 % to the BAU Case, because the transportation sector does not practice any energy conservation in both cases. Improvement of vehicle energy efficiency can be considered in the transportation sector. However, as the number of vehicles increases at the same time, fuel consumption in the transportation sector is estimated by GDP elasticity 1.0.

13.2.2 CO2 Emission Forecast

Herein, CO2 emissions are calculated based on the previous energy demand. In the calculation methods, carbon emission factors (carbon emission per heat value) and CO2 fraction factors published by IPCC are used. Energies such as fuel oil, diesel, natural gas, LPG, gasoline and so on have carbon emission factors. The following table shows representative values published by IPCC. Strictly speaking, each country has different carbon emission factors. However, IPCC representative values are used in this simulation because KSA's carbon emission factors cannot be collected. It is the same method in calculating CO2 fraction factors. Under the above preconditions, the method for calculating CO2 emissions is as shown in the following equation. In addition, the value 41.868 in the equation means conversion factor from KTOE unit to Tera Joule (TJ) unit and the value 3.667 means conversion factors from carbon emission to CO2 emission.

CO2 = Consumption*(41.868/1000)* (Ton-C/TJ*3.667)* Fraction CO2

Table 13-3 CO2 Emissions by Energy by Sector

Sector	Type of Energy	Consumption (Million toe)	Emission Factor (t-C /TJ)	Fraction of CO2	CO2 emission (Million t-CO2)
Power Sector	Diesel	3.4	20.2	0.99	10
	Fuel oil	32.9	21.1	0.99	105
	Natutal gas	80.5	15.3	0.95	188
Refinery & Petrochemicals	Kerosene	4.8	19.6	0.99	14
	Fuel & Other	3.2	21.1	0.99	10
	LPG	0.6	17.2	0.99	1
Manufacturing	Diesel	7.2	20.2	0.99	22
	Fuel & Oil	40.1	21.1	0.99	128
	Natural gas	32.7	15.3	0.95	76
Residentials	Kerosene	0.2	19.6	0.99	1
	LPG	2.0	17.2	0.99	5
Transportation	Gasoline	43.6	18.9	0.99	125
	Diesel	37.0	20.2	0.99	110

Note: Energy Consumption is values in the EEC base Case in 2030.

When calculating CO2 emissions of the BAU Case and EEC Base Case by using the above equation, the results are shown in the following table. In addition, the emissions are calculated for Power, Oil refinery & Petrochemical, Manufacturing, Residential and Transportation sectors. (Agriculture and Commercial & Service sectors use only Electricity, that is why their energy consumption is contained in the Power sector.)

Energy consumption of the EEC Base Case in 2030 is 20 % lower than the BAU Case. (Power consumption is 25 % lower). However, CO2 emissions in the EEC Base Case are 18 % lower than

the BAU Case. This is because CO2 emissions in the Transportation sector in the BAU and EEC base cases are the same. When comparing only Power sectors in both cases in 2030, energy consumption and CO2 emissions in the EEC Base Case are around 20 % lower than the BAU Case. And CO2 emission in the EEC Base Case in 2030 is 5.2 times more compared to 1990, and 2.7 times more compared to 2005. Such an increase of CO2 emissions in the EEC Base Case in 2030 is a big difference from IPCC targets that CO2 emissions should be decreased 30-50 % to 1990 levels.

Table 13-4 CO2 Emissions of the BAU Case（1,000 ton-CO2）

	1990	1995	2000	2005	2010	2015	2020	2025	2030
Power Sector	55,084	93,972	112,229	138,883	193,091	232,495	278,626	324,653	385,131
Refinery & Petrochemical	17,044	17,096	17,300	15,852	18,396	20,860	24,483	28,148	32,654
Manufacturing	31,033	33,181	42,216	61,315	101,191	140,282	190,368	245,458	315,052
Residential	2,514	2,915	3,229	3,793	4,488	5,113	5,782	6,472	7,239
Transportation	52,598	57,356	63,890	80,606	108,502	136,854	172,871	208,782	252,346
Total	158,273	204,520	238,863	300,449	425,667	535,604	672,129	813,514	992,422
1990 times	1.0	1.3	1.5	1.9	2.7	3.4	4.2	5.1	6.3
t-CO2 / person	10.1	11.3	11.7	13.0	17.1	20.1	23.6	27.0	31.0
t-CO2 / GDP	1,107	1,241	1,285	1,328	1,373	1,353	1,331	1,324	1,327

Note: CO2 emissions in the table are only calculated from energy sources.

Table 13-5 CO2 Emissions in the EEC Base Case（1,000ton-CO2）

	1990	1995	2000	2005	2010	2015	2020	2025	2030
Power Sector	55,084	93,972	112,229	138,883	191,146	218,550	247,644	271,911	304,282
Refinery & Petrochemical	17,044	17,096	17,300	15,852	18,237	19,726	21,925	23,773	25,890
Power Sector	31,033	33,181	42,216	61,315	99,650	127,987	160,428	191,167	227,391
Residential	2,514	2,915	3,229	3,793	4,444	4,819	5,185	5,523	5,877
Transportation	52,598	57,356	63,890	80,606	108,502	136,854	172,871	208,782	252,346
Total	158,273	204,520	238,863	300,449	421,978	507,937	608,053	701,157	815,786
1990 times	1.0	1.3	1.5	1.9	2.7	3.2	3.8	4.4	5.2
t-CO2 / person	10.1	11.3	11.7	13.0	17.0	19.1	21.4	23.2	25.5
t-CO2 / GDP	1,107	1,241	1,285	1,328	1,361	1,284	1,204	1,141	1,091

Note: CO2 emissions in the table are only calculated from energy sources.

13.2.3 International Comparison of CO2 Emissions

There is the opinion that CO2 emissions should not be compared using absolute values and should be compared using emission per capita and/or per GDP among the countries. This is a useful method to request the improvement of energy efficiency to currently inefficient countries. Also, it is noticed that the methods are useful for measuring the reduction in CO2 emission after 2013 (after Kyoto Protocol). Calculating CO2 emission per capita and per GDP from the KSA, and comparisons to international figures are as follows.

The KSA had a population of 23.1 million in 2005 (including foreigners but Saudis are 16.5 million) and the population is estimated to be 32.0 million in 2030. In addition, electric generation depended on fossil fuels because hydro and nuclear power stations do not exist currently in KSA. Transportation distance is longer than Japan due to the fact that KSA's territory is 2.25 million km2, which is 6 times more than Japan. Also, oil products are cheap and abundant. For these reasons, energy consumption per capita is higher than other developed countries. Therefore, CO2 emission per capita in 2005 was 1.3 times the amount of Germany's current amount. When considering the increase of their income and improvement of their lifestyle, CO2 emission per capita in 2030 will

increase 3.0 folds in the BAU Case compared to the current figure of Germany and 2.4 folds in the EEC Base Case compared to the current figure of Germany. Under the preconditions of the EEC Base Case, CO2 emission per capita in 2020 will reach the current USA level. This is under the assumption that KSA's population growth rates will decrease from 2.5 % to 1.5 % and further decrease to 1.2 %. If the population growth rate does not change from the current level of 2.5 %, emission per capita in 2020 will be 4.9 t-carbon per capita and 5.1 ton-carbon per capita in 2030. The values are almost the same as the current figure of USA.

Table 13-6 CO2 Emissions per Capita (ton-carbon per capita)

	1990	1995	2000	2005	2010	2015	2020	2025	2030
USA	5.4	5.3	5.6	5.5					
UK	2.8	2.7	2.6	2.6					
Power Sector	3.4	2.9	2.8	2.8					
France	1.8	1.7	1.7	1.8					
Australia	4.3	4.3	4.8	4.8					
Japan	2.4	2.6	2.7	2.7					
India	0.2	0.2	0.3	0.3					
China	0.6	0.7	0.7	1.0					
BAU Case in KSA	2.7	3.1	3.2	3.6	4.7	5.5	6.4	7.4	8.4
EEC Base Case in KSA	2.7	3.1	3.2	3.6	4.6	5.2	5.8	6.3	6.9

Note 1: The population includes foreigners.

Note 2: The values in the table are carbon-ton converted from CO2-ton (C -ton =CO2 x (12/44)).

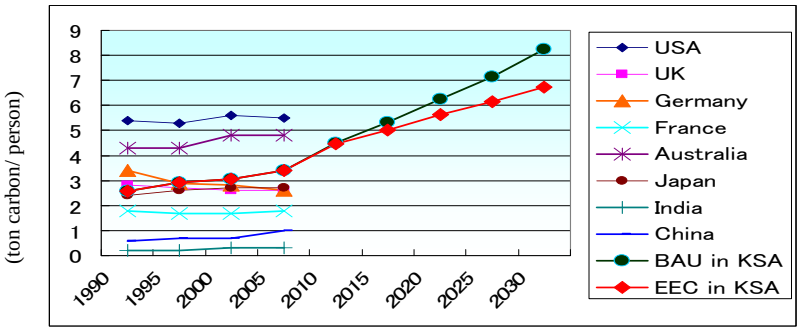


Figure 13-3 International Comparisons of CO2 Emission per Capita

Current CO2 emission per GDP (constant price in 2000) in the KSA is 362 ton-Carbon per million US$, and it is 3 folds higher than UK and Germany, but it is lower than India (764 t-carbon per million US$) and China 527 t-carbon per million US$). The trend does not change in the future. This means that the position of KSA does not change among the countries, and the trend of EEC Base Case is heading towards improvement after 2010. It means that the trends of the EEC Base Case matches the trends in the world.

Even in 2030 the trend is still higher than the main developed countries in 2005. It might be requested that the KSA make more efficient energy and change fossil energies to new and/or renewable energies.

Table 13-7 CO2 Emission per GDP (ton-carbon/million US$, GDP: 2000 price)

	1990	1995	2000	2005	2010	2015	2020	2025	2030
USA	192	178	162	149					
UK	142	126	109	100					
Power Sector	172	140	122	118					
France	95	85	77	77					
Australia	265	243	239	218					
Japan	72	72	71	71					
India			718	764					
China	614	634	582	527					
BAU Case in KSA	302	338	350	362	374	369	363	361	362
EEC Base Case in KSA	302	338	350	362	371	350	328	311	298

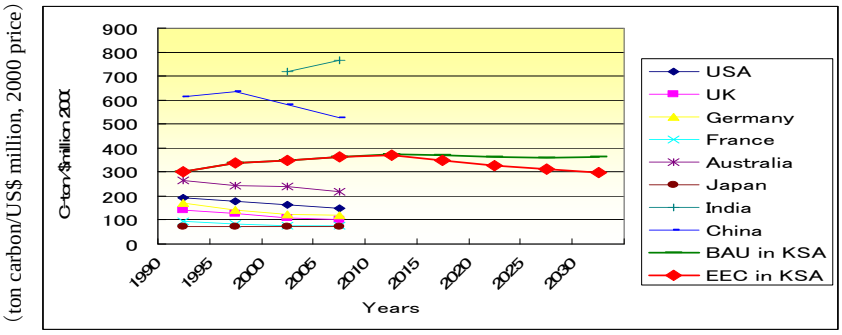


Figure 13-4 International Comparison of CO2 Emission per GDP

13.3 Future Prospects and Measures

13.3.1 Political Methods Selected

Regarding policy and measures of CO2 emission reduction, there are several kinds of methods taken by the government. The categories of the methods are “Voluntary effort methods”, “Regulation methods” and “Economic methods”. The merit and demerit of the methods are described below. In Japan, all kinds of methods in the table are applied for CO2 emission reduction. There is voluntary energy conservation of industry sector (Keidanren’s Voluntary Action Plan) involuntary effort methods, Energy Conservation Laws (Act Concerning the Rational Use of Energy) in Regulation methods, International Emission Trade and Renewable Portfolio Standard Law (RPS law) in Economic methods. As of June 2008, CO2 emission trade in the Japanese domestic market has not been implemented but the Japanese government is discussing to introduce it.

Table 13-8 Political Methods for CO2 Emission Reduction

Methods	Merit	Demerit
Voluntary Effort Methods	The targets are set with ○ High possibility ○ High cost performance ○ High social acceptance ○ More effective in Industry sector	○ Be afraid that not enough target level are settled ○ Be afraid that companies doing the voluntary efforts take economic handicaps ○ Even no action companies get merit
Regulation Methods	○ Effective to large scale sources and products ○ Easy to do due to having experiences of pollution prevention ○ Effect is limited but sure ○ More effective in Industry sector	○ Difficult to set comprehensive regulations ○ High political administration cost ○ Non incentive to CO2 reduction over the regulations
Economic Methods +Tax +Emission trade +Deposit +Subsidy	○ Realize cost minimum in society ○ Promote reasonable economic activities by market mechanism ○ More effective in Commercial and Transportation sector.	○ Difficult to set suitable tax rate ○ No proof to achieve the targets ○ High social cost

(Source: Ministry of Environment of Japan)

13.3.2 Application to Energy Conservation Measures

Understanding the above merits and demerits of the methods, and KSA's policy on energy conservation, and also considering political methods on energy conservation projects proposed by the JICA Study Team, it can be considered to apply the political strategy as outlined in the following table.

Table 13-9 Political Methods Applied to Energy Conservation Measures

Methods	Contents	Candidate Measures
Regulation by Government	It is implemented in forceful manner of the government. It is suitable for energy oriented industries and manufacturers / importers.	○ Energy Management System ○ Energy Efficiency Labels and Standards (EELS)
Voluntary Effort Supported by Government	It is service from governmental authorities and energy conservation support organizations. All kinds of sectors can participate voluntarily.	○ Training Program for Energy Manager ○ Energy Audit Service ○ Publication and Award System ○ EC Campaign ○ EC Education for Schools ○ EC Museum ○ Promotion of Architecture Technology ○ Monitoring and Awareness Survey ○ Development of R&D Scheme
Voluntary Effort by Power Companies	It is service from power generation companies. Big power consumers and ordinary factories can participate voluntarily.	○ Check System of Customer Records ○ Load Management
Emission Trade (Economic Methods)	It is suitable for promoting CDM.	
Deposit System (Economic Methods)	It is suitable for collecting used battery and bottles.	

Note: The KSA government does not consider to apply any subsidy for energy conservation policies of private companies.

Chapter 14 Economic Analysis

14.1 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.

The investments for energy conservation are implemented by individual electricity users. When the total reduction of electricity cost in the target years of energy conservation is more than the additional investment for energy conservation, the energy conservation measures implemented by electricity users are “Profitable”. On the other hand, when the total reduction of electricity cost is less than the additional investment for energy conservation, the energy conservation measures are “Not profitable”.

14.2 Expenses and Benefits

In the viewpoint of the above economic analysis, the expenses and benefits of energy conservation programs and projects are as follows.

14.2.1 Expenses in Economic Analysis

(1) Expense Items

As studied in Chapter 13, in the EEC Base Case, all kinds of sectors (agriculture, oil & petrochemical, manufacturing commercial & service, government and residential) conserve energy with a 1.0-1.5 % to the BAU Case from 2010 to 2030. Here, the EEC Base Case is called “With project” and the BAU Case is called “Without Project” in this economic analysis. It is assumed that

additional expenses for energy conservation occurs in the EEC Base Case. For increasing the effectiveness of energy conservation, it is required to promote energy conservation activities and change the mind of people in the KSA. In this economic analysis, the costs of the initiation are not included. Though accumulating costs, these are negligible when compared to other energy conservation expenses. Therefore, the cost does not have any impact on the results of the economic analysis. For achieving energy conservation targets discussed in Chapter 8, energy conservation rates and expenses are as follows.

Table 14-1 Energy Conservation Rates and Expenses (Investments) by Sector

	Energy Conservation Rates	Expenses for installing Energy Conservation Appliances and Equipment	Expenses for Installing Energy Conservation Buildings
Agriculture	1.0 %	○	
Oil &Petrochemical	1.5 %	○	
Manufacturing	1.5 %	○	
Commercial & Services	1.5 %	○	○
Government	1.5 %	○	○
Residential	1.0 %	○	

(2) Historical Investments for Energy Conservation in Japan

For calculating energy conservation investments in the KSA, historical energy conservation investment in Japan is referred to. In Japan, energy conservation measures were rapidly implemented from 1976 to 1986. The following table is the results surveyed by METI in 1996.

Table 14-2 Investment for Energy Conservation and its Rates in Japan

	Investment for EC by Large Companies	Investment & Equipment by Main Manufacturor	Ratio	Energy Intensity to GNP	Energy Conservation Rate
	Billion yen	Billion yen	%	kl/100milYen	%
1975	n.a.	n.a.		167	
1976	n.a.	n.a.		170	1.8
1977	n.a.	n.a.		163	-4.1
1978	n.a.	n.a.		154	-5.5
1979	n.a.	n.a.		156	1.3
1980	n.a.	n.a.		147	-5.8
1981	n.a.	n.a.		137	-6.8
1982	n.a.	n.a.		127	-7.3
1983	n.a.	n.a.		130	2.4
1984	n.a.	n.a.		131	0.8
1985	55.0	2055.3	2.7	126	-3.8
1986	32.6	1964.2	1.7	122	-3.6
1987	77.4	2130.0	3.6	122	0.0
1988	101.7	2605.1	3.9	121	-0.5
1989	227.9	3226.9	7.1	120	-1.0
1990	251.1	3715.3	6.8	120	0.0
1991	269.3	1983.3	13.6	117	-2.2
1992	383.6	2792.6	13.7	119	1.4
Total	1398.6	20472.7	6.8		-1.2

Investment & Equipment by Main Manufacturor
Iron&Steel, Non-Ferrous metal, Petroleum& Chemical, Textiles, Ceramic
Source: Resource & Energy Data book by METI 1996
Economic Analysis on Global Warming by IEEJ 1994
Investment & Equipment by Industry published by METI 1996

Regarding energy conservation investments, it was not surveyed before 1984. However, energy intensities to GNP can be calculated by using set energy consumption statistics and national income statistics in Japan. Investment and equipment of all companies in Japan in 1985 and 1990 were 51 trillion yen and 83 trillion yen, respectively. The investment and equipment in the table in the same years are only 2.0 trillion yen and 3.7 trillion yen. The ratios of both values were 4.0 % in 1985 and 4.4 % in 1990, respectively. By the ratios, it can be seen that the table shows investments, equipment, and energy conservation investments by major companies in Japan.

Energy conservation investments are not made if energy conservation measures are not implemented. Therefore, it can be considered that the total investment and equipment contains additional investments for energy conservation. Because most of the total investment and equipment is for expanded reproduction, the ratio between the total investment and equipment and energy conservation investments (average 7 % during the term) does not mean that the initial cost of energy conservation facility has increased.. Regarding the table, it can be said that energy conservation investments of big companies in Japan made the total investment and equipments increase to around 7 % (Fluctuation range: 3 % to 13 %).

During the term, energy intensity to GNP in 1976 had been 170 kl/100 million yen, and it changed to 122 kl/100 million yen in 1986. (In case of Japan, GNP is almost the same as GDP) The energy conservation rates during the term were up 3.3 % per year.

Meanwhile, when checking the energy conservation investments implemented by major companies in Japan, it was 55 billion yen in 1985 (2.7 % to the total investments and equipment amounts) and 383.6 billion yen in 1992 (13.7 % to the total investments and equipment amounts), the average investment ratio from 1985 to 1992 is 7.0 %. By the investments, energy intensity to GNP in 1984 (Maximum values around 1985) was 131 kl/100milion yen. However, it changed to 119 kl/100 million yen in 1992. It decreased 1.2 % per year from 1984 to 1992. The energy conservation rate of 1.2 % is almost the same value as the energy conservation rate proposed by the JICA Study Team.

(3) Investments for energy conservation in the KSA

Maximum energy conservation rate in Japan was on average 3.3 % per year from 1975 to 1984. In the next eight years, the average energy conservation rate was 1.2% per year. As the energy conservation rate of KSA is assumed to be 1.0-1.5 % per year, energy conservation investments in the KSA is 10 % higher than usual investments. This is because energy conservation investments in Japan was 7 % higher than usual investments in the eight years from 1984 to 1992. When considering these assumptions, the energy conservation investments for achieving an energy conservation rate of 1.0-1.5 % per year in the KSA are proposed as follows.

(a) Import Amount for Electric Appliances and Equipment

The KSA imports most of their electric appliances and equipment. Therefore, importing energy

conservation type electric appliances and equipment means that the monetary import amount will increase. In the previous calculation, investments for energy conservation type electric appliances and equipment make the import of the total electric appliance and equipment increase to around 10 %. If all kinds of sectors increase the import of electric appliances and equipment to 10 %, the import amount of electric appliances and equipment in the BAU Case is increased to the amount of 10 %.

Increase of amount in the Residential sector occurs by new family demand and 5 % replacement demand of existing families (durable period of the facilities is 20 years.) At the time, by purchasing energy conservation type facilities, the cost is 10 % of total imports. To determine sectoral contributions of the amount of electric facility import, electric facility for the residential sector will be subtracted from the total import amount. The remains will be distributed in correlation with the GDP.

Table 14-3 Import of Electric Facilities and Sectoral Investments (Unit: million SR)

Items	Sector	2005	2010	2015	2020	2025	2030	2010-30
Import (1990 price) of Appliances-Equipment		54,168	77,563	99,142	118,135	134,562	150,982	3.4%
Appliances & Elec-equipment Investment Cost by Sector	Agriculture 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	1,900	2,560	3,134	3,635	4,134	4.0%
	Government	0	2,120	2,722	3,178	3,511	3,805	3.0%
	Residentials	0	1,063	1,036	1,088	1,137	1,207	0.6%
	Total	0	7,757	9,916	11,814	13,456	15,098	3.4%

The energy conservation investments should be distributed to the sectors. In this chapter, energy conservation investments of a 10 % rise of electric facility imports are distributed to the sectors. The import amount of electric facilities is estimated by correlation with the total import of KSA, the sectoral contributions are calculated by sectoral GDP. However, electric facility amounts for residential sector as private consumption are estimated by the correlation with the increasing number of households.

(b) Energy Conservation Investment for Buildings

Regarding energy conservation measures for buildings, it is required. When looking at fixed capital formation amounts in national accounts in the KSA, the investments for buildings were 29 billion SR in 2000. It increased to 45 billion SR in 2006, the growth rate of the investments was 7.7 % per year during that term. When calculating sectoral building investments, the buildings for Commercial & Business sector and Government sector also require energy conservation measures. However, Agriculture and Industry sectors do not require energy conservation measures for their buildings. It can be considered that energy conservation measures are applied to housing in the future. However, this time it is assumed that energy conservation measures for the residential sector are not applied to houses.

The following table shows actual values of fixed capital formation in national accounts. The future total investments for buildings are estimated by correlation with fixed capital formation in national accounts. The contribution of components of fixed capital formation such as housing, buildings, equipment, transportation, and others are calculated by the actual contribution in the latest year.

Table 14-4 Actual Values for Fixed Capital Formation (1999 price) (Unit: billion SR)

Investment Items	2000	2001	2002	2003	2004	2005	2006	2000-06
House investments	28	28	30	28	30	32	27	-0.7%
Buildings	29	30	32	36	38	49	45	7.7%
Equipment	38	38	36	45	48	46	46	3.6%
Transportations	20	21	22	23	25	28	24	3.0%
Non-Classification	9	10	11	13	14	14	13	6.1%
Total	124	126	130	145	154	168	155	3.9%

(Source: Saudi Arabia Year Book 2003-2006)

Under the above assumptions for calculating sectoral investments of buildings, when incremental investments for Commercial and Governmental buildings are distributed by the shares of the sectoral GDPs, the results are shown in the following table. The investment amounts are incremental when Commercial and Government sectors make investments of 10 % higher compared to the investments without energy conservation measures.

Table 14-5 Building Investments and Sectoral Energy Conservation Investments (Unit: million SR)

Items	Sectors	2005	2010	2015	2020	2025	2030	2010-30
Building Investment		48,695	59,197	80,470	107,369	135,525	170,516	5.4%
House & Building	Agriculture Fishery	0	0	0	0	0	0	
	Refinery & Petrochemicals	0	0	0	0	0	0	
	Manufacturing	0	0	0	0	0	0	
	Commercials & Services		1,681	2,320	3,138	3,999	5,075	5.7%
	Government		1,875	2,467	3,181	3,863	4,671	4.7%
	Total		3,556	4,787	6,319	7,862	9,746	5.2%

(c) Total Investments for Energy Conservation

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 14-6 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).

(d) Expenses for Economic Analysis

In general, expenses in economic analysis are calculated by marginal cost. The marginal cost is defined by measuring “What is the worth of the loss consumed by the expenses”. For example, when one billion SR is invested in a sector, what kinds of chances to invest in other projects are lost by the investment? Generally speaking, the surplus capital funds are re-invested for expanded reproduction of their products. The utilization of the surplus capital funds that are used for energy conservation expenses suppresses chances of expanded reproduction. Therefore, marginal cost of the surplus capital funds matches the expanded reproduction worth. In this chapter, it can be considered that the worth of reduction of power consumption by implementation of energy conservation meets the worth of expanded reproduction. Therefore, it is assumed that the marginal cost for energy conservation investments in this economic analysis equals the total investment for energy conservation.

14.2.2 Benefits in Economic Analysis

(1) Benefit Items

As a primary benefit, power demand in the sectors is decreased by energy conservation measures. When looking at energy conservation measures through a national viewpoint, it can be pointed out as a benefit that the reduction of power demand brings a decrease of power generation, and it can be assumed that fossil energy consumption for the power sector will decrease. This is because only fossil energies are consumed for power generation in the KSA, and hydro and nuclear power are not used. It can be said that the fossil energies saved in the power sector are a tradable commodity. It is possible to export the fossil energies which are saved. Therefore, energy conservation in the KSA brings an incremental export of crude oil and oil products.

As a secondary benefit, energy conservation on power demand has the effects of suppressing additional power generation facilities. It is a benefit for the nation. The benefit can be estimated by calculating the construction cost for new power stations compared to the power generation capacities saved. In this economic analysis (under rules of World Bank (WB) and Asian Development Bank (ADB)), investment capital funds unused for power projects can be used in other new projects. When new added value is created by the investment, unused

investment capital funds are attributed as a benefit.

As a third benefit, it can be considered that CO2 emission will decrease. The KSA is currently carrying out the “Desert Greening Plan”. Reduction of CO2 emission by energy conservation is as effective as greening by plantation. The benefit of CO2 emission reduction of energy conservation is as much as the cost of the greening by plantation measures. Even though the KSA has no experience of CDM projects up to now, if the KSA can implement CDM projects in the future, it is a benefit for the KSA. As CO2 emission credits are traded in the amount of US$ 25-30/ton-CO2 in the international market, it can be considered that reduction of CO2 emission can be value at US$ 25-30/ton-CO2 in the viewpoint of economic analysis. However, the KSA is not a country committed to reduce CO2 emission, and there is no schedule to make KSA a committed country. In this economic analysis, when considering the benefits of CO2 reduction by conserving energy, thought was not given to plantations cost or CO2 emission credits.

(2) Calculation of Benefits

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 14-7 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

14.3 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 14-8 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	Miilion 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 14-9 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	Miilion SR	0	0	-284	-2,059	-4,527	-7,632	-11,625
RETURN	Miilion 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

14.4 Impact on GDP

It can be imaged that energy conservation measures for equipment and buildings, increasing crude oil export, and suppressing additional power capacities has the impact of increasing GDP growth rate in the KSA. In this section, it is analyzed how much the GDP will be impacted by the energy conservation measures.

14.4.1 Impact on Gross Domestic Expenditure (GDE)

Energy conservation measures rearranged in line with sectors are as follows.

Table 14-10 Energy Conservation Measures and Expenses (Investment) by Sector

Sector	Energy Conservation (EC) Equipment	Building
Agriculture	(1) Investment to EC type equipment	
Manufacturing	(2) Investment to EC type equipment	
Commercial & Service	(3) Investment to EC type equipment	(4) Investment to EC type building
Government	(5) Investment to EC type equipment	(6) Investment to EC type building
Residential	(7) Investment to EC type equipment	

When the above energy conservation activities are shown in the accounts of Gross Domestic Expenditure, the relations between the activities and GDE components are as follows:

Consumption	Consumption + (7)
Investment	Investment + (1)+(2)+(3)+(4)+(5)+(6) - Suppressed Power capacity
Export	Export + Incremental crude oil export
Import	Import +(1)+(2)+(3)+(4)+(5)+(6)+(7) - Suppressed Power capacity
---	---
GDE	GDE＋Incremental crude oil export

In the above figures, it is assumed that all kinds of materials, mechanical parts, and equipment for energy conservation investments are imported. Therefore, import values increase as much as the investments. As the final impact to GDE, the expression of “GDE＋Incremental crude oil export” is introduced, and the total GDE increases.

14.4.2 Changes of GDP Growth Rate by Energy Conservation Measures

As mentioned in Chapter 9, it is assumed that GDP growth rate in the BAU Case is 6.5 % in 2005-2010, 5.0 % in 2010-2020 and 4.0 % in 2020-2030, due to be supported with high crude oil prices in the international markets. In this scenario, the KSA has high growth in the near future (2005-2015) and after that, GDP growth rates gradually become stable as in past years.

Table 14-11 GDP Growth Rates 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

Prediction of GDE at the 1999 price in this model is as indicated in the following table. In the prediction, GDE components are forecasted by elasticity with the GDP. The following table is prediction of GDE without project.

Table 14-12 GDE Prediction without Project

GDE Items	Unit	2005	2006	2007	2008	2009	2010	2015	2020	2025	2030	30/05
Private Consumption	Billion SR	299	316	334	348	362	387	520	679	838	1,028	5.1%
Government Consumption	Billion SR	251	264	276	286	296	314	413	526	637	767	4.6%
Private Fixed Formation	Billion SR	125	134	143	151	159	172	242	332	426	543	6.1%
Govermental Fixed Formation	Billion SR	24	25	26	27	28	30	41	53	66	81	5.1%
Oil Sector Fixed Formation	Billion SR	20	21	26	29	27	25	25	25	25	25	1.1%
Stocks	Billion SR	10	11	12	12	13	14	17	21	25	30	4.4%
Exports	Billion SR	314	360	451	516	488	469	548	622	685	750	3.5%
Imports	Billion SR	283	320	392	436	408	397	493	580	655	731	3.9%
Total	Billion SR	759	811	876	933	966	1,015	1,313	1,679	2,048	2,494	4.9%

When implementing sectoral energy conservation measures to without projects, the following investments, incremental crude oil export, and suppressed power capacities occurs. According to Table 14-3, investments for energy conservation type equipment are from 7.8 billion SR in 2010 to 15.1 billion SR in 2030, and investments for energy conservation type buildings are from 3.6 billion SR in 2010 to 9.7 billion SR in 2030(Refer to table 14-5). As for the benefit, incremental crude oil export are 1.2 billion SR in 2010 and will increase to 50.5 billion SR in 2030 (Refer to Table 14-7). Suppressed power capacities are 0.6 billion SR in 2010 and will increase to 25.9 billion SR (Refer to Table 14-7). The investment growth rate of energy conservation of equipment is 3.2 % per year in 2010-2030. The investment growth rate of energy conservation of buildings is 5.2 % per year in 2010-2030. Both investments are implemented for attaining 1.0-1.5 % energy conservation per year in the targeted sectors.

However, the results of increase in crude oil export and suppressed power capacities are affected by the accumulation of energy conservation efforts every year. The average growth rate of incremental crude oil export is 20.4 % and the average growth rate of suppressed power capacities is 20.2 %.

Table 14-13 Investments and Effectiveness of Energy Conservation Measures

Item	GDE	Unit	2010	2011	2016	2021	2026	30/10
Incremental Appliances & Equipment Investment Cost	Agriculture & Fishery	Billion SR	0.5	0.5	0.6	0.6	0.7	2.0%
	Refinery & Petrochemicals	Billion SR	0.5	0.5	0.6	0.8	0.9	4.0%
	Manufacturing	Billion SR	1.7	1.9	2.5	3.2	3.8	4.6%
	Commercials & Services.	Billion SR	1.9	2.1	2.7	3.2	3.7	4.0%
	Government	Billion SR	2.1	2.3	2.8	3.3	3.6	3.0%
	Residentials	Billion SR	1.1	1.1	1.0	1.1	1.2	0.6%
	Total	Billion SR	7.8	8.3	10.3	12.2	13.8	3.4%
Incremental House & Building Investment Cost	Agriculture.Fishery	Billion SR						
	Refinery & Petrochemicals	Billion SR						
	Manufacturing	Billion SR						
	Commercials & Services.	Billion SR	1.7	1.8	2.5	3.3	4.2	5.7%
	Government	Billion SR	1.9	2.0	2.6	3.3	4.0	4.7%
	Residential	Billion SR						
	Total	Billion SR	3.6	3.8	5.1	6.6	8.2	5.2%
Incremental Oil Export		Billion SR	1.2	2.6	10.8	22.1	36.3	20.4%
Decrease of Investment to Power Plants		Billion SR	0.6	1.3	5.5	11.3	18.6	20.2%

When the above effectiveness is added to GDE in the BAU Case, GDE of the EEC Base Case is calculated as shown in the following table. According to the table, growth rate of private fixed capital formation increased from 6.0 % in the BAU Case to 6.2 % in the EEC Base Case. Growth rate of governmental fixed capital formation increased from 5.1 % in the BAU case to 5.6 % in the EEC Base Case. Growth rate of export increased from 2.1 % in the BAU Case to 2.4 % in the EEC Base Case. Regarding import, where investments of equipment and buildings, and suppressed power capacities are balanced, import values are almost unchanged. When calculating the total of GDP, growth rate of the GDP in the BAU Case (Without Project) is 4.63 %, and 4.77 % in the EEC Base Case (With Project), the difference between the two is 0.14 %.

Table 14-14 GDE in the EEC Base Case (With Project)

	GDE Items	Unit	2009	2010	2015	2020	2025	2030	30/09
Case of "With Project"	Private Consumption	Billion SR	362	388	521	680	840	1,030	5.1%
	Government Consumption	Billion SR	296	314	413	526	637	767	4.6%
	Private Fixed Formation	Billion SR	159	178	251	342	438	558	6.2%
	Govermental Fixed Formation	Billion SR	28	34	46	60	73	89	5.6%
	Oil sector Fixed Formation	Billion SR	27	25	25	25	25	25	-0.3%
	Stocks	Billion SR	13	14	17	21	25	30	4.1%
	Exports	Billion SR	488	470	557	642	719	801	2.4%
	Imports	Billion SR	407	408	504	588	660	731	2.8%
	Total	Billion SR	966	1,016	1,326	1,709	2,098	2,570	4.8%
Comparison	GDE Without Project	Billion SR	964	1,015	1,313	1,679	2,049	2,494	4.63%
	GDE With Project	Billion SR	966	1,016	1,326	1,709	2,098	2,570	4.77%
	Increase %	%	0.19	0.2	1.0	1.7	2.4	3.0	

14.5 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.